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Climate Change and its Effects on Agriculture in Pakistan

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Abstract
Climate change is causing damage all around the world, which is not an issue of a single country or region but a global phenomenon, the temperature is rising, sea level is rising, and rainfall patterns are changing which reveals that climate change is not false but a serious issue for the entire world, every year it's getting more dangerous due to human activities, such examples are, the lungs of the planet "Amazon rainforest" fires in 2019 the recent Australian bush-fires, and California wildfires of 2020. The main aim of this work is to identify those factors which are contributing to Pakistan's vulnerability to climate change, this climate shift is causing more serious problems for Pakistan including, a decline in agriculture productivity, water shortage, health problem, energy shortage, and forced migration, one factor in the vulnerability of Pakistan is a geographical location other factors are also discussed which are contributing to the vulnerability.

Introduction
Climate change cannot be restricted to a certain region or country. due to climate tendencies, we assure that its implications for the whole planet are visible and clear. But this issue has different intimations in some regions like some are having extreme forms and on the contrary, others have comparatively fewer impacts.

In the case of Asia, the vulnerability this much higher than in the rest of the world. More than four billion people live here. Agriculture productivity was projected to fall by 50% in the year 2020 (Kiran, 2017). South Asia is a region near to two million people and also one of the poorest regions in the world where most of the people are connected with the agriculture sector.

Apart from poverty, inequality of resources, and income, this region is susceptible to calamities, catastrophes and disasters such as floods, droughts, cyclones, earthquake landslides and soil erosion are the most expected disaster faced by South Asia. Another threat to this region is global warming and change, which is not only bullying the alternative of South Asian people but also putting the whole planet in danger.

Out of all the South Asian region, Pakistan is one of the most vulnerable countries to climate change and its challenges. From its independence, the country has come to climate change events. Due to its geographical location, Pakistan is considered as a disaster-prone country and one of the most dangerous countries to climate change. In the following section, It has to look at the climate change in Pakistan, climate change impacts in Pakistan, factors that contribute to Pakistan's vulnerability to climate change, water limitation (intensification of interstate and intrastate conflict), food security, forced migration, temperature rising and has a look on other sectors of the country.

Climate Change In Pakistan

The vulnerability of Pakistan to climate change is well known. The country has been facing this issue since 1947, after independence when industrialization took place, as a result, greenhouse gases accelerated and it paved the path to changing climate. These were not the country's policy agenda until they have some vulnerable catastrophes time after time. Pakistan's contribution to global greenhouse gas emissions is far less than others. Its contribution to GHG emission is 0.08% but still has ranked 8th in vulnerable countries to the climate change list (Naeem Akram, 2015) (Hamid, 2015).

In recent past decades, the annual mean temperature has escalated in Baluchistan and Sindh, by Global Change Impact Studies Of Pakistan. The average temperature has raised by 0.06 degree Celsius in the last century. The future prediction by climate projections shows that by the end of this century, the average temperature will be rise about 1 degree Celsius higher than the global temperature, this will have an inauspicious impact on the country (Achakzai, 2019).

Challenges to climate change are now considered as more threatened than terrorism in Pakistan. In a report suggested that, due to monsoon incantation between July and September 2019, where 235 individuals rested in peace and 169 suffered injuries and on the other hand 134, civilians died from terrorist attacks in the country in the first part of 2019, which shows that for the first time victims from monsoon rains have surpassed death toll caused by terrorism. (Khan, 2019).

Climate Change impacts in Pakistan

In the above section, we looked that how climate change has become a worse and far danger for the people and the economic growth. In this section, we will look into the impacts of climate change in Pakistan. The indication of climate change in Pakistan happens through increased water scarcity, decrease in land productivity, changing precipitation pattern, frequency and intensity of heat waves, droughts, weather-induced natural disasters, and more importantly floods, sea-level rise, forestry and fisheries, human health and tropical cyclones, etc.

Factors Contributing to Pakistan's Vulnerability to Climate Change

The main factor contributing to a country's vulnerability is its geographical location which cannot be refused. Pakistan is located in a region where heavy monsoons and rising sea levels are anticipated to be more acute than that in the past. Besides the geographical location of Pakistan, there are numerous factors contributing to the country's vulnerability to climate change. The geographical location of Pakistan is natural which paves the way for one of the most vulnerable countries to climate change, but the other factors are anthropogenic (man-made) such as deforestation, urbanization, population and unplanned development etc. Apart from this water scarcity plays a key role in the agriculture sector which is the lifeline of Pakistan's economy.

Deforestation

Deforestation is not a new issue in Pakistan but it exist for decades. Almost 68% of the country's population hangs on firewood for their daily uses. Deforestation rapidly increased in Pakistan over the past two decades. Forest are in the country was 4% in the 1990s, and in 2010, only 2.2% of forests area left to the forests. Pakistan is one of the highest rates of deforestation in Asia. This is an anthropogenic factor that is mainly caused by humans and we are the victim of forest destruction (Lashari, 2019)

According to the survey that 53% of deforestation in Dir Kohistan is black marketing of forests. (Tariq, 2015). Pakistan is in the 2nd position country where deforestation rate is at its peak. According to a survey, 17% of carbon dioxide (CO2) comes from deforestation. Industrialization and urbanization are the main causes of deforestation. More urban societies are cutting down forests areas to expand cities and live life luxury and industries need more fuels for machinery and other related product like furniture, timber etc. according to the projection for 2017, showed that the wood consumption in Pakistan is 52.6 million cubic meters, but the country is merely producing 14 mcm (Lashari, 2019).

Rapid Urbanization, Population Growth and Unplanned Development

Pakistan is one the highest urbanization speed country in South Asia, in 2017 the urban population in Pakistan has risen to 39.7% which was 37% in 010 and 17% in the year 1951. The annual rate of urbanization is 2.77% which shows that in the next 10 years half of the country's population will live in urban areas.

According to the United Nations population division by 2025 that the Lahore city will cross 12 million, and now it is 11.12 million and same is the case with Karachi that will be 19 million and currently it is 14.19 million (Domínguez, 2014).

The rapid growth of the urban population contributing to vulnerable climate change, this rapid growth in population and urbanization has serious consequences on the country's environment. The growing population led to rise in temperature due to massive energy consumption, an increase in transportation and the cutting forest area near the urban center. Similarly, water pollution is also an unplanned development that paved the path to urban floods as we saw in the Karachi flooding.

Water Scarcity

Water is the lifeline for the states whose economy is based on agriculture/hydropower. Pakistan's economy is based on the agriculture sector which contributes to 25% of its Gross Domestic Products (GDP), and has 2/3rd of its employment, 80% export and also has a major share of its water resources (Wittmann, 2012).

Pakistan has a rapid growth rate population, in 1955 Pakistan's population was 40 million but in 2015 it arrives at 188 million and it is expected that Pakistan's population will be 262 million in 2035. In the chart global ranking, Pakistan was in 14th position in 1955 and 6th in 2015-16.

Water scarcity is a major human security challenge to Pakistan as well as the agriculture sector of Pakistan. The country will face serious water scarcity by 2025 and according to a survey, it will be the most water-stressed country in the South Asian region. Around 30 million Pakistanis have no entrance to clean water. Water is not only required for the agricultural sector or drunk but also for raw materials such as cotton that export-oriented sectors. (Yusuf, 2020).

Water scarcity in Pakistan is made the country worse. The comparison between Pakistan and other countries in the region is that Pakistan uses ten times more water for growing the same crops. The Indus water treaty was plenty for both the state but with the rapidly growing population and expanding agricultural requirement, especially on behalf of Pakistan, the supply of water in Pakistan has fallen from 5000 cubic meters in 1947 to only 1329 cubic meters nowadays which become close to the level defined by United Nations as "high stress" (1000 cubic meter) (Aslam, 2013).

Energy Sector

A major contributor to vulnerable climate change in Pakistan is the energy sector, due to greenhouse gas emissions. Pakistan's GHG emissions increased over the past years and still increasing in the energy sector because of the growing population, changing patterns and economic growth. As the population growth will increase the demand for the uses of energy will also increase. In 2012 the energy sector accounted to 46% of emissions, which is considered as the main and the largest GHG emissions contributor to climate change. One of the primary sources of energy in Pakistan in 2013 was figured 48% gas, 32% oil, 31% hydropower, 7% coal and only 2% nuclear energy (ADB, 2017).

According to the National, Economic & Environmental Development study report during 2008-2009 showed that the total energy consumption of the country was 37.3 million tonnes. This energy consumption was including 43.4% gas, 29% oil, 15.3% electricity, 10.4% coal and 1.5% of LPG. The aggregate of total energy sources accounts for 51% of the total GHG emissions. In counterpoint to the last decade, the usage of petroleum has increased by 0.5% per annum, gas by 6.8%, electricity by 5%, and coal by 12.5% per annum. Whilst in the last half decade the increase of gas consumption by 9%, coal by 1.5%, and oil consumption step-down to 9.5% (ADB, 2017).

Floods In Pakistan

Floods are one of the most dangerous and devastating natural hazards which damaged a vast number of lives and properties all over the world. Floods occur every year in Pakistan with massive intensity and

frequency. It is one of the catastrophic kinds of disaster that causes extensive losses of natural resources as well as human lives.

Since 1950 Pakistan faced 19 major floods which caused economic losses worth 30 billion US$. In the last 62 years, more than 0.19 million villages have been damaged by floods and8,887 people lost their lives and 407,132 square kilometer area was affected. Besides this, the 2010 floods caused around 2,000 deaths and damaged 17,553 villages, 160,000 KM square area. (FFC, 2010).

Rainfall Patterns

Pakistan has the following four seasons, the cold season from December to March, the monsoon season from July to September, the hot season from April to June, and the post-monsoon season from October to November. (Kureshy, 1988). Round about 50% of the country area is arid, 40% is semi-arid and 10% area acquires humidity. (Khan F. K., 2002).

According to World Climate Guide during monsoon season, at least 60% of rainfall is recorded in the Punjab and Sindh provinces of the country. In the past years, the monsoon in Pakistan has become irregular patterns with unusual forces like floods. The overflow of rivers also affected widespread flooding due to the heaviest rainfall.

Task Force on Climate Change In Pakistan 2010 reported that the country has faced numerous disasters including cyclones, floods, droughts, intense rainfall, and earthquake. from the couple of decades round about 40% of the country's population are extremely prone to face multiple disasters like rainfall pattern, storms floods, and droughts. (Salma, 2012).

Pakistan Profile in the context of Floods

Pakistan is considered a disaster-prone country, it's very diverse geography and also climate conditions make it more vulnerable to various forms of disasters. Coastal areas of the country face more extreme risks such as cyclones and floods. Mountainous areas of the north are at risk of landslides, snowstorms and earthquakes. Mid river basins and deltas are also facing the risk of flooding. On the other hand, arid and semi-arid parts of the southern sides of Punjab, Sindh and Baluchistan are susceptible to droughts.

Pakistan is the most disaster-prone country in the region along with a massive loss of lives, houses, and agriculture land which is the lifeline of Pakistan's economy and affected different areas of the country every year. Floods in Pakistan usually occur due to storms, which originate from the Bay of Bengal during the monsoon season. These storms which arise in the Bay of Bengal and pass through lower India and Rajputana enter Pakistan and countries toward the northern area of Kashmir. Floods particularly hit Punjab and Sindh, whilst hill torrents tend to affect hilly areas of KP, Baluchistan and Gilgit-Baltistan (Sayeeda Amber Sayed, 2014).

Floods Management in Pakistan

Pakistan since 1947, catastrophic floods occurred in 1950, 1956 and 1957. But due to a lack of resources and institutional arrangement, there was not a broad flood management plan at the national level. Till 1976, all the provinces and local authorities were responsible to flood management and protection, but

the devastating floods of 1973, caused the loss of 474 lives and at least $2 billion in economic loss to the country (FFC, 2009). An integrated countrywide approach was initiated for the management of the floods problem which led to the formation of the Federal Floods Commission (FFC) in 1977. Current flood management adaptation can be discussed in the aspects.

- Floods Management Measures
- Legislative Framework
- Institutional Setup

Floods Management Measures

In Pakistan floods management measures primarily consist of flood protection embankments, studs, spurs and advanced flood forecasting techniques. The provincial governments have built various flood protection structures to solve local floods problem. Since the creation of the FFC in 1977, the management of floods has been practiced under a unified approach at the national level. In 1998 an everlasting National Flood Protection Plan (NFPP) was prepared. The NFPP carries phase-wise implementation in the shape of sub-plans named “ten-year national protection plan” (NFPPs). Approximately 17.8 billion (PKR), has been spent on flooding works, relief and rescue that were not enclosed in various programs since 1977.

Thus far three NFPPs have been carried out in the period from 1978 to 2007, NFPP-I (1978-1987), NFPP-II (1988-1997), and NFPP-III (1998-2007). These propositions have been funded by the federal government and some donor agencies. following the planning and assent criteria of FFC, a new project for floods is implemented under two headings. Needs driving measures to discourse local floods problem or unified measures under NFPP. Those areas are prioritized which present high economic losses, vulnerable social and economic groups, and human suffering (Muhammad Atiq Ur Rehman, 2012).

Structural Measures

Various attempts have been caries out previously to train rivers and to protect the adjacent areas from flood damage and river erosion, but sediment concentrations and extensive variation in river discharge led to erosion of river plains. Generally, flood management has depended on the requirement of structural measures for the containment of floods. Wide-ranging structural measures have been taken which include, the construction of embankments, gabion walls, spurs, flood walls, dikes, and channelization of flood water. Spurs are formed to oppose land erosion and to regulate the river’s primary course, whilst embankments are built in those places where bank floods are the major problems. (FFC, 2009). Embankments and spurs are shown in the table.

Table No.01

Province	Embankments (km)	Number of Spurs
Punjab	3334	494
Sindh	2422	46
Khyber Pakhtunkhwa	361	185
Baluchistan	602	650
Total	**6719**	**1375**

Source: FFC 2008 Annual Report

Legal Framework

Responsibilities of water come under the authority of provincial governments as per the constitution of Pakistan, but federal authorities carry out several responsibilities and tasks in the water sector mainly concerned with inter-provincial and international matters federal authorities perform integrated planning developments and management of hydropower and water resources through, FFC, WAPDA, and Indus River System Authority (IRSA). The national water policy draft was adopted in 2002, to label various issues relating to water in the country, together with floods, this policy highlights all needed structural and non-structural measures for flood management, along with strengthening flooding awareness in communities (Muhammad Atiq Ur Rehman, 2012).

Institutional Arrangements

There are various federal and provincial institutions involved in the different schemes for flood management, which are based on the given support and services are (risk-management and crisis managing bodies). These are Federal Flood Commission (FFC), Crisis Managing Institutes, Provincial Relief Departments and emergency relief cells.

Federal Flood Commission (FFC)

Federal Flood Commission (FFC) was established in 1977, the main purpose was to prepare the National Floods Protecting Plans (NFPPs) at the national level. The primary work of FFC is to figure out flood protection and river training activities, to make adaptabilities and awareness among residents. Generally, local government and other concerned agencies are responsible to flood protection schemes, and FFC has to review and approve these schemes.

Crisis Managing Institute

Crisis management is carried out throughout various administrative bodies. The country is divided into five provinces, these are divided into divisions, including districts further divided into tehsil and then unions.

Provincial Relief Departments

These entities are concerned with flood preparedness, rescue, and relief schemes, by conducting various surveys to confirm that all flooding protection bunds are sufficiently upheld before the flooding season. Further, it sets up flood centers and flood warning centers, at district and union council levels.

Emergency Relief Cells

Generally, ERC work at the national level, which handled assessments and planning of relief requirements for major hazards. The range of their tasks covers gathering fundamental requirements amidst emergencies, setting up emergency funds, and helping international donors in their attempts for relief. Local administration and provincial authorities bestow relief for catastrophe.

Flood Disaster Impacts on Pakistan Agriculture

There are massive impacts of floods on Pakistan's economy. The Pakistan Economic Survey shows that the country lost a net of 5,072 lives and $19 billion to the floods during the period (2010-2014). As agriculture is the lifeline of Pakistan's economy, the agricultural area of crops in Punjab, Sindh, KP, Baluchistan, Azad Jammu & Kashmir and Gilgit Baltistan are hit by floods in 2010, 2011, 2012, 2103 and 2014.

Table No. 02: Flood Affected Area of Crops in Million Hectares during 2010-2014

Year	2010	2011	2012	2013	2014
Punjab	0.42	0,00	0.19	0.30	0.98
Sindh	0.30	0.88	0.10	0.10	0.00
KP	0.5	0.00	0.00	0.00	0.00
Baluchistan	0.5	0.00	0.00	0.5	0.00
AJK	0.01	0.00	0.00	0.00	0.00
GB	0.00	0.00	0.00	0.00	0.00
Total	0.84	0.00	0.47	0.45	0.98

Data Source: National Disaster Management Authority (NDMA) 2010-2014

The catastrophic floods of 2010 have affected a total of 20 percent of the country's land and caused over $10 billion loss. Baluchistan and KP were hit by flash floods, whilst Punjab and Sindh were mainly affected by slow-rising riverine floods. (Abdul Rehman, 2016)

- 2011 floods hit the Guanche district of GB which caused hundred of homes and crop areas.
- 2012 floods affected, 5 million citizens, 14,270 villages, and 1.1 million acres of crops.
- 2013 August, flash floods caused about 1.5 million damages, 80 thousand houses and 1.5 million acres of crops.
- 2014 heavy monsoon rains and floods killed 367 and affected more than 2.5 million, 129,880 houses were damaged, over 1 million acres of cropland and 250,000 farmers were affected.

Pakistan's government officials report the floods caused catastrophic damage to the agricultural sector of the country. According to Food & Agriculture Organization (FAO) of the United Nations (UN) reports, floodwaters overwhelm approximately 6.9 million hectares of cropland of the country which is the most productive area of Punjab, KP and Sindh province. The primary crop of the country are cotton, sugarcane, rice, tobacco, fruits, vegetables, pulses and animal fodder. Farming is the chief way of food and also the main source to generate the country's economy. (Staff, 2016)

Economic Losses due to Crop

The damage to rice was PKR21.3 billion, sugarcane PKR 52 billion to over 80,000 hectares, PKR 22.4 billion of maize, PKR 17.3 billion of wheat stock after damaging over 667,000 tons and PKR 45 billion to fruits, fodder and vegetable. this is a massive economic loss to a country like Pakistan.

The textile industry was mostly affected due to floods disaster. The economic loss from cotton was predicted at PKR80 billion. The textile industry contributes 60% to the export of the country, with more than 2 lac deaths and the rest were facing food shortage.

Pakistan's total 23% economy is dependent on the agricultural sector and about 44% are agriculturally employed. 2010 floods has negative impacts on agriculture production due to which GDP growth of the country was reduced. According to the Ministry Of Food, the floods may have damaged crop value by up to PKR433 billion. (Staff, 2016).

Recommendations

International level

It is a fact that Pakistan has been suffering from climate change over the years, whilst the most responsible for damaging climate are the developed countries, and the consequences are faced by underdeveloped and developing countries. For countries like Pakistan to cope with climate change they need support from the international community because this issue cannot be mitigated solely and the most responsible are the developed nations. The developed world should provide a platform for the affected nations, where they can be engaged actively, there should be workshops for mitigation, and transfer of advanced technology for these nations through the Green Climate Fund, but the developed nations need to monitor whether these funds are invested properly or not. For this Pakistan requires to realize the issue of climate change to protect its population and future generation, so the country must raise its voice for such issues and be involved in workshops, and other activities at international fora.

Domestic Level

1) **Awareness among population**

   The first and foremost thing at the national level for Pakistan is to make awareness among the general masses, particularly in rural areas, through different Media, shows, newspapers, and mass campaigns throughout the country to inform residents of such issues, because the majority of our population is illiterate and don't even know what climate change is and what it can do to their lives, so the awareness is must because it can't be done without the support of the citizens.

2) **Investing in renewable energy/ technology**

   Pakistan needs to shift its economy towards less carbon-intensive, which means the power should not be derived from carbon-intensive sources such as fossil fuels, but from those sources which are less carbon-intensive, like, Wind, hydroelectric power, and solar.

3) **Utilization of Natural Resources**

   Policymakers and concerned authorities both at federal and provincial levels need to draft a policy document for natural resources, especially natural gas, to extend natural gas to those areas where locals are dependent on firewood which is a major cause of our reduction forests, particularly in northern areas. This could reduce the reduction of forests and also could be helpful to tackle climate change because trees are a carbon sink.

4) Floods management

To avoid massive damages caused by floods, there must be a policy regarding development planning, because unplanned development has caused immense destruction and is one of the main causes of disastrous floods inflow, so the government needs to highlight those areas where these developments have taken place and are still happening, so keeping floods and its intensity and frequency in mind they need to draft a measurement like there should not be any building from 200-400 meter nearby by flood plains.

5) Waste Management:

There is an urgent need for waste management in the country, as the waste is causing sea level rise and blocking drainage systems at urban centers which is the main cause of urban flooding e.g. Karachi, and Lahore.

6) Need for small-dams

The government needs to build small dams, in plain and hilly areas, which will store rainwater and as well freshwater, those in plain areas could be helpful to manage floods during the summer monsoon because the country receives 60% of rain in this period which causes floods, so these dams could work as reservoirs for freshwater storage and could also decrease the huge inflow of water which submerging towns, farms after every flood event.

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