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Impact of Climate Change on Biodiversity of Fruit Crops

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INTRODUCTION

Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and /or the variability of its properties and that persist for an extended period, typically decades or longer. (IPCC 2022). Undoubtedly, climate change will have an impact on the productivity of the world's crop production as well as the relative distribution and suitability of different crops. Research on predicting how biodiversity would respond to climate change has become very active. (Dillon *et al*. 2010; Gilman *et al*. 2010). Although there is relatively limited evidence of current extinctions caused by climate change, studies suggest that climate change could surpass habitat destruction as the greatest global threat to biodiversity over the next few decades (Leadley *et al*. 2010). Biodiversity is the foundation of life on Earth. It is crucial for the functioning of ecosystems which provide us with products and services without which we couldn't live. India is one of the 12 mega biodiversity centres with 2 biodiversity hotspots which are the reservoirs of plant genetic resources. India stands at 7thplace in the global agricultural biodiversity status. Among fruit and nut crops, there are about 117 cultivated species with 175 wild relatives of which only 25 species have been domesticated.

Projected changes in climate

The IPCC has reported 0.5 to 1.2 °C rise in temperature by 2020, 0.88 to 3.16°C by 2050 and 1.56 to 5.44 °C by 2080 for Indian region depending on future development scenario (IPCC 2022). Climate change is projected to cause variations in rainfall, increase the frequency of extreme events like as heat, cold waves, frost days, droughts and floods etc. The report finds that every tenth of a degree of additional warming will escalate threats to people, species and ecosystems.

Even limiting global warming to 1.5 degrees C (2.7 degrees F)—a global target in the Paris Climate Agreement—is not safe for all. For instance, with just 1.5 degrees C of global warming, many glaciers around the world will either disappear completely or lose most of their mass; an additional 350 million people will experience water scarcity by 2030; and as much as14%of terrestrial species will face high risks of extinction.Thus, the climate change is causing the global climatic disruption with immense impact on agriculture.

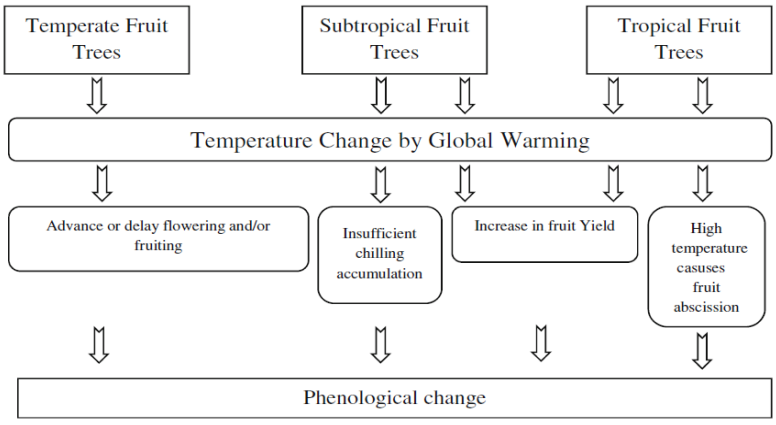
Impact of climate change on suitability of Area for particular crop

Areas suitable for red colored guava cultivation will be reduce dramatically because the minimum temperature during the coldest month may increase up to 1.9ºC, resulting in less red colour development in guava fruits. Rise in temperature may result into dramatic reduction areas suitable for development of red colour on guava. The increase in temperature from 0.7- l.0°C may shift the area suitable presently for the quality production of Dashehari and Alphonso varieties of mango. Cherries are disappearing from some districts of Kashmir valley due to erratic rains and water scarcity. It is estimated that the northern boundary of European viticulture will shift north 10 to 30 kilometres (6.2 to 18.6 mi) per decade up to 2020 with a doubling of this rate predicted between 2020 and 2050.

Shiftng in cropping pattern due to change in climate-Apple orchards are shifting to the higher altitudes of the Himalayas.

Apple cultivation is one of the most important sources of livelihood in Indian side of the Himalayas. The present study focuses on the apple orchards of Himachal Pradesh, a state within the Himalayan Mountains, a major apple producers of India. In the study, it is found that the optimum apple growing conditions in the region have been consistently shifting and farmers are shifting their orchards to the higher altitudes. For example, orchards have shifted to 1500–2500 meters in the 2000s compared to the cultivated elevation of 1200–1500 meters during 1980s. As of 2014, apples are being cultivated at an elevation of more than 3500 meters.

The shift in apple orchards to Kinnaur is associated with the decrease in snow depth. A farmer from Leo village, who grows apple since 2002, said ‘there is a decrease in snow depth from 4–5 fts in early 1970s to 1–2 fts during 2017–18’. In the lower altitudinal areas farmers are now cultivating peas, potatoes, plum whereas in higher altitudinal areas farmers started growing apples instead of peas and potatoes. 90% of respondents said a decrease in snow depth that influenced the chilling hours during winter is the main reason behind this shift in apple orchards. If the rate of upward shift will continue to maintain the optimum conditions for apple growth, apple orchards will vanish in many areas within 10–15 years as has been the fate of Solan and Sirmaur.



Temperature change leads to Phenological Modification

Climate change and pollination diversity

Climate change has the potential to alter the phenological synchrony between interacting mutualists, such as plants and their pollinators. However, high levels of biodiversity might buffer the negative effects of species-specific phenological shifts and maintain synchrony at the community level, as predicted by the biodiversity insurance hypothesis. The population abundance, geographic range and pollination activities of important pollinator species like bees, moths and butterflies are declining considerably with the changing climate. According to Millennium Ecosystem Assessment report, Pollination is one of the 15 major ecosystem services, currently under threat from mounting pressures exerted by global climate change. Climate change has led to phenological shifts in flowering plants and insect pollinators, causing mismatches between plant and pollinator populations that lead to the extinctions of both the plant and the pollinator. (Albrecht et al 2012).

Conservation of biodiversity of fruit under adverse climatic conditions.

Genetic resources conservation of fruit trees is intricate and complex in view of vast diversity of tropical, subtropical and temperate fruits germplasm belonging to various genera and species available in the country and consequent requirement of specific and complimentary conservation approaches encompassing both in situ and ex situ conservation. Plant genetic resources are of great importance as they form the basic raw materials to meet the current and future needs of crop improvement programmes. A wider genetic base, thus, assumes priority in plant breeding research aimed at developing new varieties for increased crop production. Mangifera blommesteinii, M. leschenaultii, M. superba and M. paludosa are in real danger of extinction. High genetic erosion has been noticed for jackfruit, Citrus spp. and Litchi chinensis in a survey carried out by the International Centre for Underutilized Crops (ICUC).Geographic Information System (GIS) is widely used in management of natural resources. Presently GIS is being widely used in mapping biodiversity by different organizations. GIS is a database management system with specific functions to handle spatial data, i.e., latitude and longitude. Many applications of GIS have been developed for commercial purposes or for specific management purposes, for example, Atlas, MapInfo for Windows, Arc/Info, etc. for commercial use, and GRID, FloraMap, DIVA, etc. for specific purpose of mapping biodiversity. For mapping biodiversity and its assessment for tropical fruit tree species, software such as FloraMap and DIVA which were developed by the International Potato Centre (CIP) and International Centre for Tropical Agriculture (CIAT) for research purposes. GIS has two kinds of software, viz. rector-based system and raster-based system. The rector-based system stores geographic data as points, while the rasterbased system stores data as grid cell. For mapping genetic diversity, rector-based system is popularly used. Using DIVA and FloraMap maps have been generated for fruit species like Mangifera and Citrus.

CONCLUSION

It is predicted that climate change will remain one of the major drivers of biodiversity patterns in the future.Development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases, short duration and producing good yield under stress conditions, as well as adoption of hi – tech horticulture and judicious management of land use resources will be the main strategies to meet these adverse climatic challenge.

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