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A REVIEW STUDY ON THE EFFECTS OF CLIMATE CHANGE ON AGRICULTURE, LIVESTOCK AND FORESTS IN PAKISTAN

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ABSTRACT: Climate change is a global threat to the food and nutritional security of the world. As greenhouse-gas emissions in the atmosphere are increasing, the temperature is also rising due to the greenhouse effect. The average global temperature is increasing continuously and is predicted to rise by 2°C until 2100, which would cause substantial economic losses at the global level. The concentration of CO₂, which accounts for a major proportion of greenhouse gases, is increasing at an alarming rate, and has led to higher growth and plant productivity due to increased photosynthesis, but increased temperature offsets this effect as it leads to increased crop respiration rate and evapotranspiration, higher pest infestation, a shift in weed flora, and reduced crop duration. Climate change also affects the microbial population and their enzymatic activities in soil. This paper reviews the information collected through the literature regarding the issue of climate change, its possible causes, its projection in the near future, its impact on the agriculture sector as an influence on physiological and metabolic activities of plants, and its potential and reported implications for growth and plant productivity, pest infestation, and mitigation strategies and their economic impact. The devastations and damages caused by climate change are apparent across the globe, specifically in the South Asian region where vulnerabilities to climate change among residents are high and climate change adaptation and mitigation awareness are extremely low.

Key words: Climate change, agriculture, livestock, forests, Pakistan.

INTRODUCTION

The term “climate” can be expressed as a global environmental situation which can be observed through variations in temperature, precipitation, pressure, and humidity in the atmosphere. Therefore, the term “climate change” refers to an alteration in this environmental situation through natural phenomenon or human interventions. Global warming, irregular weather patterns, melting of ice glaciers, elevating sea levels, and various other atmospheric events are caused by climate change across the globe (NASA, 2018). Several experienced researchers, scholars, environmentalists, and the general public believe that the impacts of climate change can be observed through frequent occurrences of

natural disasters such as hurricane Irma, Harvey, and Maria. The ever growing consequences of climate change require immediate attention towards the phenomenon, and the population is required to indulge in activities that promote climate change adaptation (Perkins *et al.*, 2018).

The Septembers of 2018 and 2017 recorded the fourth highest temperature in the past 139 years with 10 of the warmest summers documented since 2003 and the land and ocean surface temperatures from 2014 to 2018 being recognized as the five warmest Septembers ever reported CO₂ (Earth, 2018). This persistent rise in temperature threatens the civilization in face of irregular weather patterns, disfigurement of ecosystem, economic losses, and damage to the society (Espeland and Kettenring, 2018). The

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consequences of climate change are devastating in the short term through release of greenhouse gases and the long term through greenhouse gases' influence over basic human activities, predominantly agricultural activities and farming in Asia (Shaffril *et al.*, 2018). The geographical location of Pakistan makes it vulnerable to climate change impacts since several Asian countries are facing obstacles in sustainable and ecological development due to resource depletion, industrial development, urbanization, and economic expansion (Shaffril *et al.*, 2018). The astonishing economic and industrial growth of Pakistan and the majority of the world is dependent over excessive misuse of natural and non-renewable resources. The adverse effects of this extreme exploitation are causing permanent and damaging impact over the atmosphere. Approaches for mitigating climate change and decreasing the effects of environmental degradation should include implementation of policies with the integration of environmental knowledge, social responsibility, cultural barriers, behavioral intentions, and respect for Mother Nature.

In 2010, there was an unprecedented increase of 5.8% in GHG emissions worldwide (Hussain *et al.*, 2019a), and Pakistan's emissions rose at a similar rate. Due to the extreme impacts of climate change, Pakistan is facing potential endangerment to the economy and social and environmental development (Khan *et al.*, 2016). The rapid urban development, rise in transportation, increase in energy usage, and waste are predicted to cause a further increase in this global ranking by 2030. The effects of climate change in Pakistan are severe with high rate and intensity of occurrences such as melting of Himalayan range glaciers at a rate faster than ever recorded in history, abrupt rainfalls, unpredictable flooding, droughts, varying temperature, lack of water sources, intense heat waves, saturation of lakes (GOP, 2017-18), storms, hurricanes, landslides, earthquakes, human healthcare issues, pest diseases, seasonal changes, and alterations in lifestyle (Hussain *et al.*, 2018). Since the effects of climate change are tangible, the necessary steps and actions required against climate change include mitigation through preventing future greenhouse gas emissions and reducing the current level of greenhouse gases in the atmosphere, or adaptation through adjusting to

changes in climate, its effects, and consequences (Enríquez-de-Salamanca *et al.*, 2017).

The aim of this comprehensive review is to evaluate the effects of climate change in a socio-scientific aspect through analyzing the existing literature on various sectorial pieces of evidences across Pakistan that influence the environment. Although the review provides a thorough examination of climate change and its severe effects that pose a grave danger on Pakistan's agriculture forestry, livestock, food, water, and energy security and other climate change effects are discussed in detail as well. Numerous mitigation and adaptation practices and techniques in Pakistan are discussed in this review with an in-depth focus on its economic, social, and environmental aspects. Methods of data collection section are included in the supplementary information.

Research Methods

A systematic review of the literature was done through PRISMA (Preferred Reporting Items for Systematic Meta-Analysis). The studies related to the research goals were searched on Web of Science(Q1) Scopus (Q2), Google Scholar and Science Direct using the following keywords: climate and agriculture, climate and forestry, climate and livestock; mitigation and climate change; climate change and economics; mitigation and economics. Moreover, the search was performed for the years 1998–2022. A total of 110 documents were screened, out of which 600 papers were found to be relevant. Research papers published in journals having an impact factor were finally selected, and their results are reported here.

Causes of Climate Change

Temperature changes are caused by natural phenomena and anthropogenic activities on earth, which ultimately initiates the concentration of GHGs. Anthropogenic activities lead to the emission of greenhouse gas such as CO₂, methane, and nitrous oxide, as well as other substances that lead to ozone depletion in the atmosphere. The increased CO₂ concentration in the atmosphere can affect microbial activities in the soil, along with implications on water content, and therefore increased atmospheric CO₂ (463–780 ppm) can stimulate nitrous oxide

and methane emission from upland soil and wetlands, respectively, which nullifies the 16.6% mitigation effect of climate change as predicted by increasing terrestrial carbon sink. The agriculture sector contributes 15% of total emissions, primarily methane and nitrous oxide. The global emission of non-agricultural greenhouse gases is predicted to rise until 2055 if the dietary preferences and consumption of food energy are kept constant at 1995 levels. However, with changing preferences toward high-value foods such as milk and meat, the emissions are predicted to rise at an even higher rate. The emission can be reduced either with technological mitigation or by reduced meat consumption, or both. The livestock sector is the main contributor to greenhouse-gas emissions, and according to the IPCC, it generates around 8–10.8% of emissions; however, it can contribute up to 18% of GHG emissions based on lifecycle analysis. The main sources of greenhouse-gas emissions by the livestock sectors include enteric fermentation, N₂O emissions, liming, fossil fuels, organic farming, and fertilizer production. The use of nitrogenous chemical fertilizers also leads to greenhouse-gas emissions. With better management of crop production, N fertilizer use can be lowered by 38%. Better crop management also leads to consumption of 11% less input energy with 33% increased yields, leading to a reduction in greenhouse-gas emissions by 20% (Malhi *et al.*, 2021).

Climate Change Impacts Over Agriculture, Livestock and Forestry

Woes of the agriculture sector are likely to rise by climatic changes as most parts of the world are likely to witness extreme weather events such as soaring temperatures and alterations in rainfall patterns (IPCC 2014b, c) including Pakistan (Habib *et al.*, 2018). The climatic change in the agricultural areas interacts with the consequences of activities performed to increase the agriculture production, affecting productivity, and yields of the crop in a number of ways, which depend on the type of practices involved in the agricultural systems. In tropical countries, the crop yields may be declined due to effects of climate change such as rise in temperature as the crops have already reached the threshold of tolerance against heat and drought. Lowlands are likely to be damaged by

frequent flooding, rising of sea level, and salinization of underground water. The decrease in snowfall and rapid melting of glaciers are likely to cause drought-like situations due to unavailability of water for agricultural crops (IFAD, 2013). The conditions of the climate are formed by an arid and hot climate that is the main cause behind floods and droughts affecting severely agricultural outputs. Agriculture is the sector which has significant sensitivity towards climate change whereas this sector affects and is affected by climate change simultaneously (Balkhair *et al.* 2018).

Alterations in rainfall patterns and rising mercury in the Indus Basin are going to cut the fresh water supply; resultantly, it will affect the agriculture sector and the whole economy of Pakistan. Furthermore, indigenous genetic crop varieties are on the verge of extinction in the Indus Basin. Lack of modern techniques to irrigate the crop fields has caused water wastage as well (Hussain *et al.*, 2016). In July 2015, unexpected heavy monsoon coupled with glacial lake outburst floods (GLOF) destructed hundreds of acres of crops as well as thousands of livestock animals in the Chitral district of Khyber Pakhtunkhawa (KP) province. The local residents of the Upper Indus Basin also witnessed a rise in drought-like situations during the period of 2001 to 2011, resulting in shrinkage of agrarian area, degradation of soil quality, and decline in agricultural output as well as livestock (Hussain *et al.*, 2016). Due to extreme weather and climate vitality, rural livelihood and cash crops as cotton, wheat, rice, and sugarcane have been damaged over the decades. By keeping this factor in mind, there is a need to assess the vulnerabilities of farmers and its level at the hands of climate change. A comprehensive plan should be chalked out to increase the awareness of the farmers about climate change.

In Pakistan, livestock has a crucial importance in providing a livelihood to the residents and this sector is also being affected severely by climate change. Climatic upheavals impact the livestock extremely by causing them contiguous and even fatal diseases. Climate change affects the feed, water, fodder, and rangeland for livestock grazing, resulting in a sharp decline in meat and milk production. Livestock is greatly affected by livestock diseases, disease vectors,

quality and quantity of feed, and biodiversity (Melissa *et al.*, 2017). Massive CO₂ concentrations in the atmosphere and rising temperatures have caused the extinction of numerous animal and plant species (Abas *et al.*, 2017).

The forests in Pakistan are being affected by numerous anthropogenic factors such as global warming, floods, droughts, and land sliding. It was observed that the dying trees were the victim of insect attacks in the shape of wood debris and mud mixture rubble in stem eaten cavities. Some species of trees such as oak and rosewood have been observed drying up to a level of extinction from 1999 to 2008 in hot humid areas of Punjab province in Pakistan (Abas *et al.* 2017).

Table 1 demonstrates some of the particular considerations with practical examples that are essential while mitigating the impacts of CC in the forestry sector.

Impacts of Climate Change on Food and Energy Security

Pakistan is suffering significantly in energy, water, and food securities by climatic factors (Imran *et al.*, 2016), similar to the global scenario. Numerous factors are affecting food security and poverty due to impacts of climate change, and these issues are going to become more frequent in coming days. South Asia is the habitat of the most food-insecure residents in the world with over 300 million undernourished persons residing in the region. The higher levels of poverty and lack of food security in Pakistan is a result of climate change and weather alterations, as it impacts the largest sector of the economy in Pakistan (Ali and Erenstein, 2017).

In Pakistan, the situation is worst as the country has the long history of unplanned development which has impacted the socioeconomic fabric of the country negatively, especially in urban centers (Hussain *et al.*, 2018). Increase in vehicular use is increasing the energy consumption, ultimately posing a threat to environment and energy security. However, the concept of GHG emissions and energy security from road transport is neglected in the research articles in the case of Pakistan. Pakistan is in acute need of a balance between economic growth and improvement in environmental sustainability as well as energy

security. It is also a fact that there is a huge potential of natural renewable energy resources as compared to conventional renewable energy resources in Pakistan, as Pakistan is situated in a natural rich energy zone which has a capacity to generate 2.9 million MW of electricity from wind and solar. Moreover, the reduction in emissions must be the main agenda in the formulation of policies in order to curb CO₂ emissions and their impacts. In order to cut the daily life GHG emissions and ensure energy security, the concept of smart grids, smart cities, and smart buildings has been introduced. Some crops in Pakistan have climatic sensitivity, i.e., rice, wheat, cereals, vegetables, spices, and grains. Food security is becoming problematic due to less productivity in cropped foods, rising temperature, and shortage in rainfall patterns.

Adaptation and Mitigation Methodologies in Pakistan

Pakistan has been a victim of climate change over the past several years, and adaptation to these effects is compulsory for economic and social development. The Ministry of Climate Change has taken several steps to harmonize the masses with the national climate policy pertaining to mitigation and adaptation initiatives. To mitigate the climatic impacts, transport, agriculture, livestock, energy, forestry, town planning, and industrial sectors are areas to be worked upon (Lin and Ahmad 2017). In order to mitigate the climatic strategies at the national level, environment-friendly, renewable energy, and usage of power-efficient appliances must be ensured. As per the Intended National Determined Contributions (INDC), Pakistan requires roughly 7 to 14 billion US dollars per year to adapt these mitigation measures. About 100 million trees have been planted throughout the country under the Green Pakistan Program to mitigate the climatic effects (GOP, 2017–18.).

Coefficient of fourth independent variable of T_{Min}NOV is 0.734 but found insignificant. On the other hand, the coefficient of T_{Min}MAR explained the production of wheat in Punjab Pakistan significantly. A unit increase in the T_{Min}MAR (minimum temperature in the of march) also reduced the wheat production by -1.2113 units at 10% level of significance.

Table 1. Essential considerations while mitigating the climate change impacts on the forestry sector

Attributes	Description	Forestry example	Attributes
Purposefulness	Autonomous	Includes continuing application of prevailing information and techniques in retort to experienced climate change	Thin to reduce drought stress; construct breaks in vegetation to Stop feast of wildfires, vermin, and ailments
Timing	Preemptive	Necessitates interactive change to diminish future injury, jeopardy, and weakness, often through planning, observing, growing consciousness, structure partnerships, and ornamental erudition or investigation	Ensure forest property against potential future losses; transition to species or stand erections that are better reformed to predictable future conditions; trial with new forestry organization practices
Scope	Incremental	Involves making small changes in present circumstances to circumvent disturbances and ongoing to chase the same purposes	Condense rotation pauses to decrease the likelihood of harm to storm Events, differentiate classes to blowout jeopardy; thin to lessening compactness and defenselessness of jungle stands to tension
Goal	Opposition	Shield or defend from alteration; take procedures to reservation constancy and battle change	Generate refugia for rare classes; defend woodlands from austere fire and wind uproar; alter forest construction to reduce harshness or extent of wind and ice impairment; establish breaks in vegetation to dampen the spread of vermin, ailments, and wildfire

Source: Fischer (2019)

The RNFMAR (Rainfall in March) is also found significant in long run model. The coefficient of RNFMAR is -0.6871 at 5% level of significance i.e. A unit increase in Rainfall in the month of March results in decrease in the WP by 0.6871 unit (Abbas *et al.*, 2021) as shown in Table 2.

At the end the value of R-Square and Adjusted R-Square describes fitness of the model and the extent of variations in Wheat Production explained by independent variables. According to value of Adjusted R-Square, 74% variations in dependent variable (WP) explained by selected independent variables

Climate Change Adaptation and Mitigation with Economic Perspective

Pakistan is relatively new in the global climate finance sector with nascent institutional

resources, therefore having less exposure in receiving or disbursing global financial resources. The National Climate Change Policy of 2012 is Pakistan's leading paper on climate change, carving out the objectives for attaining climatic resilient advancements for Pakistan by mainstreaming climate change in highly vulnerable domains of the country. About 6% of the federal budget of Pakistan during 2010–2014 was sanctioned for climate-affected segments particularly energy and transportation. Pakistan described its National Determined Contribution to the Paris Agreement where Pakistan plans to reduce nearly 20% of its total greenhouse gas emissions till 2030, subject to provision of international monetary grants to fulfill the reduction costs of nearly 40 billion US dollars. Pakistan's adaptation requirements have been estimated from 7 billion to 14 billion US dollars per year (ADB, 2017).

Table 2. Long Run Estimates of Impact of Climate Change on Food Security using ARDL Approach

Dependent Variable: Wheat Production (WP)		
Variable	Coefficient	P-Value
LFWC	0.4601*	0.0613
TMaxNOV	-2.0147**	0.032
TMaxJAN	-1.4371***	0.0012
TMinNOV	-0.734	0.5671
TMinMAR	-1.2113*	0.06
RNFMAR	-0.6871**	0.0411
R-Square		0.8101
Adjusted R-Square		0.7419

Source: Batool (2022)

Pakistan has been securing funds by international climate financing from the Asian Development Bank (ADB), Global Environment Facility (GFF), the Adaptation Fund, and Japan's Fast Start Initiative. The Asian Development Bank's funding to Pakistan touched the mark of 389.8 million US dollars for both investment and technical aid during 2010–2015. A large share of this figure (96.4% or 375.9 million US dollars) was for mitigation purposes and only 13.9 million US dollars (3.6%) was for adaptation purpose. The Global Environment Facility also granted 12.5 million US dollars for mitigation activities which have been fully disbursed. The accumulation of all the fundings from different bodies is still less than Pakistan's estimated adaption requirement which is about 7 billion to 14 billion US dollars annually (ADB, 2017). According to the Global Climate Risk Index, Pakistan suffered 141 climate-caused extreme incidents over the two decades that resulted in 500 casualties per year and economic fatigue up to 2 billion US dollars per year, making Pakistan one of the most affected countries worldwide. The government of Pakistan commenced an initiative "Carbon Neutral Pakistan," with technical help from the Peoples Republic of China, to establish a local carbon market to reduce GHG emissions in June 2015 and to solicit foreign investment. The total cost of this project is estimated to be 3.85 million US dollars which have been shown in the 2016 public sector development program (PSDP) (ADB, 2017).

Fig. 1 depicts the list of current studies on sectoral impacts of CC with adaptation and mitigation measures globally.

Comparison of climate change estimated budget and actual spending (2017–18) (in PKR billions) (GOP, 2018; PD and R, 2017).

It is very essential to update the assessment of changes in climate in terms of mitigation and adaptation measures among government policymakers, corporations, and the general population as Pakistan lacks in capacity building at local, provincial as well as national levels. It is also essential to take it area-wise (rural, urban and peri-urban) because region-wise network of change in climate lays basis to chalk out policy systems for new trends by providing information regarding timing, magnitude of climatic impacts, and acceptance of expected response choices (Hussain *et al.*, 2020) which will also assist to cut the adaptation and mitigation costs. In developing countries like Pakistan, for effective implementation of concrete mitigation and adaptation policies at local and divisional levels, individuals and all the stakeholders should have basic information about climate change issues and its consequences (Hussain *et al.*, 2019b).

Conclusion and Future Perspectives

An increasing population has put a lot of pressure on agriculture to ensure the food and nutritional security of the world, which is further worsening with climate change. Even though there are uncertainties regarding the future climate

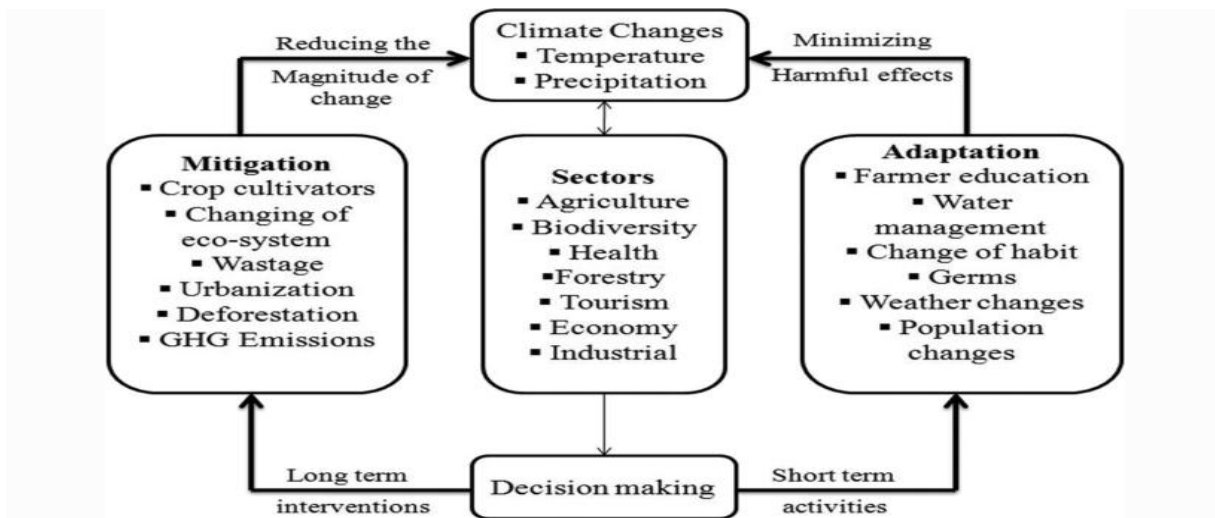


Fig. 1. Sectoral impacts of climate change with adaptation and mitigation measures

Source: Constructed by Abbas *et al.* (2022)

scenario and its possible impacts, various studies report that climate change will decrease agricultural productivity in the coming years. The key factors of climate, namely temperature, precipitation, and greenhouse gases, significantly hampered pest infestation, soil fertility, irrigation resources, physiology, and plants' metabolic activities. A number of mitigation and adaptation strategies have been developed to offset the deleterious impact of climate change on agricultural sustainability. These technologies include water-smart practices (laser land leveling, rainwater harvesting, micro-irrigation, crop diversification, raised-bed planting, direct-seeded rice), nutrient-smart practices (precision nutrient application, leaf color charts, crop residue management), weather-smart activities (stress-tolerant varieties, ICT-based agrometeorological services), carbon-smart activities (zero tillage, legumes, crop residue management) and knowledge-smart activities (agricultural extensions to enhance capacity-building). These technologies significantly reduce the effects of climate change on crops, and make them more suited to the climate by minimizing the unfavorable impacts. Climate change is predicted to cause huge economic losses at both the micro and macro levels that can be mitigated through these interventions. But these interventions must be organized at the regional or local level to improve their efficacy. Mitigation and adaptation strategies are expected

to increase farmers' income without compromising agricultural-production sustainability. The future of climate change and its associated impacts is highly unpredictable, which makes planning for mitigation and adaptation a bit complex. This necessitates the formulation of climate-resilient technologies involving an interdisciplinary approach according to the region. Suitable varieties need to be developed that could adapt to climatic variations, along with planned agronomic management and crop pest control. Farmers need to be educated regarding various climate-smart technologies, and be provided training to simplify their use at the field level.

In the past two decades, climate change has been a keen area of interest to the researchers since the effects of climate change can be observed through global warming across the world. Due to increased greenhouse gas (GHG) emissions, the global temperature is rising and the amount of warm days and nights is elevating, resulting in intense heat waves causing numerous fatalities annually in several countries including Pakistan. The adaptive capacity of Pakistan is perceived to be low due to high poverty, lack of financial and physical resources. The effects of climate change in Pakistan are highly severe with frequent occurrences such as melting of Himalayan range glaciers at a rate faster than ever recorded in history, abrupt rainfalls, unpredictable flooding, droughts, varying temperature, lack of water

sources, intense heat waves, saturation of lakes, storms, hurricanes, landslides, earthquakes, human healthcare issues, pest diseases, seasonal changes, and alterations in lifestyle.

The remedial actions against climate change include awareness building from the grassroots level, expanding environmental knowledge, and implementing government policies and regulations. A cooperated and coordinated effort among governmental institutes, policymakers, officials, environmental organizations, and community members should formulate strategies and approaches for climate change mitigation and adaptation. The outcomes of this review will provide a detailed understanding of climate change with a focus on climate change mitigation and adaptation approaches and its economic aspects as its cost reaches over 7 billion to 14 billion US dollars per annum.

The study provides a detailed understanding of current changes in climate and the threats it poses. Hence, the study presents some actionable future perspectives by taking into account effective measures for agriculture livestock and forestry, and food and renewable energy security, as well as, building and spreading awareness among the population about possible dangers and devastation of climate change:

- Firstly, the role of government needs to be proactive by eliminating inconsistencies and ineffective techniques in planning, establishing, and executing policies.
- Secondly, a laid out plan for national sustainable development should be formulated which aims at reviewing and prioritizing sustainable and eco-friendly processes leading to mitigation and adaptation.
- Thirdly, apart from governmental interference, the local residents should come forth with their experience and understanding of the climatic situation which can contribute to the development of mitigation and adaptation strategies at a higher extent.
- Fourthly, the governmental authorities, organizations, and population should pool their resources to generate and implement strategies for minimizing human interventions in natural sites such as forests, oceans, wetlands, pastures, and fertile lands.

- Lastly, the review accounted for a large sum of literature on climate change effects in Pakistan; however, there was a shortage of qualitative studies with comprehensive analysis and explanations of climatic effects. Furthermore, it is suggested that a deeper evaluation of various sectors should be conducted that affects climate, since most of the current research focuses on specific aspects yet lacks detailed examination of sectorial causes and impacts of climate change.

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دراسة مرجعية حول آثار تغير المناخ على الزراعة والثروة الحيوانية والغابات في باكستان

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2- قسم المحاصيل - كلية الزراعة - جامعة الزقازيق - مصر

في هذه الدراسة ، يعد تغير المناخ تهديداً عالمياً للأمن الغذائي والتغذوي في العالم. مع زيادة انبعاثات غازات الاحتباس الحراري في الغلاف الجوي ، ترتفع درجة الحرارة أيضاً بسبب تأثير الاحتباس الحراري. يتزايد متوسط درجة الحرارة العالمية بشكل مستمر ومن المتوقع أن يرتفع بمقدار 2 درجة مئوية حتى عام 2100 ، مما قد يتسبب في خسائر اقتصادية كبيرة على المستوى العالمي. يتزايد تركيز ثاني أكسيد الكربون ، الذي يمثل نسبة كبيرة من غازات الدفيئة، بمعدل يندر بالخطر ، وقد أدى إلى زيادة النمو وإنتاجية النبات بسبب زيادة التمثيل الضوئي، ولكن زيادة درجة الحرارة تعوض هذا التأثير لأنه يؤدي إلى زيادة معدل تنفس المحاصيل والتبخر، وزيادة انتشار الآفات، والتحول في نباتات الأعشاب، وتقليل مدة المحصول. يؤثر تغير المناخ أيضاً على السكان الميكروبيين وأنشطتهم الأنزيمية في التربة. تستعرض هذه الورقة المعلومات التي تم جمعها من خلال الأدبيات المتعلقة بقضية تغير المناخ، وأسبابه المحتملة، وإسقاطه في المستقبل القريب، وتأثيره على قطاع الزراعة كالتأثير على الأنشطة الفسيولوجية والتمثيل الغذائي للنباتات، وآثاره المحتملة والمبلغ عنها. للنمو وإنتاجية النبات، ومكافحة الآفات، واستراتيجيات التخفيف وتأثيرها الاقتصادي. إن الدمار والأضرار التي يسببها تغير المناخ واضحة في جميع أنحاء العالم، وتحديداً في منطقة جنوب آسيا حيث تكون قابلية التأثر بتغير المناخ بين السكان عالية والتكيف مع تغير المناخ والوعي بتخفيف آثاره منخفضان للغاية.

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