SUNTEXT REVIEWS

SunText Review of Biotechnology
ISSN: 2766-5097

Open Access
Review Article
Volume 1:2

Relationship between Environment and Agriculture: A Review

Toor MD[1], Rehman F[2], Adnan M[3],*, Kalsoom M[4] and Shahzadi L[4]

[1]*Department of Soil and Environmental Sciences, College of Agriculture, University of Sargodha, Pakistan*
[2]*Department of Plant Pathology, College of Agriculture, University of Sargodha, Pakistan*
[3]*Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan*
[4]*Institute of Food Science and Nutrition, University of Sargodha, Pakistan*

***Corresponding author:** Adnan M, Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan; Email: mughal3368 [at] gmail [dot] com

Received date: 25 October 2020; **Accepted date:** 15 November 2020; **Published date:** 17 November 2020

Citation: Toor MD, Rehman F, Adnan M, Kalsoom M, Shahzadi L (2020). Relationship between Environment and Agriculture: A Review. SunText Rev Biotechnol 1(2): 111.

DOI: https://doi.org/10.51737/2766-5097.2020.011

Abstract

In agriculture we can find a huge amount of literature regarding environmental management and adoption of technology for sustainable farming. This review article focus on relationship between environmental changes and their impact on agriculture. This two-way relation among environmental change and agriculture is gaining great importance. Environment is the primary determinant for the productivity of agriculture. Agriculture directly depends on the broader environment and uses about a 3rd of the world's land surface. The strength and occurrence of extreme events will rise by the global warming i.e. water deficient condition, flood, tornado that would greatly harm the water balance and agriculture production in upcoming years. Climatic change affects agriculture by emissions of greenhouse gases such as nitrous oxide, methane and carbon dioxide. The direct sources of these emissions are use of tillage practices, fossil fuels, manuring of livestock and use of fertilized agricultural soils in large proportion. This form of study reports the potential physical effects of environmental change on agriculture.

Keywords: Environmental fluctuations; Climatic conditions; Abiotic stress; Crop pathology; Food security

Introduction

According to the most current predictions the worldwide population is speedily growing and, it is estimated to extent 9.8 million in 2050 and almost 11.2 million in 2100 [1]. One of the most essential challenges for people in the next era is to generating and providing sufficient, high value food [2,3]. Moreover, environmental change is the most serious threat of environment that unfavorably affects the productivity of agriculture. Systems of plant, and hence yields of crop, are influenced by many factors which is directly related with environment, and these aspects, such as temperature and moisture, may act both antagonistically or synergistically with further factors in yields determination [4]. Worldwide environment has been fluctuating continuously over millennia but due to increase in anthropogenic activities the previous few years have perceived a substantial emissions of the greenhouse gases such as fossil fuel burning, degradation of land, industrial processes, and removal of forests. Furthermost studies undertake simply estimate the influence of temperature change on farm yields and little adaptation [5]. Others permit limited fluctuations in application of fertilizer, cultivars or irrigation. Asiatic region and the countries which lie in it are particularly susceptible to the effects of greenhouse gas emission with increased in concentrations and the prospective increased occurrence and destruction caused by floods, storms, heavy rains, water scarcities, composed with potential increase in level of sea disturb the balance of water and productivity of agriculture [6]. The significances and influence of change in climate for agriculture tend to be further severe for states with greater primary temperatures, zones with peripheral or previously degraded areas and subordinate development levels with little capacity of adaptation. Eventually, humans' practices to changing economic

and physical conditions and adapted agricultural systems. Changing crop mixes and institutional arrangements, and cultivated acreages has been accomplished by adopting new technologies which including investments in genetic developments. Such type of elasticity is indicative of major human potential to adapt to change in climatic conditions [7]. Moreover, many studies show that current activities of agriculture are an important source of greenhouse gases that are aggravated for the disruption of climate. Greenhouse gases contain Methane, Carbon Dioxide, water-vapor's and Nitrous Oxide which leads to the global warming [8]. The sectors which are leads to increase in concentration of Greenhouse gases as fractions are 63% by sector of energy, by agricultural activities 3% by industrial land use 18% by forest and 3% from the generated waste. The consideration of the scientific community has been drawn by the environmental problems which are related to agriculture, which is rotating towards the meaning of sustainable agriculture without having yet reached consensus [9]. Even though, agricultural practices could be a source of Greenhouse gases as well as a sink, notably through the carbon storage in the biomass and in soil organic matter and influenced by climate change [10]. In developing counties agriculture practices is very different as compare to developed regions, which leads to the dissimilarities of contribution of agriculture to change in climatic conditions. Greenhouse emission from agriculture sector is much more in developing countries because of the huge number of cattle and insufficient manure management, inappropriate use of agro-chemicals and mishandling of the land [11]. Furthermore, climatic change impact turns into more severe in emerging countries due to their agricultural dependence. In addition, emissions of greenhouse gases are increasing at a speed of 23 ppm per decade, subsequently in the previous 6.5 million years [12].

Agriculture and Environmental Problems

Production of agriculture results into the several environmental problems such as change in climate, loss of biodiversity, degradation of soil, and pollution of water. Agricultural activities can either degrade or sustain the environmental conditions has renowned the main negative effects of agriculture on freshwater and land, as well as the significance of landscapes that's belong to agriculture in providing yields for nourishment of human, maintaining services of ecosystem and supporting the biodiversity [13]. Negative impacts such as forests conversion, grasslands and other habitations for the use of agriculture, soil quality degradation, soil pollution and water surface aquifers and seaside marsh land through unsuitable or unnecessary use of fertilizers and pesticides, substantial crop loss and cattle genetic variety through the extent of industrial monocultures, decreasing flexibility in the face of temperature and other fluctuations [14]. Almost 40% of the worldwide ice-free land is used for the production of agriculture. Land-use change continuous like deforestation is related with several environmental problems, specially the decrease in biodiversity and the proclamation of soil carbon into the atmosphere [15]. Therefore, balancing in the production of food and environmental goals will gradually involve using land and other resources which are natural more proficiently. Agricultural activities generate both indirect and direct emissions [16]. Direct emissions arise from the application of livestock manure and use of fertilizer on agricultural soil. Although indirect emissions originate from leaching and overflow of fertilizers, emission from changes in land-use, consumption of fossil fuels for mechanization, agro-chemical and transport and production of fertilizer [17,18]. The most important indirect emissions are the variations in traditional land use and natural vegetation, including degradation of soil and removal of forests. Land with agricultural production is an inadequate natural reserve. It is expected that nearly a 3rd of worldwide arable land has been misplaced due to pollution and erosion of soil during the previous 40 years [19]. Degradation of soil usually refers to several processes, such as desertification, erosion, compaction, salinization, and encroachment of invasive species [20]. Agricultural practices lead to the 30-40% of greenhouse gases emissions through anthropogenic sources and this share may increase above 80% by 2050. Increasingly over the centuries, farming processes have grown and become more effective [21]. But, now with development in technology and new research, technologists have established the destructive effects that farms have had on the environmental conditions. Agricultural activity is accountable for 20% of the total for the worldwide total anthropogenic emissions of carbon dioxide. According to FAO statement in emerging countries there is a substantial upturn in the emission of greenhouse gases from 2001-2011 (14%), the growth occurred, due to a development of total outputs of agriculture [22].

Climate Variations

Change in climatic conditions has been forecast to impact production of agriculture through various indirect and direct pathways. Availability of water and temperature changes combined with increased deviation in conditions of weather and more repeated weather episodic events will have a direct impact on yields of crop [23]. Moreover, agricultural land is degraded very quickly. [24] For instance, growing temperatures upturn tropospheric such as ground-level formation of ozone, and enlarged ozone levels cause plants oxidative stress, which reduces the growth of plant and formation of photosynthesis. Moreover, the direct effects, leads to temperature increased may indirectly affect the yield of vegetables and fruit due to decrease the productivity of labor of farmers, affecting productivity of agriculture [25]. Change in Climatic conditions affects

agricultural system in a number of ways such as through average temperature changes; extremes of climatic conditions and rainfall with an important impact on erosion of soil like drought, floods, changes in diseases and pests, changes in amount of carbon dioxide in atmosphere, changes in the quality of nutrition of some foods, changes in season of growing, and changes in level of sea [26]. The tropical and sub-tropical region where many countries lie are more likely to be vulnerable to warming because of extra raise in temperature that will anguish marginal balance of water and damage agriculture productivity [27]. Change in climate increases the agricultural vulnerability zones such as tornadoes, overflows of water and water scarcities, in turn sensational state to the risk of losses in socio-economic sector. Change in climatic conditions may aggravate problems of salinity which in turn impact health through diet and water drinking was of the view that change in climate has noteworthy impact on friable soil and traditional systems of farming [28]. Furthermore, fluctuation in pattern of precipitation and water scarcity can cause important increase in concentrations of sodium in bodies of freshwater, disturbing irrigation and water drinking value [29].

Climatic Variation and Abiotic Stresses on Crop

Various climatic factors relative to disease should include an examination of the variability in climate of the location in question for at least the past 10-20 years. Human knowings about climate and willingness to use that understanding in societal decision-making change over the globe [30]. It is possible that climate variations over space is more essential to human development than climate variations over time. This is suggested by the fact that regions with the most changing climates are near the tropics and that countries in these areas are usually less able to deal with effects of unfavorable weather than that of the countries in temperate regions. In some countries, the internal changes of yields are greater than those predicted for other countries over much longer periods of time [31]. Short-term climate changes may have long-term consequences in some ecosystems like forests. The impact of change may depend upon the type of variation that occurs. Particularly, in marginal areas, a large biological effect is caused by a small change in frequency of extremes. There are large differences between temperate regions and tropic region with regard to the effect of precipitation and temperature on agricultural productivity [32]. Rainfall is the main production-limiting factor in the tropic region: a small variation in timing and amount of rain can result in high changes in interannual crop yields. In temperate regions, temperature is most essential in defining the length of the growing season. The precipitation interacts in a very complex manner with temperature to influence the crop growth. Any specific climate variation will affect agriculture in the tropical and temperate regions in various ways [33].

Impact of climatic variation crop pathology

Wide number of studied have been made on how climate affects plant diseases. It has been concerned with day-to-day weather conditions rather than with year-to-year climatic variability [34]. A variation in prevailing climatic conditions or a variation in climatic variability may alter plant disease development by affecting: [35]

- The speed of development and number of pathogen or vector generations
- the geographical distribution of the host, pathogen, or vector, particularly on the margins of their respective distributions
- The dispersal of the pathogen or vector with respect to synoptic-scale movement
- The host-pathogen interactions that have evolved into a functional system
- The control of disease

Environmental changes can also affect host-pathogen interactions by modifying their courses of development with respect to each other. It is also possible that climatic variations could reduce a crop's vulnerability by putting its development and that of the pathogen out of phase with each other [36].

Food security and climate change: a conceptual framework

Food systems present in biosphere, along with all other changes of human activity. Some of the significant manifestation in the biosphere that are expected be from global warming will occur in the more distant future, as a consequence of changes in average weather conditions [37]. The most likely scenarios of climate changes indicate that increases in weather variability and incidence of extreme weather events will be significant now and in the nearby future. The projected increase in mean temperatures and precipitation will not manifest via constant gradual changes, but will instead be experienced as increased duration, frequency and intensity of hot spells and precipitation events [38]. Whereas the annual occurrence of hot days and maximum temperatures are expected to increase in everywhere in the globe, the mean global increase in precipitation is not expected to be uniformly spread around the world. In general, it is expected that wet regions will become wetter and dry regions more dryer. A conceptual framework on climate change and food security interactions has been developed to highlight the variables defining the food and climate systems for this analysis [39]. The climate change and food security framework expose how climate change affects food security outcomes for the four main components of food security in various direct and indirect ways. These four main components of food security are [40]

- Food availability
- Food accessibility

- Food utilization
- Food system stability

Climate change variables greatly influence the biophysical factors, like plant and animal growth, biodiversity, water cycles and nutrient cycling, and the ways in which these are managed through agricultural practices and land use for production of food. However, climate variables also have an effect on physical/human capital which indirectly influence the economic and socio-political factors that govern food access and utilization and can also threaten the stability of food systems [41]. All of these impacts change themselves in the ways in which food system activities are done. The framework proves how adaptive adjustments to food system activities are needed all along the food chain to cope with the impacts of climate manifestations. The climate change variables that are considered in the CCFS framework are as follow; [42]

1. The CO_2 fertilization effects of higher amount greenhouse gas concentrations in the atmosphere
2. Increased rate of mean, maximum and minimum temperatures;
3. Gradual manifestation in precipitation: increase in the frequency, duration and intensity of droughts;
4. Manifestation in the timing, intensity duration and geographic location of rain and snowfall
5. Increase in the intensity and frequency of storms and floods
6. Greater seasonal weather variability and changes in start and end of growing seasons

Evidence indicates that the frequent and intense extreme weather events like droughts, heavy storms, heat and cold waves and floods marking rise in sea levels and increasing irregularities in seasonal rainfall patterns bring floods are already having immediate effects on not only food production, but also incidence of food emergencies, food distribution infrastructure, human health and livelihood assets in both rural and urban areas [43]. In addition, less immediate impacts are expected to be from gradual manifestation in mean temperatures and rainfall. These manifestations affect the suitability of land for various types of crops and pasture; the health and productivity of forests; the incidence and vectors of different types of pests and diseases; the distribution, productivity and community composition of marine resources; the biodiversity and ecosystem functioning of natural habitats and the availability of good-quality water for crop, livestock and inland fish production [44]. Arable land is likely to be lost owing to increased aridity and also associated salinity, groundwater depletion and sea-level rise. Food systems will be affected by internal and international migration, civil unrest triggered by climate change and resource-based conflicts [45].

Conclusion

The study evaluates the impact of global climate change on agricultural major crops production. Climate is the primary determinant of agricultural productivity. From this extensive review, it is concluded that globally, climate change has relationship with agriculture in one or another way. Here are also indirect emitters such as land use change; leaching of fertilizers; use of fossil fuels for mechanization; transport and agro-chemical and fertilizer production that have adverse impacts on Agriculture due to climatic variations.

References

1. Gerland P, Raftery AE, Sevcikova H, Li N, Gu D, Spoorenberg T, et al. World population stabilization unlikely this century. Sci. 2014; 346: 234-237.
2. Kalsoom M, Rehman F, Shafique T, Junaid S, Khalid N, Adnan M, et al. Biological importance of microbes in agriculture food and pharmaceutical industry: A Review. Innove J Life Sci. 2020; 8: 1-4.
3. Rehman FR, Kalsoom M, Nasir TA, Adnan M, Anwar S, Zahra A, et al. Chemistry of plant microbe interactions in rhizosphere and rhizoplane. Indian J Pure Applied Biosci. 2020; 8: 11-19.
4. MacDonald D, Crabtree JR, Wiesinger G, Dax T, Stamou N, Fleury P, et al. Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. J environ manag. 2000; 59: 47-69.
5. Jackson RD. Canopy temperature and crop water stress. Adv Irrig. 1982; 1: 43-85.
6. Welch JR, Vincent JR, Auffhammer M, Moya PF, Dobermann A, Dawe D, et al. Rice yields in tropical/subtropical Asia exhibit large but opposing sensitivities to minimum and maximum temperatures. Proce National Academy Sci. 2010; 107: 14562-14567.
7. Smithers J, Smit B. Human adaptation to climatic variability and change. Global Environ Change. 1997; 7: 129-146.
8. Ehhalt D, Prather M, Dentener F, Derwent R, Dlugokencky EJ, Holland E, et al. Atmospheric chemistry and greenhouse gases. Pacific Northwest National Lab Richland WA. 2001.
9. Robertson GP, Paul EA, Harwood RR. Greenhouse gases in intensive agriculture: contributions of individual gases to the radiative forcing of the atmosphere. Sci. 2000; 289: 1922-1925.
10. Abdi R, Taki M, Akbarpour M. An Analysis of energy input-output and emissions of greenhouse gases from agricultural productions. Internal J Natural Eng Sci. 2012; 6: 10-12.
11. Duxbury JM. The significance of agricultural sources of greenhouse gases. Fertilizer res. 1994; 38:151-163.
12. Vernooy R, Song Y. New approaches to supporting the agricultural biodiversity important for sustainable rural livelihoods. Internal J Agricultural Sustainabi. 2004; 2: 55-66.
13. Rega C, Helming J, Paracchini ML. Environmentalism and localism in agricultural and land-use policies can maintain food production while supporting biodiversity. Findings from simulations of contrasting scenarios in the EU. Land Use Policy. 2019; 87: 103986.
14. Vajpeyi DK. Deforestation, environment, and sustainable development: a comparative analysis. Greenwood Pub Group. 2001.

15. Melillo JM, Reilly JM, Kicklighter DW, Gurgel AC, Cronin TW, X, Sokolov AP, et al. Indirect emissions from biofuels: How important. Sci. 2009; 326: 1397-1399.
16. Vessey JK. Plant growth promoting rhizobacteria as biofertilizers. Plant soil. 2003; 255: 571-586.
17. Ramirez FLE, Mellado CJ. Bacterial bio fertilizers. In PGPR: Bio control and bio fertilization. Springer Dordrecht. 2005; 143-172.
18. Neilson S, Rajakaruna N. Phytoremediation of agricultural soils: using plants to clean metal-contaminated arable land. In Phytoremediation. Springer Cham. 2014; 159-168.
19. Albrecht T. Edge effect in wetland-arable land boundary determines nesting success of scarlet rosefinches (Carpodacus erythrinus) in the Czech Republic. The Auk. 2004; 121: 361-371.
20. Pacyna JM, Pacyna EG. An assessment of global and regional emissions of trace metals to the atmosphere from anthropogenic sources worldwide. Environ Rev. 2001; 9: 269-298.
21. Fearnside PM. Greenhouse gases from deforestation in Brazilian Amazonia: net committed emissions. Climatic Change. 1997; 35: 321-360.
22. Hatfield JL, Boote KJ, Kimball BA, Ziska LH, Izaurralde RC, Ort D, et al. Climate impacts on agriculture: implications for crop production. Agronomy J. 2011; 103: 351-370.
23. Toor MD, Adnan M, Raza A, Ahmed R, Arshad A, Maqsood H, et al. Land Degradation and its Management: A Review. Intern J Environ Sci Natural Res. 2020; 25: 54-57.
24. Schauberger B, Archontoulis S, Arneth A, Balkovic J, Ciais P, Deryng D,et al. Consistent negative response of US crops to high temperatures in observations and crop models. Nature communication. 2017; 8: 1-9.
25. Boardman J, Mortlock FDT. Climate change and soil erosion in Britain. Geographical J. 1993; 179-183.
26. Reidsma P, Ewert F, Lansink AO, Leemans R. Adaptation to climate change and climate variability in European agriculture: the importance of farm level responses. Euro J Agron. 2010; 32: 91-102.
27. Ogle SM, Breidt FJ, Paustian K. Agricultural management impacts on soil organic carbon storage under moist and dry climatic conditions of temperate and tropical regions. Biogeochem. 2015; 72: 87-121.
28. Bryant CR, Smit B, Brklacich M, Johnston TR, Smithers J, Chiotti Q, et al. Adaptation in Canadian agriculture to climatic variability and change. In Societal adaptation to climate variability and change. Dordrecht. 2000; 181-201.
29. Assmann SM. Natural variation in abiotic stress and climate change responses in Arabidopsis: implications for twenty-first-century agriculture. Internal J Plant Sci. 2013; 174: 3-26.
30. Hussain HA, Hussain S, Khaliq A, Ashraf U, Anjum SA, Men S, et al. chilling and drought stresses in crop plants: implications, cross talk, and potential management opportunities. Frontiers Plant Sci. 2018; 9: 393.
31. Ahuja I, Vos RC, Bones AM, Hall RD. Plant molecular stress responses face climate change. Trends Plant Sci. 2010; 15: 664-674.
32. Wang Y, Frei M. Stressed food-The impact of abiotic environmental stresses on crop quality. Agriculture, Ecosystems Environ. 2011; 141: 271-286.
33. Chakraborty S, Tiedemann AV, Teng PS. Climate change: potential impact on plant diseases. Environ pollution. 2000; 108: 317-326.
34. Chakraborty S, Murray GM, Magarey PA, Yonow T, O'Brien RG, Croft BJ, et al. Potential impact of climate change on plant diseases of economic significance to Australia. Australasian Plant Pathol. 1998; 27: 15-35.
35. Pautasso M, Doring TF, Garbelotto M, Pellis L, Jeger MJ. Impacts of climate change on plant diseases-opinions and trends. European J Plant Pathol. 2012; 133: 295-313.
36. Schmidhuber J, Tubiello FN. Global food security under climate change. Proc National Academy Sci. 2007; 104: 19703-19708.
37. Campbell BM, Vermeulen SJ, Aggarwal PK, Dolloff CC, Girvetz E, Loboguerrero AM, et al. Reducing risks to food security from climate change. Global F Security. 2016; 11: 34-43.
38. Vermeulen SJ, Aggarwal PK, Ainslie A, Angelone C, Campbell BM, Challinor AJ, et al. Options for support to agriculture and food security under climate change. Environ Sci Policy. 2012; 15: 136-144.
39. O'Mara FP. The role of grasslands in food security and climate change. Annals botany. 2012; 110: 1263-1270.
40. Tai AP, Martin MV, Heald CL. Threat to future global food security from climate change and ozone air pollution. Nature Climate Change. 2014; 4: 817-821.
41. Armah FA, Odoi JO, Yengoh GT, Obiri S, Yawson DO, Afrifa EK, et al. Food security and climate change in drought-sensitive savanna zones of Ghana. Mitigation adaptation strategies global change. 2011; 16: 291-306.
42. Mbow C, Noordwijk MV, Luedeling E, Neufeldt H, Minang PA, Kowero G, et al. Agroforestry solutions to address food security and climate change challenges in Africa. Current Opinion Environ Sustainable. 2014; 6: 61-67.
43. Vervoort JM, Thornton PK, Kristjanson P, Forch W, Ericksen PJ, Kok K, et al. Challenges to scenario-guided adaptive action on food security under climate change. Global Environ Change. 2014; 28: 383-394.
44. Ruiz KB, Biondi S, Oses R, Rodriguez ISA, Antognoni F, Mosqueira EAM, et al. Quinoa biodiversity and sustainability for food security under climate change. A review. Agronomy Sustainable Develop. 2014; 34: 349-359.