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Wheat Productivity in Variable Climates

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To better understand the economics of the wheat harvest this study was conducted in 2019. There were 35 wheat farmers who participated in the data collection. Consequently, the proportionate allocation method was used to select the farmers. On the other hand, primary data was obtained by conducting face-to-face interviews with a random sample of participants and administering a semi-structured questionnaire. The Cobb-Douglas production function, profit margin, and gross margin were utilized to analyze the data. As a result, the overall variable cost included substantial components like labor, tractors, and fertilizers. An overall profit margin of 25 percent was realized. various coefficients were found in the model for the inputs of pesticides, pesticides, and seed fertilizer. On the other side, labor and animal costs were slammed. The study suggests lowering prices to help farmers and the agricultural sector, and that the government manufacture high-yielding certified seed and distribute it to farmers.

Keywords: Wheat, Production, Economic analysis, Public participation.

Introduction

About 200 million acres of cropland are used to cultivate wheat, which is a key grain crop [1]. It is the world's second most significant cereal crop after maize, accounting for roughly 20.9 percent of global food output [2]. China, India, Russia, the United States, France, and Canada are major wheat producers. Developing countries are predicted to consume 75% of the world's wheat crop [3].

Cereals are the primary protein and energy source in most countries [4][5]. An essential portion of the human diet is wheat, a high-protein cereal crop. As a food source for humans, it is grown in a wide range of environments around the globe[6][7].

In addition to producing 19 percent of the GDP and employing 43% of the workforce, Pakistan's agriculture sector is crucial to its economic development. A major source of foreign exchange and an economic boost, as well. Agricultural commodities are in high demand because of the 2.15 population growth rate [8][9].

Wheat is grown throughout Pakistan due to ensure a steady supply of food. According to government sources, wheat is a major food crop that occupies the majority of farmland. It contributes 8.9 percent of agricultural value addition and 1.59 percent of GDP to the overall economy. In 2018-19, wheat production was expected to reach 26 million metric tonnes [10][11].

Increased population, increased wealth, and improvements in wheat processing technology have contributed to a tremendous rise in wheat consumption worldwide, but this is especially true in Pakistan. It is possible to improve wheat production by either increasing the land area under the wheat crop or increasing its yield. As a result of a shortage of available land and competition from other crops (such as sugarcane), the wheat crop has a limited ability to grow [12]. In order to increase yield per hectare, the most important factor is to use appropriate production technology, such as upgraded high-yielding cultivars, optimal planting times and weed control, and appropriate and proper input use[13][14].

There have been times of near self-sufficiency in wheat production in Pakistan, followed by periods of dismal performance. Due to terrible weather, the agriculture sector has suffered for a long period of time. Irrigation infrastructure has been extensively built. Agricultural productivity has increased due to advances in technology, such as higher-yielding seed varieties, more intense fertilizer application, and dependable water supply via canal irrigation and tube wells [15][16].

Over eighty-three percent of Americans live in rural areas, where they abuse land-based resources. The province has around 10.18 million hectares of land, with about 2.75 million hectares under agriculture, to provide the growing population's basic needs. Due to insufficient cultivation, 1.08 million hectares (34.54%) of the land remains unusable for agriculture, leaving only 1.8 million hectares [17][18].

We can see the acreage, output, and yield per hectare of wheat in during the past decade. An area of 754.2 thousand hectares of wheat was harvested yielding 1171.4 thousand metric tonnes of wheat. Over the same period, wheat production increased and wheat yield per hectare rose to 2114 kg. Greater output is a result of variables such as increased agricultural area, favorable weather conditions, and subsidized fertilizer rates [19].

An author [20][21] looked at the impact of new technologies on wheat production and discovered that adopting technology might result in a 73 percent enhanced yield. Seed variety, planting mode, and fertilizer use all have a major and direct impact on wheat output [22][23]. Wheat yield is also controlled by irrigation and weed management. Productivity is negatively correlated with landholding size and rainfall. The use of pesticides, the use of fertilizers, and even the level of temperature all affect crop yield.

Wheat yield was shown to be directly linked to inputs such as fertilizers, FYM, and irrigations [24][25]. Agricultural yields were higher in the mixed cropping zone than in the other two zones [26].

Numerous studies examined the Wheat crop's economic analysis in the literature. Wheat yield per unit in Pakistan is substantially lower than in industrialized nations, resulting in food insecurity, which is the main worry. KP has lower wheat yields than Sindh and Punjab, which exacerbates food insecurity.

Methodology

Chistian is located in South Punjab and is mostly an arid area with the least production. People preserve large areas. We visited the study site physically for data collection. Face-to-face interviews were done and the comments were noted. The data was transferred to a computer and was analyzed statistically and the findings are mentioned in the results section.

Results

Every forecast for this hot climate shows that the weather will be very bad. How well crops grow is affected in many different ways by changes in the weather. People think that a 1°C rise in temperature can cut crop yield by 10–20% around the world. In the same way, it is thought that a 1 to 3°C rise in temperature will cut crop yields by 20–30%. By the end of this century, temperatures are expected to rise by another 2–4°C, which will make this effect even worse. Extreme climate eventually changed permanently because of changes in the weather, which affected farming all over the world. Extreme changes in temperature during sensitive times like flowering, anthesis, and milking stage have a big effect on wheat yield, grain weight, and grain size at the end of the season. During anthesis, when the temperature was 36.2°C, 13% fewer seeds were made and most of the grains were sterile. If the temperature went up by 2°C, the Australian core growing area would lose up to 50% of its yield. So, heat stress is very important for how wheat will be grown in Australia in the future. Many studies are done all over the world to find out how likely it is that crops will fail because of heat, rain, drought, or changes in how they are grown. The fact that wheat grows quickly keeps it from being hurt by drought. Drought is caused by low rainfall and high temperatures, but it can be stopped in some ways.

There are biotic (insects, diseases, pests, and weeds) and abiotic (heat, cold, drought, and nutrients) stresses that hurt the wheat crop. At certain times during the growth of wheat, these things slow down or stop the growth. Wheat grows in important and good ways because of CO2, radiation, and temperature. How much wheat grows is directly affected by these things. Several studies have shown that climate change directly affects the number of crops that can be grown. When the temperature goes up by 1 degree, the growth rate and yield go down. It was observed that the temperature changed a lot during the growing season. They have made a crop model for global climate change (changes in temperature and rainfall) and how these changes will affect wheat yield. The model is based on data from the past 100 years.

When plants bloom in the north of Europe are greatly affected by how dry it is, which causes huge crop losses Wilcox and Makowski used 90 articles to make a data set about how the climate is changing in places like the United States, Spain, the United Kingdom, and Australia. The average yield varies a lot in places like the UK, the USA, and Australia. In the area of Australia, it was between 100% and +90%. At the end of this analysis, there is a meta-analysis of the production and yield of wheat in the future. Analysis showed that a high level of CO2, a drop in rainfall, and a rise in temperature all increased wheat yield, but the results depended on where they were done. The wheat meta-analysis takes a quick look at the production of wheat.

The effects of this scenario of climate change on wheat yield until 2050 are bad for wheat production. All of the studies done on wheat production were based on the idea that temperatures are going up because of global warming. To figure out how much uncertainty

there was, the researcher used five models of the world's climate, two groups of models, and two scaling methods. In the places that were looked at, it was found that yields were lower when temperatures were high and carbon dioxide levels were high. The same thing was found in other studies, too. When the temperature goes up, production goes down and spikes get sick more often. When the temperature is above 32°C during anthesis, the grains get smaller and take less time to fill the spikes, which lowers the wheat yield. Changes in how it rains have a bigger effect on wheat in places where it rains a lot. When it doesn't rain as much, the amount of wheat that grows drops by 5–7 percent for every degree that the temperature goes up The greenhouse effect and how plants react when there is more carbon dioxide in the air plants get a lot of the carbon they need from the air.

The amount of CO_2 in the air is going up every day. This rise in temperature affects not only how much ozone is in the air, but also how crops grow and how much they produce. Researchers have found that a rise in carbon dioxide speeds up photosynthesis, uses less water, and makes nutrients more accessible When the CO_2 level goes up to 1 k ppm plants speed up their photosynthesis, but this doesn't increase the plant's yield or size. As the yield of a wheat crop depends on the rate of photosynthesis, the active phase of photosynthesis, and the grain's ability to absorb water.

When CO_2 levels rise, nitrogen sink capacity rises and the photosynthetic period falls. This makes plants grow slower and make less food. In another experiment. The increased amount of carbon dioxide to 12% while reducing the number of nutrients. Only 7% more crops were grown than in the control group, but the plants needed more water. Nitrogen helps keep the carbon from sinking, which is especially important when the plant is reproducing. The researcher comes to the conclusion that fixing nitrogen with a biological process can help a plant grow. This also helps the yield of crops that do this on their own, like legumes.

If the amount of carbon dioxide goes up and the temperature goes up by a few degrees, the good things could be ruined. The wheat experiment showed that doubling CO2 and raising the temperature by 1.5 to 4°C had a bad effect on wheat yield. Every day, the temperature of the atmosphere goes up because of global warming and gases that trap heat in the atmosphere. The good things that happen to plants when carbon dioxide levels go up are lessened when the temperature goes up. When the temperature goes up, so does the rate at which the plant's leaves lose water. Still, an increase in carbon dioxide can make up for the bad effects of high temperature by closing the stomata and slowing the rate of transpiration. Higher temperatures can also help plants grow, especially in the Mediterranean, where lower temperatures make it hard for crops to grow. But higher CO2 and temperatures change how it rains in dry and semi-dry places, which is very bad for plant growth. The way it rains is changing, which has both good and bad effects on farming. In places where it rains a lot, it stops plants from growing, but in places where it rains a lot, it keeps plants from getting too wet and helps them grow well. Wheat usually grows in places that get less than 550 mm of rain a year, and the wheat plants in that area get 325 mm. But a forecast of how much rain will fall in 2070 says that a 10% rise will cut winter rain by up to 60%. According to another study, the amount of rain will go down by 15% by 2030 and by 30% by 2070. This prediction has come true over the past few years, and it is the biggest threat to wheat in the world's rain-fed areas.

A higher level of carbon dioxide is good for a C3 plant because it boosts biomass yield, metabolism, stomatal conductance, and the rate of photosynthesis. If the temperature goes up, it changes how the grains take in nitrogen and carbon and makes them less healthy. Even worse is when plants have trouble growing and making food because of drought, rain, or low humidity. Fusarium causes many diseases in wheat, such as foot rot, root rot, and head blight, which cause huge yield losses. Rhizoctonia solani is a soil-dwelling fungus. It causes root rot in wheat, which reduces yield by 50% in Japan, Europe, and the US. The number of pathogens changes a lot when the weather changes. Pathogens need the right amount of water and the

right temperature to grow and live. Germany's air temperature went up by 0.8–1.1°C from 1900 to 2000, which made it rain more in the winter. This fits the way pathogens live and makes it easier for them to live on crop waste and spread to hosts that can get sick.

Lukas et al. did an experiment to find out how long three dangerous fungi could live: F. culmorum, F. graminearum, and Rhophitulus solani. They used heating cables to control the temperature, and a pathogen-infected maize leaf was broken down. After 152 days, fungi and microbial biomass started to grow. DNA was used to measure the growth of pathogens, glucosamine was used to measure the growth of saprotrophic biomass, and muramic acid was used to measure the growth of bacteria and compare the results to the control. Also, it was seen that F. culmorum makes more DNA, so when the soil temperature went up, it didn't change much, but R. solani's DNA went down a lot. When the soil temperature was between 15°C and 25°C, R. solani grew and spread. When the temperature changed, this got all messed up, and it stopped happening at 5°C. Fusarium did the most damage when the temperature went up, which shows that there is a lot of variation in space.

Every part of agriculture is affected by changes in the weather, even insects. When it is hot and there isn't enough water, plant growth slows down. Because of global warming, this has happened. The number of insects that live on plants goes down right along with the number of plants. It also made it easier for bugs to move from place to place. This rise in temperature and drought causes wildfires and plant death, which reduces carbon sinks and raises the amount of carbon in the air. The two most dangerous insects to wheat yield are the wheat stem sawfly and the orange blossom wheat midge. They can cause losses up to the point where they are no longer worth fixing. Changes in how much carbon dioxide is in the air have big effects on plants, insects, and microorganisms. Even though there are many ways to stop them, insects and pathogens that cause diseases still cause a lot of crop loss.

Because of global warming, the biochemistry of plants changes, which has an effect on insects that eat plants and pathogens. Different things that aren't living are having an effect on insect populations because of global warming. When the temperature rises, there are more bugs, and it's easy for a virus to spread from a sick plant to a healthy one. Climate change hurts beneficial insects because they can't live in dry, hot weather, and it also makes it harder for them to kill harmful insects. Some of the bad effects of climate change are an increase in temperature and CO_2 levels, a faster rate of photosynthesis, and less agricultural production due to changes in weather patterns.

Every day, the amount of carbon dioxide in the air goes up because of how we live now and how we make things. It went up to 50% after the Industrial Revolution. It was 408 mol/mol in 2017, as shown in. People thought that by 2050, for every mole of carbon dioxide in the air, there would be 550 mol/mol of carbon dioxide. The most important part of photosynthesis is carbon dioxide, so this directly affects how and how fast plants grow. But C3 plants can't handle too much carbon dioxide. This is called the "fertilization effect of carbon dioxide" because it makes plant biomass grow. Different views of the agricultural ecosystem can explain this, but its size varies from place to place depending on the weather, temperature, and amount of water in the soil. Breathable CO2 enrichment (FACE) is a way to track how rain affects plants in dry, semi-dry, and temperate areas. Modeling shows that there are a lot of unknowns about how crops will respond to higher CO2 levels. This is because different areas respond to higher CO2 levels in different ways, like how they take in nutrients, how much water they get, and how much water they store when it is hot and dry. Wheat grows everywhere, and the weather in the Mediterranean affects about 15% of the annual yield. In the Mediterranean, rain is the main source of water, which is important for the early growth of wheat plants. Wheat doesn't do well if it doesn't get enough water when the grains are growing. This is called a terminal drought, and in the end, it hurts the crops. In order to save water, the drought is causing wheat to grow long roots and close its stomata. This could hurt

the wheat when it's time for the grain to grow. On the other hand, if there is more water, the plant keeps getting stronger and taller, but the later stages of reproduction may die off before the grain forms. It's also more likely that the plant will get sick.

Temperature changes and global warming are caused by the increase in CO2 and other greenhouse gases, which trap heat and raise the temperature of the atmosphere. Scientists now think that the temperature rises on Earth between now and 2100 will be between 1.1°C and 5.4°C higher than they thought before. If there are gases that trap heat, the temperature will change. CO2 gets into the air when coal and other fossil fuels are burned. So, if people kept using these things as energy sources, it would be impossible to know how the temperature would change. Scientists work on a lot of things to help people understand and be more aware. For example, to predict the weather, they make computer software called the "global climate model." This shows how many greenhouse gases will be in the air and how much of each there will be. For example, there are 9 billion metric tonnes of CO2 in the air every year, and if it kept growing at the same rate, there would be 12 billion tonnes by the end of 2040. But if the situation is brought under control, it could go back to the 5 billion it was in 1990. The temperature will go up if carbon dioxide emissions go up, and it will go down if they go down.

Conclusion

The effect of global warming on crop production is felt all over the world. Food prices are the first sign that there is a sudden shortage of food in the world, and if nothing is done, the problem will get worse quickly. Because of this, scientists need to find ways to make crop seeds resistant to drought, salty soil, and big diseases, which are the biggest threats. So that people can grow more wheat to meet their needs as the population grows. Adapting means doing things like sowing seeds at the right time, managing water and nutrients, pulling weeds at the right time, and using cultivars that are resistant. Changes made to the genes of plants are important tools for farming. Compared to the old way of breeding, which is hard and takes a long time, this method is simple and quick. Through molecular breeding, wheat can be made more productive and better able to handle the stresses that come from the environment and other living things when it is grown in a field. Markers at the molecular level help figure out where genes are put and how they are working. As DNA sequencing gets better, it is easier to find new genes that make crops resistant and put them into different crops. The government should make plans to stop as much global warming as possible. There should be new projects to save water and cut down on how much pesticides are used in fields. People should start their own campaigns to get the word out about things that are changing our ecosystem. Farms should be watered with water that hasn't been polluted. There should be ways to figure out how much carbon is in the air and how much it costs. During training, people should try out techniques that are good for the environment.

References

[1] M. A. Hamna Butt, Sadia Sheikh , Hafsah Batool, "Sowing Dates Effect on Production of High Yielding Maize Varieties," Int. J. Agric. Sustain. Dev., vol. 3, no. 4, pp. 116–124, 2021.

[2] J. S. Bandara and Y. Cai, "The impact of climate change on food crop productivity, food prices and food security in South Asia," Econ. Anal. Policy, vol. 44, no. 4, pp. 451–465, Oct. 2014, doi: 10.1016/J.EAP.2014.09.005.

[3] P. Kurukulasuriya et al., "Will African Agriculture Survive Climate Change ?," vol. 20, no. 3, pp. 367–388, 2006, doi: 10.1093/wber/lhl004.

[4] C. L. Spash, "The economics of climate change impacts à la Stern : Novel and nuanced or rhetorically restricted ?," vol. 3, 2007, doi: 10.1016/j.ecolecon.2007.05.017.

[5] C. Bos et al., "Postprandial metabolic utilization of wheat protein in humans," Am. J. Clin. Nutr., vol. 81, no. 1, pp. 87–94, Jan. 2005, doi: 10.1093/AJCN/81.1.87.

[6] J. M. Kirby, M. Mainuddin, and F. Mpelasoka, "The impact of climate change on regional water balances in Bangladesh," 2016, doi: 10.1007/s10584-016-1597-1.

[7] G. H. Salekdeh and S. Komatsu, "Crop proteomics: aim at sustainable agriculture of tomorrow," Proteomics, vol. 7, no. 16, pp. 2976–2996, Aug. 2007, doi: 10.1002/PMIC.200700181.

[8] P. Droogers and J. Aerts, "Adaptation strategies to climate change and climate variability : A comparative study between seven contrasting river basins," vol. 30, pp. 339–346, 2005, doi: 10.1016/j.pce.2005.06.015.

[9] GOP, "Pakistan Economic Survey 2017-18," 2018. [Online]. Available: http://www.finance.gov.pk/survey_1617.html

[10] T. Wheeler and J. Von Braun, "No Title," vol. 508, no. 2013, 2014, doi: 10.1126/science.1239402.

[11] GOP, "Pakistan Economic Survey 2018-19," 2019. [Online]. Available: http://www.finance.gov.pk/survey_1617.html

[12] H. B. Rubeena Asghar, Sabeela Asghar, "Pakistani Basmati Competitiveness in International Markets and its Macroeconomic Factors," Int. J. Agric. Sustain. Dev., vol. 3, no. 4, pp. 111–115, 2021.

[13] S. J. Vermeulen et al., "Options for support to agriculture and food security under climate change," Environ. Sci. Policy, vol. 15, no. 1, pp. 136–144, 2011, doi: 10.1016/j.envsci.2011.09.003.

[14] M. A. Khan, M. P. Fuller, and F. S. Baloch, "Effect of soil applied zinc sulphate on wheat (Triticum aestivum L.) grown on a calcareous soil in Pakistan," Cereal Res. Commun., vol. 36, no. 4, pp. 571–582, Dec. 2008, doi: 10.1556/CRC.36.2008.4.6.

[15] J. Alcamo, N. Dronin, M. Endejan, G. Golubev, and A. Kirilenko, "A new assessment of climate change impacts on food production shortfalls and water availability in Russia," vol. 17, pp. 429–444, 2007, doi: 10.1016/j.gloenvcha.2006.12.006.

[16] P. A. and S. N. H. N. Cornelisse, "the-wheat-marketing-activity-in-pakistan.pdf," Pak. Inst. Dev. Econ, vol. 12, pp. 125–135, 1987.

[17] P. B. McGarvey et al., "Expression of the rabies virus glycoprotein in transgenic tomatoes," Biotechnology. (N. Y)., vol. 13, no. 13, pp. 1484–1487, 1995, doi: 10.1038/NBT1295-1484.

[18] GOKP, "Crop Statistics in KPK (NWFP), Crop Reporting Center, Peshawar," 2010. [Online]. Available: kp.gov.pk › 2018/05 › Crops_Statistics_2013-14_KP1

[19] T. P. Barnett, J. C. Adam, and D. P. Lettenmaier, "regions," vol. 438, no. November, pp. 303–309, 2005, doi: 10.1038/nature04141.

[20] S. Siebert, "Global modeling of irrigation water requirements Petra Do," vol. 38, no. 4, 2002.

[21] S. and D. J. S. Abate, G.T., T. Bernard, S., Makhija, "Accelerating technical change through video-mediated agricultural extension: Evidence from Ethiopia," 2019, doi: 10.2499/P15738COLL2.133323.

[22] N. W. Arnell, M. J. L. Livermore, S. Kovats, P. E. Levy, and R. Nicholls, "Climate and socio-economic scenarios for global-scale climate change impacts assessments : characterising the SRES storylines," vol. 14, pp. 3–20, 2004, doi: 10.1016/j.gloenvcha.2003.10.004.

[23] Q. Mehmood, M. Riaz, M. H. Sail, and M. Moeen, "Identifying Key Factors for Maximizing Wheat Yield: A Case Study from Punjab (Pakistan)," Pakistan J. Agric. Res., vol. 31, no. 4, 2018, doi: 10.17582/JOURNAL.PJAR/2018/31.4.361.367.

[24] "© 19 9 4 Nature Publishing Group".

[25] A. Hussain, K. M. Aujla, and N. Badar, "Yield gap determinants for wheat production in major irrigated cropping zones of Punjab, Pakistan," Pakistan J. Agric. Res, vol. 27, no. 3, 2014.

[26] S. H. Anila Arif, Kashif Shafique, Khuram Ahmad Khan, "Policy Analytics-Insights from Pakistan and India Water Policies," Int. J. Agric. Sustain. Dev., vol. 3, no. 4, pp. 103–110, 2021.