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Climate Change's Effects on Agriculture

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Introduction

One of the most urgent issues facing humanity today is climate change, which has a significant impact on the environment, the economy, and society. As one of the most climate-sensitive industries, agriculture is especially susceptible to the effects of climate change. Crop production are already beginning to be impacted by changes in temperature, rainfall patterns, and extreme weather events, Aspects of agriculture include, but are not limited to, soil health and fertility .water accessibility and livestock production . Particularly in poor nations, the effects of climate change on agriculture have the potential to make already difficult issues with food security, poverty, and rural livelihoods even worse .At the same time, agriculture itself is a major cause of climate change, with a sizable amount of world emissions coming from land use change, fertiliser use, and livestock emissions.

Climate change and agriculture: an overview

Providing food for the world's expanding population, agriculture is a crucial industry for global food security. Yet, one of the industries most susceptible to the effects of climate change is agriculture. Changes in temperature, precipitation, and extreme weather can have an impact on crop yields, soil health, water availability, and livestock production as a result of climate change .Reducing greenhouse gas emissions from agricultural activities while simultaneously adapting to changing conditions is one of the biggest difficulties facing agriculture in the face of climate change. Improved agricultural methods, the creation of novel crop varieties, and the adoption of climate-smart agriculture are just a few of the initiatives needed to achieve this. By its effects on natural resources including land, water, and biodiversity, climate change not only directly affects agriculture but also indirectly affects food security. In developing nations where agriculture is a significant source of employment and income for rural areas, these effects can be extremely severe.

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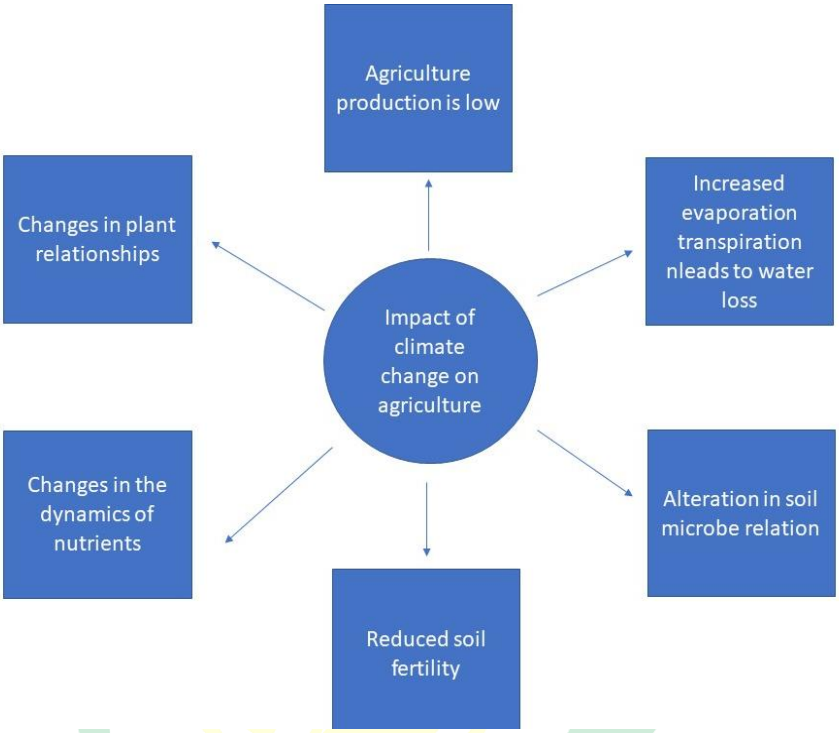
Notwithstanding the difficulties brought about by climate change, agriculture can nevertheless contribute to its mitigation. Using techniques like conservation agriculture, agroforestry, and renewable energy sources, for instance, can help agriculture reduce greenhouse gas emissions .



Impacts of climate change on crop yields

Crop yields could decline dramatically as a result of climate change, which could have a severe impact on the world's food security. Extreme weather events, altered precipitation patterns, and temperature rises can all have an impact on crop growth and development, resulting in poorer yields and lower-quality crops .The possible influence of climate change on crop yields has been estimated by a number of studies. According to one analysis, each 1°C increase in temperature by 2050 could result in a 6% decrease in global wheat production . According to another study, climate change could cause maize yields in some parts of Africa to drop by up to 30% by the year 2050 .In addition to these direct consequences, climate change can also have an indirect impact on crop yields by affecting the quality of the soil, the availability of water, and the pressure from pests and diseases . To sustain and boost food production in the face of climate change, adaptation tactics like the

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creation of heat- and drought-resistant crop varieties, the adoption of precision agriculture techniques, and enhanced water management will be essential.

Impacts of climate change on soil health and fertility

The health and fertility of the soil can be significantly impacted by climate change, which can therefore have an impact on crop growth and output. Increased soil health and fertility can be caused by altering soil moisture levels, nutrient availability, and soil structure as a result of rising temperatures and shifting precipitation patterns .Research have indicated that, particularly in sensitive areas like sub-Saharan Africa, climate change might increase the risk of soil erosion, nutrient loss, and soil degradation . Given that damaged soils are less capable of supporting crop development and production, these effects may have significant ramifications for global food security .Conservation agriculture, cover crops, and better soil management practises are examples of adaptation techniques that can lessen the effects of climate change on soil fertility and health. In addition, limiting the severity and extent of climate change impacts on soil health and productivity can be accomplished by reducing greenhouse gas emissions through sustainable land use practises.

Impacts of climate change on pests and diseases

It has been established that the occurrence and spread of pests and diseases in agricultural crops are significantly impacted by climate change. The distribution and abundance of pests and illnesses can change as a result of changes in temperature and precipitation patterns, which increases the likelihood of breakouts and epidemics in particular areas . Moreover, climate change may lessen the effectiveness of pest and disease control efforts, aggravating the effects on crops. Adaptation techniques, such as the creation of resistant crop varieties and integrated pest control techniques, are required to solve these issues.

Mitigation and adaptation strategies for agriculture

Strategies for mitigation and adaptation are required to deal with the effects of climate change on agriculture. Whereas adaptation techniques concentrate on minimising the effects of already-occurring climate change, mitigation measures aim to lower greenhouse gas emissions and slow the rate of climate change. Reducing tillage, enhancing nutrient management, and encouraging agro forestry techniques are some examples of mitigation strategies for agriculture. Crop types that are better suited to climate change may be

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developed, water management may be improved, and integrated pest management procedures may be adopted. Building agricultural sector resilience and ensuring food security in the face of climate change require both mitigation and adaptation techniques.

Conclusion

Finally, it should be noted that climate change is having a substantial and complex impact on agriculture, altering crop yields, soil fertility and health, as well as the presence and spread of pests and diseases. The livelihoods of farmers and rural people around the world, as well as global food security, are all at risk from these effects. To address these issues, mitigation and adaptation techniques are required. These include initiatives to cut greenhouse gas emissions, support sustainable agricultural practises, create crop types that are more tolerant of changing climate conditions, and enhance water management. In order to address the effects of climate change on agriculture and guarantee that future generations have access to safe and wholesome food sources, swift and decisive action is required.

Reference

Anderson, P. K., et al. (2004). Emerging infectious diseases of plants: pathogen pollution, climate change and agrotechnology drivers. Trends in Ecology & Evolution, 19(10), 535–544.

Asseng, S., Ewert, F., Martre, P., Rötter, R. P., Lobell, D. B., Cammarano, D., … You, L. (2015). Rising temperatures reduce global wheat production. Nature Climate Change, 5(2), 143–147.

Campbell, B. M., et al. (2016). Agriculture production as a major driver of the Earth system exceeding planetary boundaries. Ecology and Society, 21(4), 39.

Challinor, A. J., Watson, J., Lobell, D. B., Howden, S. M., Smith, D. R., & Chhetri, N. (2014). A meta-analysis of crop yield under climate change and adaptation. Nature Climate Change, 4(4), 287–291.

Falkenmark, M., Rockström, J., &Lannerstad, M. (2010). Agriculture, water and ecosystems: Avoiding the costs of going too far. Stockholm International Water Institute.

FAO. (2016). The State of Food and Agriculture 2016. Climate Change, Agriculture and Food Security. Food and Agriculture Organization of the United Nations.

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Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., … Toulmin, C. (2010). Food security: The challenge of feeding 9 billion people. Science, 327(5967), 812–818.

Gregory, P. J., et al. (2009). Integrating pests and pathogens into the climate change/food security debate. Journal of Experimental Botany, 60(10), 2827–2838.

Gregory, P. J., et al. (2009). Integrating pests and pathogens into the climate change/food security debate. Journal of Experimental Botany, 60(10), 2827-2838.

Intergovernmental Panel on Climate Change. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Cambridge University Press.

IPCC. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Lal, R. (2014). Soil carbon sequestration impacts on global climate change and food security. Science, 304(5677), 1623–1627.

Lal, R. (2016). Climate-resilient soils. Journal of Soil and Water Conservation, 71(1), 5A-10A.

Lal, R. (2016). Soil health and carbon management. Food and Energy Security, 5(4), 212–222.

Lal, R. (2018). Digging deeper: A holistic perspective of factors affecting soil organic carbon sequestration in agroecosystems. Global Change Biology, 24(8), 3285-3301.

Lobell, D. B., Burke, M. B., Tebaldi, C., Mastrandrea, M. D., Falcon, W. P., & Naylor, R. L. (2008). Prioritizing climate change adaptation needs for food security in 2030. Science, 319(5863), 607–610.

Lobell, D. B., et al. (2011). The critical role of extreme heat for maize production in the United States. Nature Climate Change, 1(9), 449-453.

Lobell, D. B., Schlenker, W., & Costa-Roberts, J. (2011). Climate trends and global crop production since 1980. Science, 333(6042), 616–620.

Olesen, J. E., Bindi, M., &Conijn, J. G. (2018). Impacts and adaptation of European crop production systems to climate change. European Journal of Agronomy, 101, 1–11.

Pautasso, M., et al. (2012). Impacts of climate change on plant diseases—opinions and trends. European Journal of Plant Pathology, 133(1), 295–313.

Porter, J. R., et al. (2014). Food security and food production systems. In Climate Change 2014: Impacts, Adaptation, and Vulnerability (pp. 485-533). Cambridge University Press.

Powlson, D. S., Stirling, C. M., Thierfelder, C., White, R. P., & Jat, M. L. (2016). Does conservation agriculture deliver climate change mitigation through soil carbon sequestration in tropical agro-ecosystems? Agriculture, Ecosystems and Environment, 220, 164–174.

Ray, D. K., Gerber, J. S., MacDonald, G. K., & West, P. C. (2015). Climate variation explains a third of global crop yield variability. Nature Communications, 6, 5989.

Ray, D. K., Ramankutty, N., Mueller, N. D., West, P. C., & Foley, J. A. (2012). Recent patterns of crop yield growth and stagnation. Nature Communications, 3, 1293.

Rosenzweig, C., et al. (2014). The agricultural model intercomparison and improvement project (AgMIP): Protocols and pilot studies. Agricultural and Forest Meteorology, 170, 166-182.

Sanford, M. R., & Zambrano, J. (2013). Climate change and plant disease incidence and severity in US forests. In Climate Vulnerability (pp. 55–70). Elsevier.

Smith, P., Davis, S. J., Creutzig, F., Fuss, S., Minx, J., Gabrielle, B., … Edenhofer, O. (2016). Biophysical and economic limits to negative CO2 emissions. Nature Climate Change, 6(1), 42–50.

Smith, P., Gregory, P. J., Van Vuuren, D., Obersteiner, M., Havlík, P., Rounsevell, M., ... & Diaz, S. (2014). Competition for land. Philosophical Transactions of the Royal Society B: Biological Sciences, 369(1639), 20120270.

Smith, P., Haberl, H., Popp, A., Erb, K.-H., Lauk, C., Harper, R., … Tubiello, F. N. (2013). How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? Global Change Biology, 19(8), 2285–2302.

Thornton, P. K., Boone, R. B., & Galvin, K. A. (2015). Climate change and livestock in Africa: Impacts, adaptation, and mitigation. Springer.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Vermeulen, S. J., Aggarwal, P. K., Ainslie, A., Angelone, C., Campbell, B. M., Challinor, A. J., … Thornton, P. K. (2012). Options for support to agriculture and food security under climate change. Environmental Science & Policy, 15(1), 136–144.

Vermeulen, S. J., Campbell, B. M., & Ingram, J. S. I. (2012). Climate change and food systems. Annual Review of Environment and Resources, 37, 195–222.