Review Article

Climate change and its impact on Food Security

ABSTRACT

Food security and climate variations are the major concerns affecting global community in adverse manner. Climate change is one of the greatest challenges faced by the global community today. Impact of climate change is severe. Each degree of rise in the global mean temperature is associated with threat to life, economy and also food security. This paper reviews the literature produced by researchers focusing on climate change and its impact on Food security. The review has shown that myriad of studies focuses on the impact of climate change on food security. The paper urges for a need to study the adaption and approaches for climate change which includes climate smart agriculture. The approaches will manage the landscapes, improve productivity, enhanced resiliency and reduced emissions.

INTRODUCTION

Food security, is the state achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. (FAO,1996). It is expected that the world's population will be increased to one third; The FAO estimates that, if current income and consumption growth trends continue unabated, agricultural production will have to grow by 60 per cent to satisfy the expected increased demands for food and feed. Climate change affects affects food systems directly which includes changes in rainfall pattern which causes drought or floods, or warm or cool temperature which leads to changes in length of growing season. Climate changes also have indirect effect like changes in market, food prices and supply chain infrastructure.

1. Climate changes and its impact on various crops

Researches have suggested that agriculture productivity would decrease as the temperature rises due to climate change. Also the incidences of pests and other crop diseases will be on rise. The Indian Agricultural system is rain –fed, in absence of a robust irrigation infrastructure the country agriculture production will go down over time. The demand for water for agriculture will increase with climate change. Food security is closely related to crop yield; if the reduction in the yield continues, it intensifies global food crisis. The increase in global average temperature and change in rainfall rates has direct or indirect impacts on agriculture. The increase in temperature leads to high evaporation rate, which pushes the need for more water.

Table 1: Impact of climate changes on various crops

Crop	Impacts of increase in temperature	Impacts of increase in CO2 concentration
Paddy	Keeping the CO2 level constant at 380 ppm, a temperature increase of 2 0 C will result in yield loss of ~ 18% (Krishnan et al. 2007).	Keeping the temperature rise constant at 0 0 C, and an increase in the CO2 concentration at 400 ppm, the yield is expected to rise by 16.27%.
Wheat	A 0.50 C increase in winter temperature could reduce wheat crop duration by seven days and reduce yield by 0.45 ton/hectare. An increase in winter temperature of 0.5◦ C could cause 10% reduction in wheat production.	
Maize	Increase in mean air temperature by 3°C above the present ambient conditions would reduce maize yield.	An increase in CO_2 concentration up to 700 ppm has a positive effect on the maize yield. However, temperature rise dominates over the positive effect of CO_2 concentration significantly when it is 30 C above the current ambient temperature conditions
Mustard	Rise in temperature by 50 C would reduce yield by 20.9% (Boomiraj et al.2010)	Increase in CO2 level to 450 and 550ppm respectively would increase the crop yield.

Climate change will aggravate rice production under climatic variability. Rice growth is sensitive to temperature, where warm daytime temperatures provide ideal conditions, and extreme heat events over 35 °C for even a few hours can impair plant physiology and deteriorate rice quantity and quality .(Hatfield etal). The increasing maximum temperature have adverse effect on rice yield if it coincides with the flowering stages, and results in a yield reduction. Increase in minimum temperature at grain filling stages is expected to have a positive effect on rice yield. Both the increasing trend of maximum temperature and decreasing trend of minimum temperature are apprehended to reduce the rice yield In India, climate change will reduce rice yield by 3 to 5% under medium emission scenario and 3.5 to 10% under high emission scenario (Palanisami et al 2017). Temperature Impact on wheat crop- Above normal high maximum temperature coinciding with the flowering stage of wheat and other rabi crops has been found to cause pollen/flower sterility thereby causing appreciable yield reduction of rabi crops. However,

as per a research result increase in both maximum and minimum temperature during the growing period of wheat has been found negatively correlated with yield.

2. Climate change and its impact on livestock production

Climate change has direct and indirect impact on the livestock. Direct effects refer to climate and CO_2 impacts on livestock thermoregulation, metabolism, immune system function, and production. Indirect effects derive from the influence of climate on feed production, water availability, and pest/pathogen populations. (Collier *et al*. 2019).Heat stress effects the milk production. Heat stres also cause imbalance in the levels of prolactin, thyroid hormones, glucocorticoid, growth hormone, estrogen, progesterone and oxytocin which ultimately affects the milk production (Prathap *et.al*.2017).

3. Climate change and climate variability are impacting forests

Forest ecosystems are sensitive to climate change.climate change has significant effects on species distribution, the growth rate and structure of forests. The changes in the climate are likely to strongly affect forest ecosystems by altering the growth, mortality and reproduction of trees. Forest ecosystems are sensitive and subject to climate change to produce detectable effects on trees and sapling growth in natural forests. Climate change particularly facilitates drought, fire and insect disturbance; thus, changes increase carbon dioxide concentration, reduce the strength of carbon sinks and may turn carbon sinks into source. Forest fires directly a loss of habitat, kill plants and animals in the forest ecosystem.(Marshet and Fekado,2019)

4. Climate change affects food security in all its dimensions: access, availability, utilization and stability

The food production is affected by the climate change and thus affects food availability. The climate change will increase the food price, hence restricting the access to food. Climate change has its impact on quality of water , which is required for absorption of nutrients. Climate change has been found to have an impact on food safety, particularly on incidence and prevalence of food-borne diseases. Increased climate variability, increased frequency and intensity of extreme events as well as slow ongoing changes will affect the stability of food supply, access and utilization.

Climate Smart Agriculture for Food Security

Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change.(Lipper et al,2014).It is a climate resilient practice. Components of climate smart agriculture consists of productivity, adaptation and mitigation. It is an approach for transforming and reorienting agricultural development under the new realities of climate change. Climate smart agriculture is a clear consideration of climatic risks that are happening more rapidly and with greater intensity

than in the past. It requires changes in agricultural technologies and approaches to improve the lives of those still locked in food insecurity and poverty and to prevent the loss of gains already achieved. CSA has a positive and significant impact on households' food security, measured in terms of food consumption score and dietary diversity score. Moreover, CSA can raise food security by raising crop productivity and reducing the risk of crop failure by mitigating the adverse impacts of climate change. (Ali *et al.*2023.

Conclusions

Researches have shown the impact of climate change on the food security. The focus today should be on strategies for adapting to the negative impacts of climate change. Climate change has perverse effects agriculture productivity, livestock productivity, forest ecosystem which negatively affects the well-being of households and communities.This paper argues the researchers to focus on CSA approach and on the ways through which communities can exploit the opportunities generated by climate change. This perspective will help to adapt to the current and future climate change in sustainable ways.

References

Ali, H., Menza, M., Hagos, F., Haileslassie, A. 2022. Impact of climate-smart agriculture adoption on food security and multidimensional poverty of rural farm households in the Central Rift Valley of Ethiopia. J ournal of Agriculture and Food security. 62 :1-16.

Bodirsky B. L. Rolinski S. Biewald A. Weindl I. Popp A. Lotze-Campen H. 2015 Global food demand scenarios for the 21st century. PloS one 10 (11), e0139201.

Collier, R. J., Baumgard, L. H., Zimbelman, R. B., Xiao, Y. 2019. Heat stress: Physiology of acclimation and adaptation. *Animal Frontier: The Review Magazine of Animal Nutrition*. 9(1): 12-19.

FAO. 1996 Report of the World Food Summit, FAO, Rome. https://www.un.org/en/development/devagenda/food.shtml#:~:text=At%20the%20World%20Food%20Summit,in%20the%20world%20by%202015.

Hatfield, J.L. and Prueger, J. H. 2015. Temperature extremes: Effect on plant growth and development. *Whether and climate Extremes*. 10: 4-10.

Lipper, L., Thornton, P., Campbell, B. *et al.* Climate-smart agriculture for food security. *Nature Clim Change* **4**, 1068–1072 (2014). https://doi.org/10.1038/nclimate2437

Marshet N G, Fekadu H H. 2019.Review on Effect of Climate Change on Forest Ecosystem. International Journal of Environmental Science Natural Resources. 17(4).

Palanisami, K., 2017. Climate Change and India's Future Rice Production: Evidence from 13 Major Rice Growing States of India. SF J Global Warming 1:2.

Prathap P, Archana, P.R.., Joy, A., Veerasamy, S., Krishnan, G., Bagath, M., Manimaran, V. (2017). Heat Stress and Dairy Cow: Impact on Both Milk Yield and Composition. *International Journal of Dairy Science*. 12: 1-11.