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RESEARCH ARTICLE

# Impact of Climate Change on Agriculture Sector in Pakistan: A Case of District Lodhran, Southern Punjab-Pakistan

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**ABSTRACT**

Climate change is one of the most influential factors that affect agriculture production, and its impact has rapidly increased over the years. It has also affected the production of major crops like cotton, wheat, maize, rice, and sugarcane in Pakistan. The objective of the study was to investigate the impact of climate change on the agriculture sector of Pakistan. For this purpose, a cross-sectional study was designed, and farmers (n=385) were approached from district Lodhran located in Southern Punjab-Pakistan using a multistage cluster sampling technique. Data were collected by using a questionnaire as an interview schedule. The descriptive statistics were presented via frequency and percentage, while the Pearson correlation coefficient was applied to fulfil the study objectives. Results showed a significant negative relationship between climate change and agriculture production. In addition, all the variables of the study were negatively associated with endogenous construct including climate change (r= -0.606**, p<0.000), soil water (r=-0.304**; P<.000), crop production (r=-0.477**; P<0.00) food security (r=-0.605**; P<0.00), and pests and disease (r=-0.305**; P<0.00). It was concluded that climate change significantly affected the agriculture production in study area which needs serious attention to address the issue. It is suggested to mobilize the agriculturists to play their active role in guiding and training the uneducated farmers for dealing with climatic changes to avoid their adverse effects on productivity of different crops.

## INTRODUCTION

Climate change is one of the alarming concerns of people around the globe with concomitant hostile impacts on water resources, biodiversity, human health, agriculture manufacturing, forest, socio-economic zones and animal health. It has been that semi-periphery and periphery countries are going hand in hand regarding severe and intense changes due to global climate change in contrast to core countries (Syed *et al*., 2022). Due to high-temperature northern areas of Pakistan experienced a renowned swing in monsoon patterns and increased incidence of cyclones over the preceding year, impacting the agriculture sector (Abubakar, 2020). According to Ahmad *et al*. (2015), Pakistan is the 5$^{th}$ most vulnerable country exposed to climate change. An increase in urbanization and population density might have overwhelming impacts in terms of climate changes (Anwar *et al*., 2020). Similarly, Gupta *et al*. (2021) also reported that agriculture production highly depends on weather and climate change conditions. It has been noticed that temperature changes, carbon dioxide ($CO_2$) and a decline in rainfall rates are expected to impact crop growth significantly. Due to sudden climate changes worldwide, food production is considered vigilant with successful adaptation and appropriate irrigation. Therefore, global agricultural production should be promoted because of twice of $CO_2$ fertilization impact. It has also been impacted by

water resource reduction caused by climate change (Cline, 2007).

In India, Gupta *et al*. (2021) reported that one of the most alarming impacts of climate change had been noticed on the soil used for agriculture production. Because of changes in the types, forces, and recurrence rate of livestock pests and crops, the accessibility and water supply limits and the austerity of soil erosion changes due to climate change (Adams *et al*., 1998). Due to unfavourable climate conditions in India, the risk of soil fertility has increased, directly impacting the quality and quantity of the crops. Of all the consequences of climate change, groundwater recharge, groundwater level, soil moisture, and drought frequency significantly impact different areas the most seriously (Allen *et al*., 2004). Various studies showed another impact of climate change. It has been said that dry seasons below temperatures would lessen and even damage crop growth and production (Mahendra, 2012). According to Chen *et al*. (2016) tendency of the ordinary annual eagerness to the net income is highly dependent upon the seasons; the borderline could be significant (if warm) or hostile (if chilly).

In a report by International Monetary Fund (IMF) increase in 10 °C temperature would result in a decline in wheat production by 4% to 5% and will decrease overall by 1.7% agricultural production. Furthermore decrease in 100-millimetre rain would reduce growth by 0.35% (Swaminathan, 2009). In the previous few decades, the temperature of Asian regions has been noticed; about 37% of their population is associated with the agriculture sector. As everybody knows, the state of carbon dioxide in the atmosphere cannot be reversed because of ozone layer depletion (Anonymous, 2020). However, it is still possible to halt or minimize excessive future production of $Co_2$ and usage of chlorofluorocarbons which devastates ozone gas. This could be done by preventing the probable 30% increase in greenhouse gases due to deforestation, and fuel burning can be compensated by increasing the usage of geothermal and solar energy, which Pakistan is well endowed with, instead of cutting off the greenery and burning of trees wood for fuel. We know that biosphere is the main sink of carbon dioxide. Huge afforestation and agroforestry farming initiatives can encourage to give enough vegetation to have enough carbon dioxide because present carbon dioxide in the atmosphere can only decrease through planting more and more trees on earth which would be converted into atmospheric carbon dioxide into wood's tissues as recommended by green peace, and international environmental organization in Morocco held in 2001 (Anonymous, 2001). According to the Global Climate Risk Index, climate change has impacted many countries, and Pakistan is one of those countries vulnerable to climate change. It has been ranked as the 5$^{th}$ most harmfully affected country due to rapid climate change, which significantly impacts not only the livelihoods but also the agriculture sector and trade in Pakistan (Awan and Yaseen, 2017; Garg, 2021).

According to the Climate knowledge portal Pakistan report (Chaudhary, 2017) on the import and exports trends of Pakistan during the year 2017, there were 32.2 percentage points (pp) for chickpea, 16.3 pp for Maise, 0.41 pp for cotton, 0.24 pp tropical fruit, while -0.03 pp on cattle mile, 0.01pp on cattle meat, -0.29 pp on wheat and -0.24pp on vegetable imports (negative sign denotes potential decreases). In contrast, there were 23.6 pp of rice exports. To counter the complex problem of climate change, equally complex solutions comprise various fields of human activity and stakeholders. Multiple sponsors, i.e. civil society, institutions of research, and public and private sector universities, play a significant role in the production of reaction to climate catastrophe together with governmental representatives. At present, local governments are essential in taking hold of climate change overall, especially climate change adaptation. However, little research has been paid to adapting policies in developing countries like Pakistan. Prior studies in the area have focused on the need for adaptation (Abid *et al*., 2015).

This study aims to examine the impact of climate change on agriculture production in southern Punjab, Pakistan. Interestingly, prior literature was based on systematic reviews, but this study is among the pioneer to focus on empirical assessment to fill this gap in the context of Southern Punjab-Pakistan. Also, very rare studies addressed this problem in prior literature. Consequently, this study seeks to examine climate change's impact on South Punjab, Pakistan's agriculture sector. Moreover, this study will be helpful for social scientists, policymakers and field experts to understand farmers' points of view regarding the impact of climate change on agriculture production. Keeping in view, this study was conducted to find out the impact of climate change on agriculture production and also to analyze its impact on agriculture production's consistency, direction and magnitude in Southern Punjab-Pakistan.

## MATERIALS AND METHODS

A cross-sectional study was conducted in district Lodhran, Punjab, Pakistan from January-April 2022 and survey method was employed for data collection from farmers. In line with prior research methodology of Ashraf *et al*. (2019), who worked on the socio-economic impediment to the usage of modern mechanized ideals in southern Punjab's agriculture sector, the multistage cluster sampling technique was opted to select the respondents. At first, the cluster was developed based on geographical regions to achieve the

sample size for the survey. District Lodhran consists of three tehsils, namely Dunyapur, Lodhran and Kahror Pakka. In the next stage, Dunyapur was selected randomly from 3 tehsils of district Lodhran. Most of the population of tehsil Dunya Pur was associated with the agriculture sector. After that, three union councils, namely, Chak No. 360/WB, Jallah Arain and Qutab Pur, were selected from 22 union councils of tehsil Dunyapur through a simple random sampling technique.

Furthermore, a simple random sampling technique was used to achieve the sample size. Accordingly, a sample size of 385 was computed based on the previous recommendation (Comrey and Lee, 2013). The larger sample size is better than the smaller one due to the generalizability and accuracy of the outcome (Tabachnick *et al*., 2007). A semi-structured interview schedule in the native language was used to collect the data. The interview schedule was used because most of the target population was illiterate. Data were analyzed using SPSS version 23, and this software acquired results through frequency and percentage.

**Measurement**

The questionnaire was prepared from the indicators of previous studies of and Mumtaz *et al*. (2019); Gupta *et al*. (2021), Malhi *et al*. (2021) and Mumuh *et al*. (2021), while it was used as interview schedule. In the first section of the questionnaire; farmers were asked about their socio-demographic characteristics, and in the later sections, they were asked about the impact of climate change on soil, temperature, food security, water, $CO_2$ and pests and diseases from the adopted items of Mumtaz *et al*. (2019); Gupta *et al*. (2021); Malhi *et al*. (2021) and Mumuh *et al*. (2021).

**Statistical Analysis**

For coding, recoding and making the results researchers used statistical package for social science SPSS-22. Basic information of the respondents was presented through frequency and percentage and to analyze the direction, magnitude and consistency of the association between agriculture production growth and climate change Pearson Correlation coefficient with a 95% confidence level were applied to the data.

## RESULTS

This section represents the distribution of respondents in terms of their socio-economic status and demographic profile. In the next section relationship between climate change and agriculture production has been observed.

**Descriptive statistics**

Table 1 shows the distribution of the respondents to socio-economic status and demographic profile. Out of 385 respondents, 89(23.1%) the respondents had mentioned their age span of 30-40 years, while 18(47%) belonged to the age group of 41-50 years, and about 115(29.9%) reported their age >50 years. 245(63.6%) had mentioned their qualification was illiterate, while 79(20.5%) said that they had completed primary level to middle-level education, whereas 61(15.9%) had done matriculation or intermediate. Furthermore, 145(37.6%) reported their family size from 4 to 6 members, while 161(41.9%) mentioned their families comprised of 7-10 members and above, but 79mm(20.5%) had 1-3 members in their families.

Likewise, 171 (44.4%) of the respondents said that they were living in the joint family system, while 139 (36.2%) were living in extended families, and only 75 (19.4%) were from a nuclear setup. Similarly, 198 (51.4%) of the respondents reported their monthly income from 10,001-20,000PKR, while 77 (20%) mentioned 1000-10,000PKR, 69 (18%) and 41 (10.6%) mentioned their monthly income from 20,001 - 30,000PKR and above. When they were asked about land ownership, 89 (23.1%) had 1canal to 1acre, 66 (17.1%) had 1acre to 5acre while 61 (15.9%) and 51(13.2) mentioned their land ownership 6acre to 10acre and 1 to 2 canals respectively but 46(12%), were the owner, but 31(8%) were both, i.e. owner and

**Table 1: Distribution of the Respondents concerning their Socio-economic Status, Landownership and Types of Crops they cultivate.**

| Items | Categories | F | (%) |
|---|---|---|---|
| Age | 30-40 years | 89 | 23.1 |
| | 41-50 years | 181 | 47 |
| | >50 years | 115 | 29.9 |
| Education | Illiterate | 245 | 63.6 |
| | Primary-middle | 79 | 20.5 |
| | Matriculation-intermediate | 61 | 15.9 |
| Family size | 1-3 heads | 79 | 20.5 |
| | 4-6 heads | 145 | 37.6 |
| | 7-10 and above | 161 | 41.9 |
| Family type | Nuclear | 75 | 19.4 |
| | Joint | 171 | 44.4 |
| | Extended | 139 | 36.2 |
| Monthly income | 1000-10,000PKR | 77 | 20 |
| | 10,001-20,000PKR | 198 | 51.4 |
| | 20,001-30,000PKR | 69 | 18 |
| | Above | 41 | 10.6 |
| Land ownership | 1-2 canal | 51 | 13.2 |
| | 2 canal-1acre | 89 | 23.1 |
| | 1-5 acre | 66 | 17.1 |
| | 6 -10 acre | 61 | 15.9 |
| | 11-20 acre | 39 | 10.1 |
| | 21-30acre | 33 | 8.6 |
| | >30acre | 46 | 12 |
| Farming | Owner | 134 | 34.8 |
| | Tenant | 221 | 57.2 |
| | Both | 31 | 8 |
| Types of cultivated crops | Cereal crops | 61 | 15.9 |
| | Vegetable | 149 | 38.7 |
| | Mixed crops | 175 | 45.4 |

N=385, f=frequency, %=percentage.

**Table 2: Pearson Correlation Coefficient Relationship between climate change, soil, groundwater level, food security, crop production, pests and diseases.**

| Variables | M | SD | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| Climate change | 45.2 | 8.11 | 1 | -.606** 0.000 | -0.304** 0.000 | -0.477** 0.000 | -0.605** 0.000 | -0.305** .000 |
| Soil | 30.7 | 6.04 | | 1 | -0.301** 0.000 | -0.478** 0.000 | -0.474** 0.000 | -0.305** 0.000 |
| Water | 6.50 | 1.9 | | | 1 | -0.605** 0.000 | -0.601** 0.000 | -0.304** 0.000 |
| Crop production | 31.7 | 5.04 | | | | 1 | -0.504* -0.000 | -0.302** 0.000 |
| Food security | 6.40 | 1.9 | | | | | 1 | -.0304* 0.000 |
| Pests and disease | 6.30 | 1.7 | | | | | | 1 |

N=385, M=Mean, SD= Standard Deviation, p<.000**, r= correlation coefficient.

tenant. Lastly, 175(45.4%) were growing mixed crops, 149(38.7%) were growing vegetables and 61(15.9%) were growing cereal crops.

Table 2. Showed the results of the correlation between climate change, soil, water, crop production and food security.

The climate of a country plays a vital role in its agriculture production, and a majority of the population of Pakistan is associated with the agriculture sector. Therefore, the objective of the present study was to investigate the impact of climate change on agriculture production. Results have been generated from farmers' responses in Southern Punjab, Pakistan. Findings of the study showed that there is a significant negative correlation (p<0.000) between all the variables, i.e. climate change (r=.-606**, p<.000), soil water (r=-.304, p<-.000), crop production (r=-.477**p<.000) food security (r=-.605**, p<.000) and pests and disease (r=-.305**, p<.000). It means rapid climate change is badly affecting the soil of the agriculture land, reduced rainfall and high temperature are causing paucity of water for agricultural land. Furthermore, it has been clear that there is also an increase in unsuitable weather conditions that badly impact crop production and food security. The study showed a significant negative correlation between temperature, carbon dioxide, water, soil, pests and diseases and climate change. If the temperature increases, soil, water level of the fertile land, pests and diseases, food security and crop production will be affected.

## DISCUSSION

In our first finding, the soil has been negatively associated (r=-.301**, p<.000) with climate change which means a rapid change in the climate results in the devastation of agricultural land. These findings have been considered authentic because a prior study conducted by Gupta *et al*. (2021) reported that due to rapid climate change and the emergence of unsuitable weather leads to soil infertility which later results in a decline in the quality and quantity of the food being grown (Allen *et al*., 2004). Hence, we can say that the first and foremost attack of climate change can be observed through the land's fertility.

Likewise, our study finds that there is also a negative relationship (r=-.304**, p<.000) between underground water levels and climate change. These findings are confirmed by Eckhardt *et al*. (2003). They said that climate change directly influences groundwater recharge, groundwater level, soil moisture and risk of drought and flood in various areas. The decline in irrigation water streaming because of shortfall in rainfalls leads to reduced areas under irrigated crops and probably increased areas under rain-fed crops in the next season.

Furthermore, a significant negative relationship (r=-.504*, p<.005) has been found between crop production and climate change, which means the increasing temperature can also be destructive to crop production. These findings are also aligned with the statements of the Anonymous (2011) climate change is a significant threat to the food production in the agriculture sector of Pakistan because its productivity is highly influenced by various factors such as reduced rainfalls, temperature variation, variabilities in the dates of harvesting and sowing and access to water because the increase in 1$^{o}$C would cause 6% to 9% decline in food productivity (Mizina *et al*., 1999;; Smit and Skinner, 2002 and Mumtaz *et al*., 2019).

Similar to the above findings, the increase in pests and diseases also threatens food security (r=-.304*, p<0.005). According to Mahato (2014), the food production system is vulnerable to climate change, like the difference in precipitation and temperature, which directs a widespread of diseases and pests and thereby decline in a country's food security by impacting harvest. While distinction in occurrence and supply of pests and pathogens cause indirect impact, a decrease in agriculture production is due to distinction in the patterns of pests and disease associated with climate change.

**Conclusions and recommendations**

This study has been conducted to analyze the impact of climate change on the agriculture sector of Southern Punjab-Pakistan. The overall research covers a momentous period with quantitative data measurement techniques. Two findings, descriptive and Pearson correlation coefficient, are established and presented. The overall study showed a negative relationship between climate change, water, food security, pests and diseases and agricultural land soil. It is believed that the agriculture sector is the backbone of economy of Pakistan and due to it more attention is needed by this sector. Henceforth, fear of reduced production due to changing climate is one the emerging concern in agriculture sector which needs some immediate steps to be taken.

On the bases of findings, it also suggested that policy makers should launched awareness campaign at community level to instruct the farmers about the impact of climate change, also set up the awareness programs through radio and television to aware former about weather condition. By practicing these recommendations increased threat to agriculture sector in Pakistan can be reduced and agricultural production and food security can be made possible.

**Authors' contributions**

All authors contributed equally to this work. All authors read and approved this manuscript before publication.

**REFERENCES**


Abid M, J Scheffran, UA Schneider, and MJESD Ashfaq, 2015. Farmers' perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan. Earth System Dynamics, 6: 225-243.

Abubakar SM, 2020. Pakistan 5th most vulnerable country to climate change. Retrieved from: Reveals German watch report Dawn, (https://www.dawn.com/news/1520402 assessed on March 13, 2022).

Adams RM, BH Hurd, S Lenhart and N Leary, 1998. Effects of global climate change on agriculture: an interpretative review. Climate Research, 11: 19-30.

Ahmad A, M Ashfaq, G Rasul, SA Wajid, T Khaliq, F Rasul and RO Valdivia, 2015. Impact of climate change on the rice–wheat cropping system of Pakistan. 2nd edition. In: Handbook of climate change and agroecosystems: The agricultural model intercomparison and improvement project integrated crop and economic assessments, pp: 219-258.

Allen DM, DC Mackie and MJHJ Wei, 2004. Groundwater and climate change: a sensitivity analysis for the Grand Forks aquifer, southern British Columbia, Canada. Hydrogeology Journal, 12: 270-290.

Anwar A, M Younis and I Ullah, 2020. Impact of urbanization and economic growth on CO2 emission: a case of far east Asian countries. International Journal of Environmental Research and Public Health, 17: 2531.

Ashraf MU, M Asif, AB Talib, A Ashraf, MS Nadeem and IA Warraich, 2019. Socio-Economic Impediments in Usage of Modern Mechanized Technological Ideals in Agriculture Sector: A Case Study of District Lodhran, Punjab-Pakistan. Pakistan Journal of Life and Social Sciences, 17: 86-92.

Awan AG and G Yaseen, 2017. Global climate change and its impact on agriculture sector in Pakistan. American Journal of Trade and Policy, 4: 109-116.

Chaudhry, Q. U. Z, 2017. Climate change profile of Pakistan. Asian development bank. Retrieved from:https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan accessed on December 17, 2021.

Anonymous, 2020. Carbon Dioxide Information Analysis Center. Retrieved from: www.cdiac.ess-dive.lbl.gov. https://cdiac.ess-dive.lbl.gov/ accessed on March 1, 2018.

Chen S, X Chen and J Xu, 2016. Impacts of climate change on agriculture: Evidence from China. Journal of Environmental Economics and Management, 76: 105-124.

Cline WR, 2007. Global Warming and Agriculture: Impact Estimates by Country. 1st Edition Washington: Center for Global Development and Peterson Institute for International Economics, pp: 178.

Eckhardt K, and U Ulbrich, 2003. Potential impacts of climate change on groundwater recharge and streamflow in a central European low mountain range. Journal of Hydrology, 284: 244-252.

Garg P, 2021. Reviewing the Options for the Agricultural Sector to Adapt to Climate Change: Case Study of the Niagara Region, ON.https://dr.library.brocku.ca/bitstream/handle/10464/15026/Brock_Garg_Pulkit_2020.pdf?sequence=1.

Gupta AK, D Yadav, P Gupta, S Ranjan, V Gupta and S Badhai, 2021. Effects of climate change on agriculture. Food and Agriculture Spectrum Journal, 2: 91-95.

Anonymous, 2001. Intergovernmental Panel on Climate Change bulletin. Retrieved from: https://www.ipcc.ch/newsletter/.

RV Krejcie and DW Morgan, 1970. Determining Sample Size for Research Activities.

Educational and Psychological Measurement, 30: 607-610.

Mahato A, 2014. Climate change and its impact on agriculture. International Journal of Scientific and Research Publications, 4: 1-6.

Mahendra DS, 2012. Climate change, rural livelihoods and agriculture (focus on food security) in Asia-Pacific region. Retrieved from: http://202.54.18.156/pdf/publication/WP-2011-014.pdf accessed on October 2, 2015.

Malhi, GS, M Kaur and P Kaushik, 2021. Impact of climate change on agriculture and its mitigation strategies: A review. Sustainability, 13: 1318.

Mizina SV, JB Smith, E Gossen, KF Spiecker and SL Witkowski, 1999. An evaluation of adaptation options for climate change impacts on agriculture in Kazakhstan. Mitigation and Adaptation Strategies for Global Change, 4: 25-41.

Mumuh MZ, N Herlina, M Falah, E Saringendyanti, K Sofianto and NM Zin, 2021. Impact of Climate Change on Agriculture Sector of Malaysia. International Journal of Energy Economics and Policy, 11: 138.

Anonymous, 2011. Economic Survey of Pakistan. Fonance Division, Govt. of Pakistan, Islamabad, Pakistan.

Smit B and MW Skinner, 2002. Adaptation options in agriculture to climate change: a typology. Mitigation and Adaptation Strategies for Global Change, 7: 85-114.

Swaminathan MS, 2009. Science and sustainable food security. In: Sustainable Food and Water Security. World Scientific Publishing Company, 185-224. https://doi.org/10.1142/9789814282116_0012.

Syed A, T Raza, TT Bhatti and NS Eash, 2022. Climate impacts on the agriculture sector of Pakistan: Risks and solutions. Environmental Challenges, 6: 100433.

Tabachnick BG, LS Fidell and JB Ullman, 2007. Using multivariate statistics: Allyn & Bacon/Pearson Education,5:481-498.