

Review Article

# Climate change and its impacts on Agriculture in Pakistan

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## Abstract

Climate change is a global issue. The major impacts due to climate change are more observable in Pakistan. As climate is changing in Pakistan and this changing climate are affecting agriculture, water resources, biodiversity and health. These are affecting due to floods, droughts, pollution and increase in sea level. The major cause of climate change is greenhouse gases which are released due to human activities. It is discussed that global climate is changing that is affecting food and energy production in Pakistan and also in world.

## 1. Introduction

We all have right to live in freedom and safety but climate change alarm the life of billions of people on this planet. Climate change means long-term change in temperature and weather patterns. Actually, the alternations in the solar cycle are responsible for such changes. But, since the 1800s human activities like burning of fossil fuels have been the cause for such changes. The burning of fossil fuels causes combustion which increases the heat and light results to rise in the temperature of the earth, this is Greenhouse effect. For example, industrialization, deforestation and fuel-based transportation are major causes of increased greenhouse gas emission. Climate change has lay a lot of countries at risk and the chance of threat is remarkably more for economically developing countries. In general, changing climate has serious effect on Pakistan. Pakistan is geographically placed in that area which has more effects of climate change. Climate change is a crucial problem in our country due to which our country is highly at risk. As climate is changing in South Asia due to which climate of Pakistan has also changes over the past decades with remarkable influence on our environment.

Climate changes like drought, heat and uttermost weather conditions, additionally melting of glaciers has also affected some rivers of Pakistan. Due to sudden change in climate, social and environmental issues occur. In history, 2010 floods reveal the destructive results on millions of people who lost their homes and get injured. These climatic changes put Pakistan's income, housing, food and security at risk. So, the Government of Pakistan must think carefully to take action against the harmful effects of climate change. Climate influence every part of our life and has vast impacts on our living, our health and on our future. This changing in climate is due to humans and these changes have large impacts on our lives. It is crucial for us to understand that how climate is changing so that we can make ready ourselves for the fu-

ture. The purpose of this review is to examine the problems of climate change in Pakistan and its complex effects on environment and also introduced the strategies to overcome the climatic changes.

### 1.1. Climate Change in Pakistan

Pakistan is among those countries that is most affected by climate change that's why it is big issue of our country. Pakistan is highly unsafe to climate change because of different types of topography, such as marshy areas of Karachi and Gwadar, deserts of Punjab and Sindh and hilly areas of KPK and Baluchistan due to which different parts of our country face severe issues when it comes to climate change. The climate of Pakistan is changing continuously due to greenhouse gasses that have harmful effects on environment and people. In Pakistan due to heat, drought and severe weather conditions, glaciers are melting that has impacted on rivers of Pakistan. From 1999 to till now, Pakistan categorized as fifth country which is affected by severe weather caused by changing climatic conditions. Pakistan frequently observes some of the world's significant maximum temperatures. In Pakistan, heatstroke affected thousands of people during heat wave in 2015, and a large amount of population is at danger. Climate change and its impacts in Pakistan are more evident due to global warming. In future, it is possibility that these dangerous climatic impacts may be more effective. The effect of climate change is different in world, somewhere it effects more like in developing countries its impacts are more severe. These climatic changes have negative effects on natural resources. Pakistan is also facing severe climate change because of melting of glaciers, floods and droughts. As in our country per head salary is low and also there is also deficiency of proper capacity development so the effect of climate change in our country will be more severe. Climatic changes have extensive impacts like reduction in agricultural yield, changes in availability of water is increasing and increased utmost climatic events.

## 1.2. Causes of Climate change

The climate is becoming more serious due to human activities. Due to human activities our climatic make-up is changing. The main reason behind it is burning of fossil fuels and deforestation that increase greenhouse effect. As global warming increases the temperature of earth due to which large amount of energy assembles and these cause more effect. Actually, human activities are responsible for release of greenhouse gases like carbon dioxide that changes the make-up of atmosphere and results in increase of temperature of Earth that is global warming.

Another cause of climate change is air pollution. Climate change and air pollution are essentially attached since greenhouse gases and air contaminants arise from the same origin which is burning of fossil fuels. The process of burning releases both greenhouse gases and air contaminants. Both Climate change and air pollution affect the quality of air at both local and international level. Air pollution not only affects climate change but also affect human health. Many air contaminants like particulate matter cause disease in humans.

Mostly air pollution has effects on those who live in densely populated areas due to release of gases during transportation that damage the quality of air. There is also risk of industrial hazards that scatter poisonous mist which may cause death to those people that live in surrounding areas. Climate change that occurs due to air pollution affects the geological distribution of many contagious diseases. The only choice to deal with this issue is through public knowledge combined with interdisciplinary approach by analyst, physicist, national and International Corporation must mark the exposure of this danger and design viable solutions.

**1.3. Greenhouse Gases:** are also the main cause of climate change. In greenhouse, sunshine enters, and heat is maintained. The main reason for the release of greenhouse gases are human activities due to which other gases like oxygen and nitrogen become unable to reach on the planet. Due to human activities temperature of earth is increasing at a faster rate and this high temperature has severe effects on climate. These effects cause to increase the strength of intense weather events such as flood, drought that effect millions of people and result in loses. Burning of fossil fuels is the main source of greenhouse gas emissions that are harming the environment. Land-use changes like deforestation, which is the main source of greenhouse gas emissions and continuously increasing the temperature of earth due to which climate is affecting. These days forests or trees are cutting for other purposes like to design grazing land, when trees are cut they let out carbon dioxide which they have been storing from atmosphere. Thus, deforestation is responsible for greenhouse gas emissions.

Due to pollution our environment is affected that result to increase in temperature and made people more sensitive to health issues due to air pollution. The sources of air pollution are cars, buses, trucks, power plants, industries and factories that are not only major source of climate change but also af-

fecting human health. These contaminations cause cancer, asthma heart attack and other severe health issues. To preserve health and environment from these contaminations, we must clean our air. Another reason of changing climate is natural factors such as changes in solar radiations, monsoons, changes in earth's orbit and levels of carbon dioxide.

## 1.4. Current Situation of Climate change in Pakistan

Pakistan is located in a temperate zone. The climate of Pakistan is changing continuously as topography of country is changing. The climate of Pakistan is normally warm and dried near coastal region and continuously become cold in Northern upland. Most of the countries receive very small amount of rainfall, with deviation of Northern regions, where monsoons conduct more than 200mm rainfall from July to September. In August 2022, severe rainstorm causes disastrous floods in Pakistan. Due to this rainstorm millions of people affected and it also affect agriculture of our country. The flood of 2022 was made remarkably severe by climate change which was caused by humans. Pakistan is making less than 1% greenhouse gas footprint including carbon dioxide, which is the largest source of climate change due to which Pakistan is now fifth most climate affecting country in world, that cause to lost thousands of lives and bear economic losses due to climate change from 1999 to 2018. Changing of weather, increasing of temperature, changing of monsoons and natural calamity are some effects of climate change that Pakistan faced in current years. Similarly, Azad Kashmir is suffering with the same effect of climate change like changes in weather patterns and natural calamity that resulted in flood, shortage of water and other problems.

In this current era water is the main reason of climate crisis. Water and climate change are indistinguishably connected because climate change affects the water severely. The most effect of climate change is decreasing of water due to uncertain rainfall, floods and drought. Change in climate making worse both shortage of water and threats related to water like flood and drought. In this era millions of people are facing shortage of water and don't have approach for drinking of clean water. This problem will become severe in coming days and there is chance that more people will be affected to this problem due to climate change and increase in population. Only a little amount of water is fresh and useable on this planet which is now starting to destroy due to climate change. The quality of water, not only in Pakistan but also in worldwide, is continuously affecting due to high temperature, constant floods and droughts making worse forms of pollution. This shortage of water is affecting food supply because this water is also used for agriculture.

## 1.5. Climatic stresses faced by Pakistan:

**1.5.1 Floods:** The main climatic events or stresses faced by Pakistan are flood, drought and heat waves but the major climatic stress is flood because floods are increasing in Pakistan and are causing vast losses to life. Among all stresses flooding is most destructive and harming the natural calamity and causes huge loss of human lives, framework and natural deposit. Many examples found in history about severe impacts due to floods like in August 2020, due to few days'

rain destroy thousands of homes across Pakistan. Flooding also affect agriculture and livestock and also demolish large number of houses and roads. Floods affect all provinces of Pakistan, mostly flooding happens in late summer months during monsoon season it can also happens due to glacial lake floods which is mainly due to increase in summer temperature.

In Pakistan, susceptibility to floods and other risks are high. Most of population of Pakistan lives in dangerous areas that has insufficient framework and where shortage of daily basic needs and there is no consciousness about avoidance from disaster. In North Pakistan, people's source of income was their agricultural land. These peoples depend only on this land and they are totally disconnected from main cities, so crops that grown on land are the only source of their income. Therefore, when flood demolish their land, then their source of income and survival is at risk. Due to repeated floods, most of the people change to other areas to safe themselves from continuous damage.

**1.5.2. Drought:** Another climatic stress faced by Pakistan is drought, which is a common phenomenon in our country. Droughts are environmental calamity. It can occur for short or long period that depends on condition of that area. From the early 2000 onwards, droughts mostly occur in Sindh and Baluchistan regions due to low rainfall. Due to drought conditions grassland is decreasing. In Pakistan drought is making worse food insecurity because our economy depends on agriculture. It also activates extreme migration and cause deprivation and deaths. Many examples found in history about severe impacts of droughts like droughts of 2000 and 2002 in Pakistan was so serious that cause to destroy living of people. Many people were affected due to these droughts and many were enforced to migrate. These droughts also affect livestock.

People, who live in deserts, are facing heat stress and shortage of water in these years that cause shortage of water in arid regions of Pakistan. Most of the people depend on groundwater assets which are continuously decreasing at a fast rate. So, to fulfill the demands of people in arid regions, a new activity arise which is business person sell water from tankers to insecure people at higher rate. People of Thar mostly migrate to large cities to find a work during drought periods. They only come back to their homes during monsoon season to harvest crops. Water is a big problem of our country which is causing insecurity to people. There is need to construct small dams in arid areas where water availability is low but due to lack of government funding it is almost impossible.

**1.5.3. Heat stress:** It is observed that heat stress is most strongly cause of migration in rural Pakistan. Due to increase in temperature our agricultural yield is decreasing. In arid regions the percentage of heat waves is increasing which results in loss of lives. In history, it is found that in 2015, due to heat waves hundreds of people died in Karachi. After that they started to take preventive measures like stay moisturize and safe from travelling during day to safe themselves from

loss of lives. Heat waves are also affecting food security because due to increase in temperature yield is decreasing. Climatic stresses like heat waves or increase in temperature cause to decrease in yield particularly affect winter crops like wheat, which is our staple crop. Actually, wheat is sensitive to heat stress which cause to decrease in yield of wheat that will affect the poor people of rural areas. In Pakistan heat stress in winter season provoke the migration of people from rural areas. Climate change is a reason for migration of rural people to urban areas. In Pakistan agriculture is the source of income for almost half of population. Most people are small land holder farmers who are highly sensitive to yield lose. Heat stress has powerful negative impact on crop yield because increase in temperature cause loss of irrigation demand Due to climate change, water shortage is increasing. As population is increasing day by day, this climatic change cause serious hazard to national food supply and yield of cash crops. The major source of water is alarming the future accessibility of water.

### 1.6. Impacts of Climatic change

It is widely accepted fact that climate change cause unfavorable effects on agriculture, food security, water resources, biodiversity, human and animal health and socioeconomic consequences. It is expected that, Underdeveloped and backward states go through adverse changes due to climate change as compared to the developed nations.

### 1.7. Impacts of climate change on Agriculture

Agriculture is the main economic part of Pakistan, which has also severely affected by climate change. It assists about 45% of country's agriculturists and 21% to Gross Domestic Product (GDP). Out of total area of Pakistan, cultivated area is more than irrigated area. Irrigation is very crucial to Pakistan, as more irrigated area is in Punjab and less in other provinces. Crops are extremely vulnerable to water quantity and changes in temperature in irrigated agriculture system. Climate change cause unfavorable effects on high-yielding resources and eventually on agriculture of the country. The major climatic events such as high temperature, rainfall, changes in monsoons, and serious climatic stresses such as floods, droughts and heat waves may all result in decrease of agricultural yield. In Pakistan, small land holder communities are more sensitive to climate change that makes more than 80% of the total agriculture community. The major effects of climate change on agriculture are Short Growing Season Length, Heat stress at reproducing stage and increasing of water for crops. Due to these factors, yield reduces in dry and semidry areas. It is forecasted that in 2040, if temperature will remain continuously increasing then agricultural yield will be decreased by about 8-10%.

Climate change badly affects the crop yield, but particularly high temperature and low rainfall decrease the crop yield. In many countries yield of wheat is severely affected due to maximum temperature. The main climatic stresses that reduced the production of cereals are drought and temperature. Climatic changes like temperature and shortage of water also affect the reproducing stage of plant. In beginning stage of flower, water shortage badly affects cereal crops and

increase in temperature during flower development stage may also cause sterility in cereal crops. That's why yield of cereals is greatly affected by climate change. Drought stress affects wheat badly at growth stages due to which yield of wheat reduced. Drought stress also affects the yield of legume crops like Mash bean and soybean.

Due to climatic changes, distress of agricultural regions is increasing because in most areas of world are facing severe weather conditions including Pakistan. Due to climatic changes yield of agricultural crops has affected as they are vulnerable to climate changes. Changing in rain fall affect the agricultural region and also financial system of Pakistan. Shortage of modern techniques caused diffusion of water. In history it is found that in 2015, unusually heavy rainfall destroyed hundreds of acres of crops and thousands of animals.

### 1.8. Impacts of Climate change on Livestock

Climatic events like different weather patterns extremely affect livestock and crop yield. In Pakistan, farm animals are also affected very badly by climate change. Climate change also badly affects the feed, water and fodder for farm animals that cause to reduction in meat and milk production. Animals are also affected by diseases and diseased feed. Due to high concentration of carbon dioxide gas in atmosphere, there is danger of elimination of many animal and plant species. Climate change particularly heat stress badly affected the livestock and also their fodder development. The population of livestock has also severely affected by drought and their growth has been decreased. Heat stress has also affected dairy animals and cause to decrease milk production. Due to climatic changes livestock's also face health issues. The health of farm animals is mainly affected by temperature. Climate change has direct and indirect effects on livestock. Direct effect of climatic changes on farm animal's health is occurrence of diseases and death and indirect effects includes diseases that affect them.

### 1.9. Impact of Climate Change on Food Security

Another effect of climate change is the potential increase of hunger and malnourishment. Climatic change is making worse the threat of food insecurity and malnourished through utmost weather events such as drought and floods, which has unfavorable effects on source of income and food security. Due to climate change, increase in sea level, also impacting source of income in marshy or coastal areas. In past, millions of people have adequate food but now most of population is facing shortage of food, due to which chronic malnutrition reduced. Climate change is the main reason that adversely affects food safety and increase undernourishment. It is expected that hunger and malnourishment is one of the most adverse impacts of climate change. Due to unfamiliar weather events, household income and food safety has affected and hence become major cause to increase the poverty. Agriculture is the backbone of our country, but now Pakistan is facing adverse problems such as scarcity of water and less rainfall. Due to increase in temperature and changing pattern of rainfall is causing scarcity of water which give rise to increase the problem of food safety due to reduces yield.

### 1.10. Impact of Climate Change on Water Resources

In Pakistan water resources are adversely damaged by climate change due to change in rainfall patterns, emission of greenhouse gases and repetition of climatic events such as floods and drought. As climate is changing it also change the water cycle due to increase in temperature, change in rainfall and monsoon events, melting of glaciers and increase in sea level, that are causing to reduction of water. The shortage or reduction of water is a world issue which frighten those countries where population is continuously increasing, due to which Pakistan is facing shortage of water. In Pakistan, Karachi is facing scarcity of water due to increase in population and water pollution. It is a basic reason that Pakistan is facing water scarcity due to human overpopulation, restrained urbanization of cities and climatic events that result in floods and drought.

Climate change affects glaciers, lakes and groundwater of Pakistan. Due to release of greenhouse gas in atmosphere that increases temperature of earth which is result of climate change. As temperature increases glaciers start to melt and run on land surface that cause to increase the sea level in world. Due to these reasons' disaster occurs like floods in Pakistan are due to melting of glaciers. It is discussed that as climate change results hot temperatures, which hot the water and cause to decrease the oxygen consumption rate in lakes due to increase in water temperature, consumption of oxygen is reduced. Consequently, these regions become dead zone due to low oxygen and no microorganism can remain alive, which is injurious for water quality of lakes as decrease in Biological Oxygen Demand disturbs the whole food cycle and result in death of aquatic life. In many areas' groundwater is utilized as drinking source but due to climate change freshwater and groundwater sources become very short as the supply of ground water is decreasing due to lands being immersed with salty water. So, it is crucial to control the water disaster.

### 1.11. Impacts of Climate Change on Biodiversity

The main reason of climate change is high level of Carbon dioxide, changing patterns of rainfall and temperature increase the seawater, drought, heat waves and floods. Due to increase in temperature and carbon dioxide level have adverse impacts on plant and animal life. Moreover, adverse changes in temperature, floods and sea level change the biodiversity or ecosystem. Similarly, change in temperature and rainfall increase the dying out of species. Due to changing in temperatures and flooding, climate change applies more force on natural environment. It directly impacts developmental organisms and also affects decay, biogeochemical cycle, botanical composition and interconnection. It also indirectly affects habitat or ecosystem through changing flow of water and other climatic patterns like floods so, species fail to remain alive under these climatic conditions. Climate change has immediate effect on animals because it is primary source of diversity and destruction process. The main cause of specie death is global warming or increase in temperature, which cause the loss of habitat. Many animals will be at risk when their habitat or ecosystem will be disrupted.

### 1.12. Impacts of Climate Change on Health

Due to floods, storms and heat waves disease causing agents such as bacteria viruses are increasing the possibility of disease. The relationship between increasing temperature and risk of diseases are familiar for few years. Due to increase in rain and heat, mosquitoes increase their orbit and when they come in touch with humans they increase the risk of diseases. Floods also cause to waste drinking water and spreading disease causing agents which give rise to viruses, cholera and other diseases. Climate change also change the way of acting and involvement with others, its proof is present in history that due to heavy rainfall occurrence of COVID-19 increased as people were gathered together in small area. High temperature and different weather events can affect air, which cause health issues. Due to harsh weather patterns like severe floods and storms put human health in risk. The patterns affect human health due to decreasing accessibility of clean food and water. The major impact of climate change is food security and nourishment which is due to high amount of Carbon dioxide in atmosphere.

### 1.13. Strategies to Mitigate Climate Change in Pakistan

Pakistan is among those countries which are mostly affected by climate change. Due to these climatic changes, people are severely affected which are floods, prolonged heat waves, shortage of water and food scarcity. The bad thing about these impacts is that these are continuously getting more severe. The strategy to mitigate the climate change is to decrease the greenhouse gases into the atmosphere. The straightest and cost-effective strategy is to locate solar electric panels at home to use renewable energy source. By using little sources of carbon dioxide for production of electricity, it can decrease release of greenhouse gas due to electricity as compare to fossil fuels so to mitigate these climatic changes, Government should help.

- The Government should accept critical reforestation and afforestation plan on hills because northern areas have critical deforestation problem which is due to deficiency of electricity and natural gas.
- The government should help to construct dams for storage of rain water
- They should arrange garbage control plan for mountainous areas because mountain center have no place to discard their waste. They throw waste in rivers or burn it or submerge it in soil due to absence of proper waste dumping system.
- Another strategy to mitigate climate change is to prohibit diesel automobiles that cause to melt glaciers at rapid rate that affect the human health.
- Put climate change at first concern in governmental program because it will affect every area of human and industrialization and needs to be consider at every level.

These achievements are essentially needed, but it should keep in mind that it is not only duty of Government. The citizens should take step on these climatic change issues and should do work with government to carrying out these strategies. Climate smart Agriculture has need of working anxiously with farmers to modify their crop handling policy into

resilient application that maximizes the effects of climate change. The result of climate smart agriculture will demand integrated approaches to crop rotation, fertilizer application, selection of seed and irrigation management. Native people are more sensitive to climatic impacts. These resilient climates smart agriculture system demand transmission and many comment circuits so that the practices can be continuously modify to the different cropping practice.

### 1.14. Future Scenario of Climate Change

Greenhouse gases remains in air for long duration due to which greenhouse gas absorption will continue to increase and stay uplifted for years. Furthermore, if concentration of atmospheric greenhouse gas continues to exist balanced then air temperature of planet will keep on heated because of oceans that reserve heat. Due to increase in greenhouse gases and temperature, these will affect climate of hundreds of years in future. Global warming is continuously noticed from few decades. It is presumed that temperature is increasing in future at least 2.7 Fahrenheit by 2100. It is predicted that climate change in coming years will be more than the past. According to International Panel on Climate Change, the amount of carbon dioxide in air will increase in next hundreds of years. Due to these changes the world is getting hot. Actually, the temperature is increasing due to burning of fossil fuels and greenhouse gases that enters into the air. Due to temperate climate sea level increases because of melting of glaciers. It is projected that sea level will increase to 0.25 to 0.30 meters by 2050 and in 2100 it will increase more. Due to hot surface of oceans, extensive storms occur. It is anticipated that these hot oceans cause the escalation of these storms. Due to ocean's environment temperature of sea surface will continue to hot that unable the sea animals to survive and these are at danger [1-16].

## 2. Conclusion

Pakistan is highly affected by climate change due to many reasons. The main reason for changing climatic conditions is greenhouse gases. Pakistan is facing many climatic stresses that are heat waves, floods, drought and scarcity of water that affect quality of life. To safe country from climatic changes government should take steps to mitigate the climate change. Growing plants is the most attractive policy to mitigate climate change and to increase forest area in country that will increase the magnitude of greenhouse gases to absorb. Due to these climatic changes, glaciers are melting at a faster rate. Government play an important role in organizing and carrying out the strategies, there should be continuous improved proposal that should focus on adapting the climate change in sustainable way.

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