Bulletin of Business and Economics, 13(3), 79-83
https://bbejournal.com
https://doi.org/10.61506/01.00446

Economic Assessment of Hybrid and Non-Hybrid Maize Crop in Sahiwal Division Under Changing Climate

Faheem Ur Rasool[1], Dr. Muhammad Abdul Rahman[2], Dr. Nasir Mahmood[3], Dr. Shahid Mahmood[4], Dr. Qasim Raza[5]

Abstract

It is a fine admissible verity all over the world that the changing climate exerts influence on all the kinds of survivals. As an agricultural based economy Pakistan rely on well-being of agriculture and it makes huge contribution in the gross domestic product (GDP) of Pakistan. Agriculture totally nature based and it is straight exaggerated by the exchange behavior of different climatic variables i.e. humidity, rainfall as well as temperature. Minor alter in one of these variables can cause extreme alter in the production of crops and the country's economy damaged in the result of yield loss. This study will be focused on climate changing impact on hybrid as well as non- hybrid maize crop within Sahiwal division, in the province of Punjab, Pakistan. Sahiwal division is the well-known agricultural production location and on the other side, it is very sensitive to climate change. That is the reason behind the study of the economic assessment of hybrid and non-hybrid maize crop under the climate change in Sahiwal division. With the help of arranged set of questions, check the impact of crop production on net farm revenue and Ricardian analysis operated to quantify the supposed impact due to changing climate. After estimating net farm revenue, it is a regressed against climate, soil and socio-economic variables. Study helps out in assessing the climate changing impact on hybrid as well as non-hybrid maize crop and plus suggesting adoption practices to farmers and thus giving reasonable policy support in the end.

Keywords: Climate change, Hybrid and non-hybrid maize crop, Net farm income revenue, Stake holders, Ricardian analysis, Sahiwal Division

1. Introduction

Climate change point out to any change in the environment that supports for an extensive period-regularly; numerous years or extensive. Climate irregularities demonstrate to changes in climatic circumstances inside a more unassuming time, similar to month, season or a year. Variations, for instance, the repeat or force of precipitation, cyclones and temperature can be brilliant and part of uniform environmental instability. Climate change impact economic progress especially to the agricultural economies consistently reliant upon the nature and climate. Alter in temperatures, mean and serious climate occasions can change the yield, pay, well-being and other social parts of survival. Climate change is a worldwide situation and no nation has sufficient ability to oppose this alter (Uzma et al.,2010; Audi, 2024).

Consistent saving funds rate, a lower yield because of climate change will prompt a proportionate decrease in investment, which in this manner will push down future production (Fankhauser & Tol 2005; Singh & Kumar, 2023).

Changing in environment will essentially affect farming productivity in late and coming many years; in light of examination studies led at local, provincial, continental and worldwide levels. From the industrial revolution, earth mean surface air temperature has increased by 0.8 °C in recent years. Revealed that the hottest ten years over the last many years was the 2000s and the latest hottest year is 2014.Yearly temperature in-wrinkled reliably, which influences the financial area of Pakistan. The noticed typical warming pattern in focal as well as southern area of Punjab, Pakistan has gone since 0.80 to 1.4 °C during the beyond thirty years and can increment 2-4°C later on, which can be an intense danger to the agricultural sector (Abbas et al., 2017; Ashiq et al., 2023; Khan & Hassan, 2019).

Climate change is a significant trial faced all over the planet and its force of weakness is more toward developing countries. Climate change is transforming into a more unpleasant issue for global food security. Cultivating region is seriously fragile to climate change regarding crop production. Yields of arising countries can weaker against regular issues and climate change, which might achieve an agreeable impact on crop value similarly as farmer's compensation and work. Global climate risk list situated Pakistan in top 10 negatively affected countries by climate change (German Watch, 2021).

Developed countries enjoy relative benefit in industrial sector still on other hand developing economies enjoy near benefit in farming area. The developing nations profoundly rely upon agricultural area for their development and economic development. Generally, Asian nations developing and rely upon agriculture and farm animals. A major test looked by developing nations is high population growth rate which led to the issue of food shortage (Mahmood et al., 2021; Khalid & Ullah, 2022).

There are plenty of challenges brought about by climate change for the agriculture sector, including decreased agricultural productivity, balance between production and revenues in regions of the world where food insecurity is already extremely high, and reduced capacity to withstand extreme weather. Heavy but unpredictable precipitation, frequent and severe droughts, floods, tornadoes, heat waves, and other weather extremes could result from even a cautious estimate of a 2◦C warmer climate. The Antarctic ice cover continues to recede, causing a global impact on weather patterns. According to the UNDP, since 1930, almost one-third of central Asia's glacier area has gone away. The devastating floods in Pakistan in 2010 and the heat wave in Russia may serve as examples of the kind of terrible occurrences that might happen on Earth. 2010 was both the wettest year on record and the hottest year ever recorded. Climate change is critical to a country's food security and economy, particularly in developing nations (Kang & Banga, 2013; Ali & Audi, 2016).

Many small hold ranchers of South Asian assorted conditions develop maize. High temperature-lenient maize assortments, subsequently, can possibly safeguard maize ranchers from serious yield misfortune because of intensity stress and assist them with adjusting to environmental change influences (Tesfaye K. et al., 2017; Ali et al., 2021).

[1] M.Sc. Hons Agricultural Economics Scholar, Department of Economics and Agricultural Economics, PMAS Arid Agriculture University Rawalpindi, Pakistan, faheemrasool009@gmail.com
[2] Lecturer, Department of Economics and Agricultural Economics, PMAS Arid Agriculture University Rawalpindi, Pakistan, arahman@uaar.edu.pk
[3] Lecturer, Department of Economics and Agricultural Economics, PMAS Arid Agriculture University Rawalpindi, Pakistan, nasir@uaar.edu.pk
[4] Associate Professor, Department of Environmental Sciences, PMAS Arid Agriculture University Rawalpindi, Pakistan, shmahmood@uaar.edu.pk
[5] PhD Economics, Department of Economics and Agricultural Economics, PMAS Arid Agriculture University Rawalpindi, Pakistan, qreza110@gmail.com

In the urbanized world, maize is an important component of supply and industrial commodities since it gives food and dietary certainty to the poorest regions of Africa, Asia, and Latin America. More than 73% of the world's maize crop is found in developing nations, with a greater portion of the crop growing close to the ground and, worse, in middle-income nations where maize provides the most dietary calories for a vast number of people. Climate change exacerbates already complex problems and undercuts efforts to improve food safety and reduce poverty in Sub-Saharan Africa (K. Tesfaye et al., 2018).

The increment of maize production is critical to the human being existence, human government assistance, and advancement of public farming along with animal cultivation. From single perspective, maize productivity delicate to environmental changes from planting to ripening. The impact of an Earth-wide temperature boost on maize yield development was essentially negative (T. Wang et al., 2022).

J. P. Aryal et al. (2019) has presented this study that agribusiness in South Asia is helpless against environmental change. Therefore, transformation measures expected to support agrarian efficiency, to diminish weakness, and to improve the strength of the farming framework to environmental change. There are numerous transformations rehearses in the creation frameworks that have been proposed and tried for limiting the impacts of environmental change. Some financial and political arrangement adds to transformation, while others might hinder it (J. P. Aryal et al., 2020).

Farming risks arise mostly because of the variation in environment. Worldwide maize is the high yield grain crop and has great importance for Pakistan, where rapid population increasing rapidly, demand for food and fodder already clean out the accessible foodstuff, supply and forage stock. From total production of maize crop, 60% used in fowl feed, 25% used industries and remaining used as food for human being and livestock. Maize crop add value about 0.5% in gross domestic product (GDP) and 2.7% in agricultural. In 2016–2017, cultivation of maize on 1334 thousand hectares, and the production of maize about 6.130 million tonnes, screening an increase of 16.3% from the earlier year of 5.271 million tonnes (GOP, 2016a). In the cropping system of Pakistan maize, hold an important position. After wheat and rice, maize grown in almost all provinces of the countryside, but Punjab and Khyber Pakhtunkhwa are key regions of maize production. Maize varieties related to hybrid and non-hybrid growing in Punjab Province. Private sector plays important role in the creation of hybrid varieties of maize crop. Due to high yield hybrid cultivars are very well liked by farmers (Shoaib Akhtar et al., 2018).

Atmosphere has adverse effect collectively developed and underdeveloped nations but rising nations will have to face extreme results because of their economic dependence on farming. Crop growing is vulnerable to changing climate so developing countries more climate sensitive due to their less industrial and ability about money management. Temperature rise in Pakistan is supposed to be more noteworthy than normal worldwide expand and turn down efficiency of agriculture. In addition, danger of food stuff uncertainty and neediness because of changing climate and in the upcoming years, the nation may face an increase in these issues. Pakistan's 22.8 percent area and 49.6% population are at risk owing to climate change, which has resulted in a 0.76°C increase in temperature during the last 40 years. The Punjab province of Pakistan will see a decrease in maize production in the future as a result of climate change. The growing season of crops is badly impacted by extreme weather conditions, and as a result, crop yield is gradually declining (Siddiqui et al., 2012).

2. Data and Methodology

This study uses a quantitative approach by employing time series and cross-sectional data. Data is collected from the Division Sahiwal. Sahiwal, Okara and Pakpattan are the districts of Sahiwal division. Total of 150 sample size taken in which 75 are hybrid maize farmers and 75 are non-hybrid maize farmers. From each district 50 total samples are collected in which 25 samples are of hybrid maize farmers and 25 samples are of non-hybrid maize farmers. Through random sampling technique data will be collected from Sahiwal division. Data will be collected through well-structured questionnaire.

In this study Ricardian model is employed. The Ricardian model relies on the quadratic formulation of climate. Main reason for using quadratic equation is that it gives nonlinear relationship of climate variables with net revenues which estimates the increasing or decreasing trend of climate variables over time. It also estimates marginal impact of climate variables (Ouedraogo et al., 2006). It represented as:

$$\mathbf{R = B_0 + B_1 F_1 + B_2 F_2 + B_3 Z + B_4 G + \mu}$$

Here F1 and F2 shows the quadratic and level terms for temperature and precipitation, μ represents the error term. These F1 and F2 terms represent the non-linear relationship between the land revenues and climate. A U-shaped revenue function obtained when there is a positive quadratic term, whereas, hill shaped function obtained when there is negative quadratic term (Thapaet al., 2010).

2.1. Model Specification for Longitude, Latitude & Altitude

This technique will be used to bring variability in the climate data. A simple Regression will be used to estimate the temperature and rainfall changes. The model specifications are as follows:

Where:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \mu$$

Y = Temperature and rainfall

X_1= Longitude of a location (equator)

X_2= Latitude of a location (prime meridian)

X_3= Altitude of a location (sea level)

μ = Error term

3. Results and Discussion

Table 1: Ricardian Analysis Results For Net Farm Revenue

Model	Coefficients	t-stat	P value
Constant	-2976559.442	2.073923875	0.04051
Dummy	72788.81493	30.06639592	0.00000
Mean Temperature	120409.4422	1.692560228	0.09348
Mean Temperature Square	-2305.870119	1.669864706	0.09790
Mean Rainfall	-1479.852428	4.429191263	0.00002
Mean Rainfall Square	1.484797125	4.377108846	0.00003
Mean Maximum Temperature	48600.116	3.602512455	0.00048
Mean Maximum Temperature Square	-653.3874307	3.469294004	0.00076
Mean Minimum Temperature	92226.88004	0.798775593	0.42621
Mean Minimum Temperature Square	-2262.082323	0.761659957	0.44795
Farming Experience	-104.4223819	1.133457227	0.25958
Family Size	-2786.454544	-4.67381407	0.00001
Education	958.4002932	1.6706927	0.09773

p-value < .05 is significant.

This study used dummy variable for hybrid and non-hybrid maize crop in the model. '1' is used for the hybrid maize growers and '0' is used for the non-hybrid maize growers. The results shows that hybrid farmers has significant positive impact on net farm revenue and the 't' and 'p' values are highly significant. If there is one unit change in hybrid maize seed then it will cause an increase of Rs. 72788.81493 per acre in net farm revenue. Likewise the farmer perceived the same revenue from hybrid maize crop as compared to non-hybrid maize crop. Farmers observed increase in net farm revenue when used hybrid maize seeds.

Considering the impact of mean temperature there is a positive relationship between mean temperature and net farm revenue. As t-stat shows the value at 1.69, indicates that one degree change in mean temperature changes the net farm revenue to Rs. 120409.4422 per acre. Although the quadratic term shows that if there is an increase in mean temperature, then it will cause a decrease in net farm revenue. So, if there is an increment of one degree in temperature, it will cause a decrease of Rs. 2305.870119 per acre in net farm revenue. According to the respondents when the temperature increases, the decrease in net farm revenue is observed due to quality difference between hybrid and non-hybrid as the hybrid seeds are more efficient and capable of producing more yield than non-hybrid seeds. Sidddiqui et al. (2012) has presented this study that temperature rise in Pakistan is supposed to be more noteworthy than normal worldwide expand and turn down efficiency of agriculture.

Considering the impact of rainfall there is a highly significant negative relationship between rainfall and net farm revenue. As p-value is 0.00002 and t-stat value is 4.43 indicates that 1mm increase in rainfall decreases the net farm revenue to Rs. 1479.852428 per acre. Gul, M.(2015) has presented the study that production of agriculture heavily depends on temperature, precipitation and other variables of climate. Climate changes have become threatening to agriculture by lessening its efficiency.

Considering the impact of mean maximum temperature there is a highly positive relationship as 't' and 'p' values are significant. Although quadratic term for mean maximum temperature shows negative relationship between mean maximum temperature and net farm revenue and the results are negatively significant at 5 percent significance level. The results for quadratic term shows that if one degree changes in mean maximum temperature then it will cause a decrease of Rs. 653.3874307 per acre in net farm revenue.

Considering the impact of minimum temperature on the net farm revenue are not significant, although the quadratic term shows that an increase of one degree in minimum temperature will cause the net farm revenue to decrease. The negative impacts of extremely high or low temperatures may also be mitigated by using conservation technologies (P. I. Ater & G. C. Aye, 2012).

In case of family size of the respondent the results are highly significant. The result shows that if, the family size is increased by one unit, it will decrease the net farm revenue by 2786.454544 thus showing negative relationship between the net farm revenue and family size. It seems logical that whenever a family member's standards increase, less money should be allotted to farming since the funding is being used for fulfilling those demands. A further explanation would be that when a family expands many of the family members find more convenience and economic prosperity in non-farm occupations. There is less labor required to perform farming while there are more consumers for the produce obtained by the farming. A further major issue in the nation is the division of land within family members, which reduces the output of agriculture and ultimately reduces net farm earnings from the land being divided.

Considering the impact of farming experience and education of the farmers both are not significant but the results showed that if the farmers are not well experienced then it also impact the net farm revenue and education is the important socio-economic variable as the farmers are more educated result is the better adoption of the new innovations, technological changes, herbicides, pesticides and many other factors are contributing in the enhancement of agricultural production. Smallholder maize farming households finding it less difficult to recognize challenges and search out possible fixes in suitable places once they get formal

education. Smallholder maize farming households were more vulnerable to climatic pressures as illiteracy restricted their access to information, especially from written sources (D.T. Adu et al., 2018).

4. Conclusion

The present investigation investigates a variety of elements that affect net farm revenue, with particular emphasis on factors associated with climate, socioeconomic level, and the distinctions between hybrid and non-hybrid maize farms. Hybrid maize acceptance significantly boosts agricultural net revenue. More specifically, hybrid maize planters report a gain of Rs. 72,788.81 per acre compared to non-hybrid growers. This result illustrates the financial advantages of implementing hybrid varieties of maize. The mean temperature and net farm revenue have an intricate relationship. An initial advantage worth Rs. 120,409.44 per acre is derived from a one-degree increase in the mean temperature. The relationship becomes negative when the quadratic factor is taken into account, demonstrating that an additional increase in mean temperature will eventually lead to an overall reduction in net farm revenue per acre of Rs. 2,305.87.

The general amount of rainfall has an important influence on net farm income. Every millimeter of rainfall leads to an acre of maize yielding less, or Rs. 1,479.85 less. This highlights the negative effects of excessive precipitation. Similar to mean temperature, maximum temperature demonstrates a positive initial collaboration with net farm revenue, with significant "t" and "p" values. However, the quadratic term shows a negative relationship, for every degree increase in the maximum temperature, net revenue from agriculture diminishes by Rs. 653.39 per acre. The causal connection between minimum temperature and net farm revenue is not statistically significant, despite the fact that its quadratic term indicates that increases in a minimum temperature could trigger a decrease in net farm revenue.

Conclusions demonstrate that there exists a statistically significant negative relationship between family size and net farm revenue. For every extra family member, the average agricultural revenue per acre declines by Rs. 2,786.45. This could be explained through workers switching from farming to non-farm jobs and by resources being taken away from farming in order to provide for a larger family. The results, while not statistically significant, suggest that farmers with lower levels of schooling and work experience could negatively impact net farm revenue.

Whenever it's related to the implementation of new advancements and technologies that have the possibility to boost production from agriculture, education is very crucial. The study concluded by emphasizing the importance of socioeconomic issues, the complicated influences of meteorological variables, and the notable positive impact of hybrid maize on farm revenue. According to these outcomes, determines promoting the adoption of hybrid maize, efficient use of water, and awareness among farmers might significantly increase the long-term viability and revenue potential of agriculture.

5. Policy and Recommendation

- Encourage farmers to embrace the hybrid varieties through providing financial incentives, such as subsidies on hybrid maize seeds. Organize projects to inform farmers about the positive aspects of hybrid corn and to train them in the best methods for growing it.
- Through regional agriculture cooperatives and agricultural extension services, make guaranteed that timely and cost-effective access to excellent in quality hybrid seeds, fertilizer products, and other essential inputs is made available.
- Develop and promote efficient water conservation approaches and irrigation techniques that mitigate the adverse consequences of excessive rainfall. Invest in the research and development of new crop varieties that are capable of handling extreme weather and temperature fluctuations. Enhance weather forecasting systems and give farmers timely information so they are able to make sensible choices about when and how to plant crops and harvest.
- Develop educational initiatives that will improve farmers' competence with modern methods of agriculture, which include the implementation of pesticides, herbicides, and cutting-edge technology. In order to alleviate the financial burden on agricultural resources and provide larger families with alternate sources of income, give vocational training in non-farm occupations. In order to improve economies of scale and maximize productivity, policies which promote consolidation and cooperative methods of farming should be promoted with the objective to address the issue of land fragmentation.
- For the benefit of marginal and small-scale producers to invest in enhanced farming methods as well as science and technology, make financing and financial services convenient to them.
- To cut down on post-harvest losses and guarantee timely delivery of goods to markets, construct and improve infrastructure needed for transportation and storage. Strengthen market linkages and transportation networks to give access to regional and local markets, as well as ensuring farmers receive reasonable prices for their commodities. In order to develop new crop varieties and farming practices that are suitable under changing climatic factors, increase the funding for agricultural research institutions. To make sure that farmers benefit from the latest advancements, strengthen extension services for agriculture to help narrow the gap between research and real-world implementation on farms. A number of responses suggest that the extension department is not functioning to its maximum capability. It is crucial that adequate action be taken towards enhancing the extension department's performance.
- Governments and other agricultural stakeholders may assist farmers thrive by implementing these policy ideas into execution, which would increase net farm income and facilitate sustainable agricultural growth.

References

Abbas, G., Ahmad, S., Ahmad, A., Nasim, W., Fatima, Z., Hussain, S., ...&Hoogenboom, G. (2017). Quantification the impacts of climate change and crop management on phenology of maize-based cropping system in Punjab, Pakistan. *Agricultural and Forest Meteorology*, 247, 42-55.

Abid, M., Scheffran, J., Schneider, U. A., & Elahi, E. (2019). Farmer perceptions of climate change, observed trends and adaptation of agriculture in Pakistan. *Environmental management*, 63, 110-123.

Akhtar, S., LI, G. C., Ullah, R., Nazir, A., Iqbal, M. A., Raza, M. H., ...& Faisal, M. (2018). Factors influencing hybrid maize farmers' risk attitudes and their perceptions in Punjab Province, Pakistan. *Journal of Integrative Agriculture*, 17(6), 1454-1462.

Ali, A., & Audi, M. (2016). The Impact of Income Inequality, Environmental Degradation and Globalization on Life Expectancy in Pakistan: An Empirical Analysis. *International Journal of Economics and Empirical Research (IJEER)*, *4*(4), 182-193.

Ali, A., Audi, M., Bibi, C., & Roussel, Y. (2021). The Impact of Gender Inequality and Environmental Degradation on Human Well-being in the Case of Pakistan: A Time Series Analysis. *International Journal of Economics and Financial Issues*, *11*(2), 92-99.

Aryal, J. P., Sapkota, T. B., Khurana, R., Khatri-Chhetri, A., Rahut, D. B., & Jat, M. L. (2020). Climate change and agriculture in South Asia: Adaptation options in smallholder production systems. *Environment, Development and Sustainability*, *22*(6), 5045-5075.

Ashiq, S., Ali, A., & Siddique, H. M. A. (2023). Impact of innovation on co2 emissions in south asian countries. *Bulletin of Business and Economics (BBE)*, *12*(2), 201-211.

Audi, M. (2024). A Discussion on the Role of International Regimes in Mitigating Global Warming and Climate Change. *Journal of Energy and Environmental Policy Options*, *7*(2), 36-42.

Fankhauser, S., & Tol, R. S. (2005). On climate change and economic growth. *Resource and Energy Economics*, 27(1), 1-17.

Kang, M. S., & Banga, S. S. (2013). Global agriculture and climate change. *Journal of Crop Improvement*, 27(6), 667-692.

Khalid, I., & Ullah, S. (2022). The Role of Community Engagement in Environmental Protection. *Journal of Energy and Environmental Policy Options*, *5*(4), 44-47.

Khan, M. N., & Hassan, T. (2019). Balancing Economic Growth and Environmental Sustainability through Energy Consumption in Pakistan. *Journal of Energy and Environmental Policy Options*, *2*(4), 109-116.

Siddiqui, R., Samad, G., Nasir, M., & Jalil, H. H. (2012). The impact of climate change on major agricultural crops: evidence from Punjab, Pakistan. *The Pakistan Development Review*, 261-274.

Singh, U., & Kumar, K. (2023). Exploring the Interconnection Between Anthropogenic Activities and Greenhouse Gas Emissions: An Empirical Study. *Journal of Energy and Environmental Policy Options*, *6*(4), 43-53.

Tesfaye, K., Kruseman, G., Cairns, J. E., Zaman-Allah, M., Wegary, D., Zaidi, P. H., ...&Erenstein, O. (2018). Potential benefits of drought and heat tolerance for adapting maize to climate change in tropical environments. *Climate risk management*, 19, 106-119.

Tesfaye, K., Zaidi, P. H., Gbegbelegbe, S., Boeber, C., Rahut, D. B., Getaneh, F., ...&Stirling, C. (2017). Climate change impacts and potential benefits of heat-tolerant maize in South Asia. *Theoretical and Applied Climatology*, 130, 959-970.

Wang, T., Li, N., Li, Y., Lin, H., Yao, N., Chen, X., ...& Feng, H. (2022). Impact of climate variability on grain yields of spring and summer maize. *Computers and Electronics in Agriculture*, 199, 107101.