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Impacts of Climate Change on the Productivity of Tobacco Crop in Pakistan

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Abstract - Pakistan's tobacco production is greatly impacted by climate change, which influences many elements of crop development and cultivation. Reduced yields of tobacco can result from the direct effects of rising temperatures brought on by climate change on tobacco growth and development. Changing rainfall patterns can lead to water scarcity, affecting tobacco crops and forcing farmers to switch to drought-tolerant crops. Changes in the growing season can affect growth, which can affect planting and harvest times. Diseases and pests will be affected by climate change. For example, higher temperatures can increase the spread of certain pests, requiring more aggressive pest management. Floods, and hurricanes are examples of extreme weather events that will occur frequently and severely, damaging crops, affecting supplies. Climate change has the potential to impact soil fertility and quality, as soil erosion, nutrient depletion, and soil composition. Community health may be affected by reduced productivity and income instability, as well as greater social and economic disruption. Implementing stricter laws and safety standards to combat climate change could create barriers for smokers who must change the way they work to adapt to environmental change. The chemical properties of tobacco, such as its nicotine concentration, flavor profile, chemical composition, curing and drying procedures, and the likelihood of pollutants infiltrating tobacco fields, can be impacted by climate change. Adaptation strategies should be adopted to mitigate the effects of climate change on tobacco cultivation in Pakistan. These include crop diversification, developing climate-resilient tobacco varieties, improving water management, implementing precision agriculture, adaptive crop planning, integrated pest management, soil conservation practices, education, and capacity building, weather information and early warning systems, policy support and insurance, and continuous research and innovation.

Keywords - Climate Change, Agriculture Crops, Tobacco Crop, Pakistan.

I. INTRODUCTION

Climate change is an issue that greatly affects industries, especially the farming sector, in developing nations such as Pakistan. Pakistan's agriculture is particularly sensitive to climate change because it heavily depends on natural resources [6]. The impact of climate change on Pakistan is influenced by its location diverse ecosystems and socio-economic factors. Key indicators of climate change in Pakistan include rising temperatures shifting monsoon patterns increased occurrences of weather events like droughts and floods and their consequences, for parts of the country [5]. The shifting weather patterns can impact the growth, yield and quality of crops disrupt pollination and pest control change water availability and irrigation needs and lead to an increase, in crop diseases and pests. It is highlighted that these effects present challenges to food security and livelihoods in regions on agriculture [16].

In Khyber Pakhtunkhwa province, tobacco is an important source of income that significantly contributes to the national economy [13]. Various tobacco kinds are grown in Khyber Pakhtunkhwa. The three primary varieties of tobacco cultivated in the region are flue-cured, dark air-cured, and burley tobacco. Every kind has unique characteristics, uses, and needs from customers [1]. Khyber Pakhtunkhwa tobacco producers use a variety of cultivation procedures and techniques, which are determined by the cropping systems, planting tactics, fertilization, pest and disease management, and harvesting methods specific to tobacco farming [2]. There are 50,000 tobacco growers in Pakistan, and 27,500 growers in Khyber Pakhtunkhwa, stretched across 30,354 hectares in the districts of Swabi, Mardan, Charsadda, Buner, and Mansehra, generate 98% of the FCV tobacco grown in the country. In Pakistan, approximately 75 million kg of FCV tobacco is produced annually which is mainly used in the cigarette industry [12].

Tobacco is a prime cash crop in Pakistan and is severely affected by adverse climatic conditions. Changes in various climatic factors i.e. precipitation, temperature, and wind have a direct impact on tobacco yield [3]. This paper considers the possible effects of tobacco plant growth, yield, quality, and chemical composition of harvested leaves [10]. The initial information on global warming and its effects on agriculture underscores the increasing global concern over climate change and highlights the need to know what this means for certain economic sectors such as tobacco production [1].

Changes in temperature and precipitation have been demonstrated to have noticeable effects on the development and productivity of tobacco plants [5, 7]. High temperatures can harm the physiological activities of a plant (including respiration and photosynthesis) leading to depletion in output of tobacco crop [3]. Meanwhile, changes in the pattern of rainfall can also be effective on the growth rate and production of tobacco plants [3], [6].

Prolonged drought or heavy rainfall can have a significant impact on the growth and development of crop s, resulting in reduced productivity and yield [7], [8]. Climate change can also reduce tobacco yields by in creasing the spread of pests and diseases [5, 7]. Climate change has a significant impact on tobacco produ ction in Pakistan because it can affect many aspects of crop production and growth. Qualitative research i s needed to better understand the impact of climate change on tobacco crops and yields in Pakistan.

OBJECTIVES

The main objectives of our study are to investigate the direct and indirect effects of climate change on tobacco cultivation, understand the socio-economic impacts and develop adaptation strategies for sustainable tobacco production in Khyber Pakhtunkhwa province.

SCOPE OF THE STUDY

The scope of the study determined the geographical area of interest, namely, Khyber Pakhtunkhwa province of Pakistan, and indicated that the main objective was to study how climate change affects tobacco production in the region.

II. SOME OF THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON TOBACCO

1. Temperature Changes

Climate change-induced rising temperatures can have a direct influence on tobacco growth and development. The ideal temperature ranges for tobacco production and how exceeding or deviating from it can result in heat stress, less photosynthesis, poorer yield, and less desirable tobacco leaves [18].

2. Water Scarcity

Climate change is likely to influence rainfall schedules and lead to water shortages. Tobacco crop highly depends on irrigation water. High temperatures and less rainfall could prevent the water availability for tobacco. This could result in lower yield and quality of tobacco [14].

3. Changes in growing Seasons

Changing climate scenarios may alter the prevailing growing season of tobacco. Variations in temperature and precipitation can cause disturbances to the ideal growing conditions, resulting in adjustments to the timing of planting and harvesting. This may create problems in managing and planning tobacco crops.

4. Pest and Disease Dynamics

Due to climate change, the spread and infestation of pests and diseases become more prevalent in tobacco crops. The control of these pests increases the cost of production [15].

5. Extreme Weather Events

The intensity and frequency of extreme weather events such as floods, rain and storms will accelerate i n Pakistan. These disasters can damage crops, disrupt supply chains, and cause economic losses for sm okers.

6. Soil Quality and Fertility

Due to high temperatures and lack of water, drought conditions were reported in many districts of KP. Soil erosion, malnutrition, and changes in soil composition affect the soil's ability to produce good tobacco crops.

7. Social and Economic Impacts

Growing tobacco is an important source of income for many farmers in Pakistan. The social and economic structure of the population may be affected by reduced and unstable income from tobacco crop [17].

III. HERE ARE SOME WAYS IN WHICH CLIMATE CHANGE CAN AFFECT THE CHEMICAL QUALITIES OF TOBACCO

1. Changes in Nicotine Content

Exposure to climate conditions, especially temperature, and daylight presentation can impact the nicotine substance of tobacco. A hike in temperatures may lead to an increase in nicotine levels, influencing the flavor and addictive properties of the tobacco.

2. Altered Flavor Profile

The variations in climate can influence the flavor quality of tobacco. The components that determine the taste and scent of tobacco are synthesized based on temperature, humidity, and soil composition. Any modification in these factors will change their synthesis resulting in sensory qualities — likely a matter affecting marketable value.

3. Shifts in Chemical Constituents

Cigarettes contain many chemical compounds, including sugars and alkaloids. Climate change may affect the ability to synthesize certain compounds. For example, temperature can change the ratio of alkaloids to sugar production, thus affecting the overall chemical composition of tobacco [11].

4. Impact on Curing and Drying Processes

Climatic conditions during the curing and drying process greatly affect the chemical composition of tobacco. Changes in temperature and humidity can affect how this process works, resulting in changes in the content of some compounds.

5. Increased Risk of Contaminants

The incidence of diseases entering tobacco crops may be higher due to extreme weather conditions associated with climate change, such as storms or floods. Contamination with bacteria or contaminated water can contaminate the tobacco plant with harmful substances, altering its medicinal properties and putting the user's health at risk.

6. Pesticide and Chemical Usage

Climate change may alter the prevalence and distribution of pests and diseases, leading to changes in the use of pesticides and other chemicals in agriculture. This may have a direct impact on the chemical residues found in tobacco leaves.

7. Quality Control Challenges

İf inconsistency in quality control due to climate change happened, then chemical makeup of a uniformed tobacco product is no longer easy to keep unchanged, which may have been caused by such fluctuations.

IV. HERE ARE SOME OF THE KEY WAYS IN WHICH TOBACCO CULTIVATION AND PRODUCTION CAN INFLUENCE THE CLIMATE

1. Deforestation

Since forests must be destroyed to create filed for tobacco plants, the production of tobacco frequently results in severe deforestation. Deforestation decreases forests' overall ability to function as carbon sinks, which increases the concentration of greenhouse gases in the atmosphere by releasing carbon dioxide (CO_2) that has been stored in trees.

2. Land Use Change

Due to land use changes in Pakistan, the land availability for tobacco crop is drastically reduced. This may cause the soil and vegetation to release stored carbon, which would upset the ecosystems' car bon balance. Land use changes may also be a factor in biodiversity loss and soil deterioration.

3. Energy Consumption in Tobacco Processing

The preparation and curing of tobacco leaves are energy-intensive. The traditional flue-curing methods sometimes imply burning wood which increases the carbon emissions. Besides, heavy on energy processes are also required in the industrial processing of tobacco like drying and making cigarettes because all these processes involve the production of energy directly from heat or fire.

4. Chemical Inputs

The utilization of fertilizers, pesticides, and other chemicals in tobacco cultivation contributes to greenhouse gas emanations. Besides, the deterioration of natural matter in soils treated with certain fertilizers can lead to the discharge of nitrous oxide, a strong nursery gas.

5. Water Use

Tobacco cultivation requires a substantial amount of water, and wasteful water systems enhance water shortage and environmental debasement. Changes in precipitation designs related to climate alteration may assist compound water push in districts where tobacco is grown.

6. Waste Generation

The tobacco industry produces a significant amount of waste, including the disposal of tobacco leaves, stems, and fabricating by-products. Inappropriate transfer of this squander can lead to natural contamination and contribute to the discharge of methane, a potent nursery gas, amid the decay of natural matter.

7. Transportation and Distribution

Explicitly, more vehicles are used in the transportation and distribution of green and cured tobacco, which damages the environment by emitting CO_2 emissions.

8. Health Impacts

Despite not being a direct cause of climate change, tobacco use's negative effects on health must be taken into account. Smoking tobacco causes air pollution and adversely affects respiratory health by releasing carbon monoxide and other toxins into the atmosphere.

V. ADAPTATION STRATEGIES THAT CAN HELP MANAGE THE IMPACTS OF CLIMATE CHANGE ON TOBACCO

Adapting tobacco crop to cope with the impacts of climate change requires a holistic approach that considers the various environmental stressors associated with climate change. Here are some strategies that can be employed to enhance the adaptation of tobacco crop:

- The erratic nature of tobacco growing profitability is increased by the climatic issue in tobacco-producing countries. Severe hailstorms struck Swabi in 2023, seriously harming the tobacco crop. The crop's quality and total output were affected by the series of hailstorms and a temperature variation, especially in May and early June. Due to fewer leaves in April and May, farmers who planted tobacco in March as opposed to February suffered less harm. This pertains to how abrupt temperature changes can interfere with the chemical interaction that occurs between sugar and nicotine. The increasing frequency of hailstorms in Swabi is linked to climate change, as evidenced by the changing patterns of clouds and rainfall from Kashmir. Previous information suggests that, compared to other districts, Swabi has more hailstorms and flash floods. In addition, the tobacco crop may be threatened by climate change if the monsoon rains move from July and August to April, May, or even March. Delaying the planting of tobacco crops in the areas of Swabi, Mardan, and Nowshra is advised to lessen these consequences.
- Planting in seasons with more consistent rainfall and milder temperatures can help lessen the effects of climatic variability (farmers who planted in March instead of February reported less hail damage).
- Growing Climate-Resilient Varieties (short maturation period, early maturing, resistant to heat and moisture stress, and pests linked to climate change).
- Heat- and drought-tolerant cultivars are strongly advised for the Buner and Mansehra regions.

- Alternate tobacco crops with other appropriate crops to disrupt pest and disease cycles, enhance soil health, and lessen the agricultural system's overall susceptibility to hazards associated with climate change [9].
- It is anticipated that rainfall in the majority of the districts will increase over the spring and summer, but it will grow more intense and irregular, leading to floods and droughts. A temperature increase may result in increased evapotranspiration throughout the summer, although an increase in rain is negligible.
- The scarcity of water is becoming a major issue, thus it's imperative to put effective water management techniques in place. This entails investigating drought-tolerant irrigation strategies, putting in place rainwater gathering systems, and embracing irrigation techniques that use less water. Tobacco plants can benefit from reduced water stress and optimal water consumption through the use of drip irrigation and soil moisture sensors.
- Practices including cover crops, mulching, using biochar, line ploughing, and adding organic matter can improve the health and structure of the soil.
- Adapt fertilization methods to the soil and climate. By using suggested fertilizers, plants can become more resilient overall and learn to handle stress better.
- Use IPM-sustainable methods for pest control should be implemented.
- The use of precision agriculture technology should be encouraged.
- Providing farmers with education and training on CSA practices can empower them to adapt to changing conditions.
- By implementing climate-smart agriculture practices, the government should assist the tobacco growers. The financial risks that farmers face can also be reduced by posing insurance choices for crop losses brought on by climate-related disasters.
- Tobacco cultivation's environmental impact may be minimized by reforestation initiatives, more energy-efficient curing techniques, a decrease in chemical inputs, promotion of agroforestry.
- New research and innovation should be sponsred to adress the the evolving challenges posed by CC.

VI. CONCLUSION

To manage the adverse impacts of climate change on tobacco crop production, we need to adopt a comprehensive plan. Farmers are advised to rotate crops, choose climate-resilient varieties, enhance soil and water management, and delay sowing in areas with a higher frequency of hailstorms and flash floods. Rainfall is likely to increase, leading to floods and droughts. Precision agriculture can diminish environmental impacts and improve resource utilization. Weather data, early warning systems, education, and extent building on climate change adaptation-related comportment are examples of important resources. Government support and insurance measures can lessen financial risks. Reforestation, low-energy curing methods, and alternative packing materials reduce the environmental effect of tobacco growing. Research and innovation must be continuous to develop new technologies and methods.

VII. RECOMMENDATIONS

- Climate change is a global phenomenon but its impacts are localized and vary from area to area in
- Pakistan.
- Adaptation action plans for each district should be consistent with the changing climate in the coming years.
- Technology needs assessment leading to adaptation of new technology is necessary for water and agriculture sectors to cope with the impacts of changing climate.

- There is a need to establish an effective system for weather and climate services with the coordination of concerned organizations to grasp the socio-economic benefits.
- The temperatures in the mountainous areas are increasing faster than in plains that have ımplications for water resources and glaciers melting.

REFERENCES

[1] Ahmad, I., & Ahmad, M. Bacterial spot caused by *Xanthomonas vesicatoria* devastated tomato production of Khyber Pakhtunkhwa-Pakistan. *International journal of phytopathology*, 11(1), 77-95. 2022.

[2] Ahmad, I., Islam, Z. U., Subhan, F., Imran, M., Khan, M., & Hassan, S. Adoption of Integrated Pest Management (IPM) Practices in Flue Cured Virginia Tobacco Crop. *Middle-East Journal of Scientific Research*, 19(6), 760-768. 2014.

[3] Ahmad, M I., & Ma, H. Climate Change and Livelihood Vulnerability in Mixed Crop–Livestock Areas: The Case of Province Punjab, Pakistan. *Multidisciplinary Digital Publishing Institute*, 12(2), 586-586. 2020.

[4] Ahmad, S., Abbasi, M. N. A., & Ullah, A. Is the Tobacco Production Profitable in District Swabi: An Empirical Analysis. *Human Nature Journal of Social Sciences*, 3(3), 1-11, 2022.

[5] Ali, G. Climate change and associated spatial heterogeneity of Pakistan: Empirical evidence using multidisciplinary approach. Elsevier BV, 634, 95-108, 2018.

[6] Ali, S., Liu, Y., İshaq, M., Shah, T., Abdullah, A., Ilyas, A., & Din, I. Climate Change and Its Impact on the Yield of Major Food Crops: Evidence from Pakistan. *Multidisciplinary Digital Publishing Institute*, 6(6), 39-39, 2017.

[7] Ali, S., Ying, L., Nazir, A., Ishaq, M., Shah, T., Ye, X., & Tariq, A. Rural farmers perception and coping strategies towards climate change and their determinants: Evidence from Khyber Pakhtunkhwa province, Pakistan. *Journal of Cleaner Production*, 291, 125250, 2021.

[8] Aziz, N. Hydrological Modeling and Impact of Climate Change: (Historical Overview on Northern Areas of Pakistan). *International Journal for Research in Applied Science and Engineering Technology*, 8(11), 326-328, 2020.

[9] Bellon, M. R., Kotu, B. H., Azzarri, C., & Caracciolo, F. To diversify or not to diversify, that is the question. Pursuing agricultural development for smallholder farmers in marginal areas of Ghana. World Development, 125, 104682, 2020.

[10] Geist, H. J. Tobacco and deforestation revisited. How to move towards a global land-use transition. Sustainability, 13(16), 9242, 2021.

[11] Gouvea, D. R., Gobbo-Neto, L., & Lopes, N. P. The influence of biotic and abiotic factors on the production of secondary metabolites in medicinal plants. Plant bioactives and drug discovery: principles, practice, and perspectives, 17, 419, 2012.

[12] https://ptb.gov.pk/production-different-types-tobacco-pakistan-million-kgs(Acceess on 17-07-2024).

[13] Hussain, A., & Yousafzai, B. K. Socioeconomic and Environmental Impacts of Tobacco Farming in Khyber Pakhtunkhwa, Pakistan: Impact of Tobacco Farming in Pakistan. Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences, 59(3), 67-79, 2022.

[14] Prasad, P. V. V., Staggenborg, S. A., & Ristic, Z. Impacts of drought and/or heat stress on physiological, developmental, growth, and yield processes of crop plants. Response of crops to limited water: Understanding and modeling water stress effects on plant growth processes, 1, 301-355, 2008.

[15] Raza, A., Razzaq, A., Mehmood, S. S., Zou, X., Zhang, X., Lv, Y., & Xu, J. Impact of climate change on crops adaptation and strategies to tackle its outcome: *A review. Plants*, 8(2), 34, 2019

[16] Trenberth, K. E. The impact of climate change and variability on heavy precipitation, floods, and droughts. *Encyclopedia of hydrological sciences*, 17, 1-11, 2005.

[17] World Health Organization. Tobacco and its environmental impact: an overview. World Health Organization, 2017

[18] Yang, L. Y., Yang, S. L., Li, J. Y., Ma, J. H., Pang, T., Zou, C. M., & Gong, M. Effects of different growth temperatures on growth, development, and plastid pigments metabolism of tobacco (*Nicotiana tabacum* L.) plants. *Botanical studies*, 59(1), 1-13, 2018.