



RESEARCH PAPER

Effect of Climate Change on Food Productivity and Food Security of Pakistan

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PAPER INFO	ABSTRACT
<p>Received: October 19, 2021</p> <p>Accepted: December 29, 2021</p> <p>Online: December 31, 2021</p> <p>Keywords: Facebook Memes, Multimodal Critical Discourse Analysis Negative Projections of Pakistani Women, Visual and Linguistic Analysis</p> <p>*Corresponding Author: b_shimly@yahoo.com</p>	<p>This study was conducted to review the impact of climate change on the food production and food security of Pakistan. It further explored the climate risks for vulnerable populations and suggested interventions for adaptation and mitigation of climate-related risks. The study finds that climate change is a global problem which poses serious threat to the security and prosperity of the world. Despite being a global problem, its impacts will be felt unequally across various regions of the world. These impacts are likely to be felt more severely in developing countries like Pakistan. Climate change has become one of the biggest problems for Pakistan by threatening our water resources. The findings indicate that we need strong adaptation and mitigation efforts to prevent the worst impacts of climate change on our food production and food security system. The study also suggests that raising awareness among farming communities, the agencies and stake holders involved in agricultural supply chains is critical to implement adaptation policies and impact mitigation strategies.</p>

Introduction:

The world is facing a constant threat due to gradual changes in its climate (WHO, 2014). The food security and prosperity of mankind is at stake due to climate change (Wheeler & Braun, 2013). The environmental changes are gradually but adversely affecting various dimensions of our lives especially by decreasing water resources and food production processes (Barnett, & Adger, 2007; Lesk; Rowhani; Ramankutty, 2016). Various regions of our planet are not exposed equally to the impacts of climate change, although it is a global issue. Most of the low income and developing countries are much more vulnerable due to their dependence on environmentally sensitive agricultural productivity (Cline, 2007).

Pakistan is a developing and resource poor country. It is facing serious social issues due to very unfavorable socio-cultural conditions and fast growing population (Abbas, Z., 2009). The geographic area of our country comprises of mostly arid and semi-arid regions which are very prone to recurring long duration droughts, large-scale country wide devastating floods, horrible earthquakes, and sudden landslides (Anjum et al., 2012; Asian Development Bank, 2017).

Agriculture is the main source of our livelihood and backbone of economy. Being agricultural country, our prosperity and economy is heavily dependent on its climate-sensitive cultivated land, nature depended water resources for livelihoods and food security (Abbas, Z., 2009). Irrigation water is the most important input and lifeline for agriculture for which our country largely depends on River Indus (receiving water from Himalayan glaciers) and its tributaries. (Majeed & Piracha, 2011). However, the unbalanced and quickly melting glaciers due to global warming the system is under threat. As most of our cultivated land is an arid and rainfall dependent, the country has always faced shortage of irrigation water not for agriculture only but for urban masses and industrial uses. In this scenario climate change which threatens the country's water resources, is an additional stress for the country (Asian Development Bank, 2017).

Attaining food security is one of the main objective of our plans and policies. But climate change has made it a big challenge to increase strengthen and stabilize the food production systems in this country (Ullah, 2017). Climate change has a substantial influence on all four dimensions of food security i.e. availability, access, utilization and stability (Mehmood, 2009). These facts demonstrate that climate related food security issues must be addressed on priority by all stakeholders. Immediate, evidence based and consistent actions are urgently needed to make our agricultural production systems resilient to climate shocks. These climatic issues are needed to be addressed at top priority level by formulating and then effectively implementing adaptation strategies (Qureshi, 2015).

Climate change is a hot issue which is being studied by researchers of various disciplines (IFAD, 2010). An important dimension of climate change which deserves the urgent attention of researchers is that how climate change effects on agricultural systems and food security issues in our country (Khan, 2011). Further research on climate change impacts and various adaptation strategies are needed as there is also a research gap in this area. The present study will fill this gap of scientific literature.

Literature Review

Lobell et al., (2008) have demonstrated that some of the most profound and direct impacts of climate change over the next few decades will be on agricultural and food systems. Their findings show that increasing temperatures and declining precipitation over semiarid regions are likely to reduce yields for corn, wheat, rice, and other primary crops in the next two decades. These changes could have a substantial impact on global food security.

Climate change has already caused significant impacts on water resources, food security, hydropower, human health especially for African countries, as well as to the whole world (FAO, 2012). Since the 1990s, rising commodity prices and declining per capita cultivated area have led to decreases in food production, eroding food security in many communities (FAO, 2012). Many regions that lack food security rely on local agricultural production to meet their food needs. Primarily tropical and subtropical, these regions are substantially affected by both global climate variations and global commodity price fluctuations. Warming in the Indian Ocean (WHO, 2014) and an increasingly "El Nino-like" climate (WHO, 2014) could reduce main-season precipitation across parts of the Americas, Africa, and Asia.

Today, millions of hungry people subsist on what they produce. If climate change reduced production while populations increase, there is likely to be more hunger. However, it may still be possible to reduce world hunger through programs that feed the poor during crises and by investing in agricultural inputs such as fertilizer and improved varieties that can

dramatically increase yields (FAO, 2012). Improved environmental monitoring and prediction systems can provide more effective early warnings, which may help governments to take action to preserve the thin agriculture production margins by which many make ends meet (FAO, 2014).

Material and Methods

The objectives of this paper were to review the impact of climate change on the food production and food security of Pakistan. This paper is based on a desk review of available literature. Data related to climate change, agriculture and organic agriculture is very limited in our country; therefore the information was collected mainly through web search and it is presented primarily for raising awareness among various stakeholders and policy formations. Some personal observations and views were also captured and added.

To explore the material of our search and ensure that no any relevant literature missed a snowball search was conducted on the reference lists of all the literature to maximize the quality and quantum of relevant information. The search was conducted of all relevant journals including following three relevant disciplinary journals: Environmental Health, The Lancet, and Climatic Change.

Pathways through Which Climate Change Effects:

A gradual and steady rise in temperatures is being caused by climate change. The climate change is constantly making our weather erratic and aggressive which causes climate induced disasters frequently and intense consequently increasing food insecurity (Cline, W.R. 2007). It is also expected that temperature extremes are likely to become more frequent and aggressive all over the country, which may increase drought spells significantly. The drought spells can cause adverse effects on our crop production processes (Fahad, Shah, Jianling Wang, 2020).

The weather patterns are increasingly becoming unpredictable, aggressive problematic and erratic. Similarly rain falls patterns have also changed across all arid plains and along sea coasts resulting in droughts of extended periods. Our agriculture is closely related for its water requirements to the monsoon rainy season which is unfortunately delayed in various ecological zones of country, with important and sometime severe implications for its agriculture sector. Generally it is believed that it is going to have adverse impacts on agriculture production (Chaudhry, 2017).

Effect of Climate Change on Agricultural and Food Security Systems:

The climate change is adversely affecting the agriculture productivity systems and food security and has made it more challenging and difficult to achieve food security targets (Mehmood, 2009). The climate change has already disrupted our ecosystems, and ensuring food security has become the most daunting challenges for planners, producers and country managers (Iqbal, 2009).

Direct Effects of Weather Extremes on Production of Crops:

Farm crop production is directly affected by the change in weather. There are optimum temperature limits for the growth of plants and rise in temperature from these limits affects the grain production of crops, increasing food insecurity (Janjua, et al., 2010). The literature shows that about 38% of Pakistan's population are food insecure due to their limited access and economic affordability of food. Under this scenario, the hindered food

production and accessibility due to climate change may exacerbate their food problems (Ali et al., 2017).

The rise in temperature and changes in rainfall pattern negatively affects the grain, fruits and vegetable production of our country. It has been observed that droughts, water crisis and floods are frequently occurring throughout the country (Amir, 2009). More than 80% of farmers in drought-affected areas of Sindh keep livestock but facing acute shortage of animal feeds due to decreased fodder production. They are facing difficulties due to scarce water availability, weather related livestock diseases and deaths of weak starved animals (Anjum, Saleem, Cheema, Bilal & Khaliq, 2012). The monsoon rainfalls in Sindh, during 2018 were observed to be almost 70% below previous average. Similarly in Balochistan the rains were almost 45% lower than that of average. It is obvious that such a drastic reduction in rainfall resulted in shortages of irrigation water, food production, and fodder availability.

It was estimated by The UN Food and Security Cluster that the drought affected approximately 5 million people in 26 districts of Sindh and Balochistan provinces in the previous years. It was declared that approximately 1.3 million people experienced a food crisis in seven drought-affected districts in Sindh (GRFC 2020). The report further states that the residents of these hazard hit areas could hardly get adequate food. They lack economic power to afford adequate nutritious foods and other necessities of life and non-food expenditures (GRFC, 2020).

Weather Extremities and Hazards:

Globally all countries are facing an alarming situation due to increase in temperature and change in weather (Yang & Jones, 2014; Uyttendaele, & Hofstra, 2015). High temperature are causing the melting of glaciers on an unprecedented rate which can result in floods every year. Moreover in the long run it is likely to cause the depletion of water resources and consequently food shortage (Ashraf, 2016). Weather extremities which include extended droughts and floods can directly affect crops, livestock and infrastructure. Decreased quantity of harvests result in increase of food prices and drastically lowers the income of households because of reduced food stocks. These circumstances make the survival of farming community involved further difficult (Field C B., 2014). Smallholder farmers are adversely affected by weather events as lack finances to invest in the systems and cannot recover from the losses of these shocks. Vulnerability of people to weather shocks depends on their dependence on the affected sector, adaptation capacity and frequency of shocks.

Climate Change Impact on Pests:

Climate change is the most important factor for the spread of pests and diseases. Climate change can affect the reproduction, survival and geographical distribution of pests (Chakraborty et al., 2011). Temperature and rainfall are the main factors which control the spread of pests and diseases. In general, an increase in temperature and precipitation levels favors the growth and distribution of most pest species (CIMMYT, 2020).

The reports published by FAO contain warnings to the South Asian countries that locust attack can increase and spread during favourable climatic conditions (FAO, 2020). In the presence of favorable temperature, the locust population are capable to increase up to 20 times within three months. The report mentioned that under favorable weather conditions, 38% of the area of Pakistan is favorable to serve as breeding places for the locusts. FAO report further predicts that locust can cause significant losses in areas where

major wheat and other rabi season crops like gram, chickpeas, and oilseeds are grown. It was informed that if not controlled, the locust might damage crops and affect food security and livelihood of the most susceptible communities in Pakistan. It can be concluded that locust outbreaks can cause food insecurity among communities with low adaptive capabilities (IPC, 2021).

According to a study published by FAO (2021), locust attacks can cause losses to agriculture case up to Rs. 205 billion rupees if the losses are calculated at 15% damage level. When the losses are considered at 25% damage level, the losses are estimated to be about Rs. 352 billion rupees, and approximately Rs. 464 billion for kharif crops. These huge losses make it an urgent issue which demands effective and successful control of locust infestation.

Effect of Extreme Events, Climate-Related Disasters

It has been reported that whenever climate extremes occur in major producing areas, food price are often increased after such disasters. Disasters like floods, droughts and insect pests attack can reduce productivity, destroy infrastructure, limit market access, and food supply processes reduce household incomes, affect livelihoods and increase food insecurity (Aksoy et al., 2010). Moreover, disasters can degrade ecosystem, increase soil erosion losses, decline land fertility and increase salinization of soils. These natural processes increase environmental deterioration and affect the availability of goods and services, decline economic opportunities reducing livelihood necessities. Agriculture is the most affected sector by climate extremes if the magnitude of impacts is considered. A recent analysis by FAO in various developing countries shows that 25 percent of all economic losses caused by climate induced hazards (FAO, 2015). The actual losses in agriculture sector are likely to be much higher because these losses have been calculate on the basis of total losses to the country. It was estimated that the countries had suffered 80 billion losses to crops and livestock during the period in question.

Mitigation and Adaptation Strategies

Adaptive capacity of agricultural systems can be enhanced by making the systems more resilient (Sheikh, et al., 2011). This goal can be achieved by appropriate measures that are locally suitable and system compatible and site-specific. Small and medium scale farmers, livestock owners, fish farming communities and those involved in supply systems are need to adopt a suitable steps, which can be determined according to local conditions (Smit & Skinner. 2002).

Broad adaptation strategies

Climate change is mainly changing rainfall patterns and reducing irrigation water availability, which is vital for maintaining productivity levels. It follows that by adopting measure that increase the efficiency of water use is required for building strong livelihoods (Sultana, Ali, Iqbal & Khan, 2009).

Adaptation measures which can increase the efficiency of this scares resource, include storage of water for irrigation, adoption of improved irrigation technologies, promoting those agronomic operations like zero tillage technologies and increase in organic matter so that water holding capacity of soil could be increased (Ashraf, 2016).

Similarly important measures for crops cultivation would be the use of new varieties or breeds, which have low water requirements and higher environmental

tolerances (Thornton & Herrero, 2014). It will be better to consider increased diversification of varieties or crops because it will avoid the risk of particular crop failure (Sultana et al., 2009). Still there are adaptive changes in crop management such as by adjustment in planting dates, selecting various cultivars and judicious and need based irrigations have been found to increase crop yields considerably, depending upon on the region and crop being considered. By adopting better and scientific post-harvest technologies, for example adjusting the percentage of grain moisture required for drying and changing the storage practices according to prevailing weather conditions after harvest (Thornton, & Herrero, 2014).

Adaptation Options for Livestock Production

The experts have devised and suggested a broad range of adaptation measures for livestock management and production for livestock owners of different scales: These suggestions about animal breeds, feeding systems, and production system are different between small and large-scale production (Thornton, 2009). Developing livestock breeds suitable to prevailing environment, fodder crops and forages are main components for developing resilient systems to climate hazards (ICEM, 2013). Most of livestock breeds available with our farmers are generally well adapted to prevailing high temperatures as well as harsh and aggressive environments, but their spread may be limited by trade constraints which might be reconsidered. Suitable breed selection, developing breeds suitable to local environment, genetic improvement strategies, proper vaccination, disease control and improved fodder may be effective strategies for climate change resilience (Thornton et al., 2015).

Agricultural Development:

Investment on the development of agricultural and related infrastructure, can enhance adaptation. Small scale farmers and livestock owners need support from government agencies and private sector engaged in this business (HLPE, 2013). Civil society organizations can also play an important role. An important benefit of investments in agriculture is that it may play a key role to eradicate poverty. It is further demonstrated by experts of World Bank that agricultural development strategies should focus on smallholder in their programs (FAO/OECD., 2012).

Establishment of efficient marketing system and development of better linkages of smallholder farmers to domestic, national and regional markets will play an important role to support adaptation actions. Moreover investment is needed to develop market linkages to food processors, and small-scale traders (Vaqr & Asif, 2016). Other facilities like low-priced credit and crop insurance against natural hazards may be provided. The problems of smallholders relating to financial needs for input expenditures like fertilizers, seeds and medium- and long-term investments, are needed to be addressed at priority (Gorst, Ashley, Dehlavi, Ali, Groom & Ben, 2018).

Conclusion

This study indicates that the climate change impacts on food production systems, water availability, crop yield, crop water productivity and food security are going to be severe if not dealt with scientifically and rationally. Future climate projections show that temperature will increase and the patterns of precipitation may change in major crop producing regions and areas. Climate change impacts on crop yield are often integrated with its effects on water productivity and soil water balance. Global warming will influence temperature and rainfall, which will directly have effects on the irrigation water availability and crop productivity. Crop yield is constrained to crop varieties and planting areas, soil degradation, growing climate and

water availability during the crop growth period. With temperature increasing and precipitation fluctuating, water availability and crop production will decrease in the future. Under this scenario it has become crucial for this country to formulate and implement effective strategies for climate change adaptation. The study also suggests that raising awareness among farming communities, the agencies and stake holders involved in agricultural supply chains is critical to implement adaptation policies and impact mitigation strategies. Improving water productivity and keeping stable relations with global food suppliers will be vital for food security.

Recommendations

The Government should adopt appropriate policies through its relevant institutions at national and level to enable and support the suggestions presented above. Special efforts are needed to support small-scale food producers in their efforts so that they could adapt to climate change (FAO, 2010).

It will be highly desirable to establish dedicated institutions and formulate policies which are needed for the prevention and management of risks and vulnerabilities to climate change. International cooperation and support can be sought for particularly managing transboundary pests and diseases (IPCC, 2012.). It should be essential to secure access of smallholder and women to such public goods and services. Ensuring land tenure by making proper policies is very important to enable farmers to benefit from the value addition of the land and to encourage them in adopting a long-term strategies IPCC. 2014).

A majority of our farmers are uneducated. They are not aware of climatic change and its impacts on crop production systems. They have limited knowledge of improved varieties and crop production technologies (Zaheer & Nawaz. 2020). It is high time to disseminate relevant information to farming communities with a focus on small scale farmers. Agricultural experts and scientists must develop site specific and farmer friendly technologies. Moreover farmer field schools and demonstration centers must be established to motivate the farmer for adoption of climate resilient practices and technologies. Awareness raising is one of the most effective means to adaptation that addresses the present and future impacts of climate change (Arlt, Hoppe & Wolling, 2011).

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