

Impact of Climate Change In Indian Agriculture- A Review

SIVA KUMARI. B*

1. Department of Botany, Andhra Loyola College, Vijayawada-8, A.P, India

Abstract: Climate change has a serious impact on different types of natural resources on the globe especially water, which sustains life on this planet. Changes in the biodiversity, natural resources and biosphere are adversely affecting health and quality of human life. Throughout the 21st century, India is projected to experience warming above global level. India will also begin to experience more seasonal variation in temperature with more warming in the winters than summers. Longevity of heat waves across India has extended in recent years with warmer night temperatures and hotter days, and this trend is expected to continue. The average temperature change is predicted to be 2.33°C-4.78°C with a doubling in CO² concentrations. These heat waves will lead to increased variability in summer monsoon precipitation, which will result in drastic effects on the agriculture sector in India. Climate models predict a gradual rise in carbon dioxide (CO₂) concentration and temperature across the globe. These models, however, are not very precise in predicting future changes in local weather conditions. Local weather conditions such as rain, temperature, sunshine and wind, in combination with locally adapted plant varieties, cropping systems, and soil conditions can maximize food production as long as plant diseases can be controlled.

Key Words: Climate change, Agriculture productivity, Rainfall

I. Introduction

Agriculture production is directly dependent on climate change and weather. Possible changes in temperature, precipitation and CO₂ concentration are expected to significantly impact crop growth. The overall impact of climate change on worldwide food production is considered to be low to moderate with successful adaptation and adequate irrigation [1]. Global agricultural production could be increased due to the increase of CO₂ fertilization effect. Agriculture will also be impacted due to climate changes imposed on water resources [2,3]. India will also begin to experience rapid seasonal changes in temperature with more warming in the winters than summers [4,5]. India has experienced 23 large scale droughts starting from 1891 to 2009 and the frequency of droughts is increasing. Climate change had a great threat to agriculture and food security. Water is the most important agricultural input in India, as 55% of the total cultivated areas do not have irrigation facilities. India with diverse soil and climate comprising several agro-ecological regions provides ample opportunity to grow a variety of crops especially horticultural crops which form a significant part of total agricultural produce in the country comprising of fruits, vegetables, root and tuber crops, flowers and other ornamentals, medicinal and aromatic plants, spices, condiments, plantation crops and mushrooms. It is estimated that all the horticulture crops put together cover nearly 11.6 million hectares area with an annual production of 91 million tonnes. Though, these crops occupy hardly 8% of the cropped area in India, with approximately 30% contribution in agricultural GDP.

Currently we are able to secure food supplies under these varying conditions. All climate models predict that there will be more extreme weather conditions, with more droughts, heavy rainfall and storms in agricultural production regions. Such extreme weather events will influence where and when diseases will occur, thereby imposing severe risks and potential crop failure. In developing countries like India, climate change is an additional burden since ecological and socioeconomic systems already face pressures from rapid population, industrialization and economic development. India's climate could become warmer under conditions of increased atmospheric carbon dioxide.

However, per capita consumption of fruits and vegetables in India is only around 46g and 130g against a minimum of about 92g and 300g respectively recommended by Indian Council of Medical Research and National Institute of Nutrition, Hyderabad. The knowledge about the impact of climate change on horticultural crops is limited. Addressing problems of climate change is more challenging in horticulture crops compared to annual food crops. The issues of climate change and solution to the problems arising out of it requires thorough analysis, advance planning and improved management. The crop productivity is subjected to number of stresses and potential yields are seldom achieved with stress. Climate change is predicted to cause an increase in average air temperature of between 1.40C and 5.80C, increases in atmospheric CO₂ concentration, and significant changes in rainfall pattern (Houghton et al. 2001). Impact of climate change on four sectors of the economy,

namely Agriculture, Water, Natural Ecosystems and Biodiversity and Health in four climate sensitive regions of India, namely the Himalayan region, the Western Ghats, the Coastal Area and the North-East Region.

The present challenges like global climate change, water and soil pollution, less water availability, urbanization etc adds up to the situation. In combination with elevated temperatures, decreased precipitation could cause reduction in availability of irrigation water and increase in evapotranspiration, leading to severe crop water-stress conditions. Vegetable production is threatened by increasing soil salinity particularly in irrigated croplands which provide 40% of the world's food. Fruits, vegetables, flowers, medicinal plants and tubers are grown from tropical to temperate, some horticultural crops like spices and plantation crops are location specific. In order to sustain our horticultural production with present day challenges we have to have packages to manage abiotic stresses. The nature and magnitudes of stress vary.

Climate change poses serious challenges to human and places unprecedented pressure on the sustainability of horticulture industry. Therefore, the development of horticultural crops that can withstand stress will be the single most important step we may take to adapt the changes we have faced today and will face in the future.

II. Consequences

India is home to 16% of the world population, but only 4% of the world water resources. Agriculture is directly dependent on climate, since temperature, sunlight and water are the main drivers of crop growth. While some aspects of climate change such as longer growing season and warmer temperatures may bring benefits in crop growth and yield, there will also be a range of adverse impacts due to reduced water availability and more frequent extreme weather conditions. These impacts may put agricultural activities at significant risk

Indian agriculture consumes about 80-85% of the nation's available water [6]. The quantity of water required for agriculture has increased progressively through the years as more and more areas were brought under irrigation. Surface water and groundwater resources have played a significant role in irrigation and also in attaining self-sufficiency in food production during the past three decades. Availability of water from different sources and its utilization in the country. The consequences of such rapid change are - global warming, change of seasonal pattern, excessive rain, melting of ice cap, flood, rising sea level, drought, etc. leading to extremity of all kinds. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor vernalization. Western Ghats and surrounding regions may be deprived of normal precipitation due to abnormal monsoon.

Vulnerability, rarity and rapid extinction of plant species will be among the other consequences. Plains of India will face similar kind of problems. Nobel Laureate Pachauri said, total agricultural land will shrink and the available land may not remain suitable for the present crops for too long. Farmers have to explore options of changing crops suitable to weather. He also pointed out that climatic changes could lead to major food security issues for a country like India.

Impact of Climate Change on Crop Productivity

Two major parameters of climate change that has far reaching implications on agriculture in general and horticulture in particular are more erratic rainfall patterns and unpredictable high temperature spells will consequently reduce crop productivity. Latitudinal and altitudinal shifts in ecological and agro-economic zones, land degradation, extreme geophysical events, reduced water availability, rise in sea level and salinization are postulated (FAO 2004).

Particulars	Value
Geographical area	329 Mha
Average rainfall 120 cm	120 cm
Rainfall variation	100 mm western most region to 11000 eastern most region
Annual precipitation	4000 billion cu. m
Available water resources	1869 billion cu. m
Utilizable Surface water(storage and diversion) Groundwater (replenishable))	1122 billion cu. m 690 432
Present utilization (surface 63%, groundwater 37%) Irrigation Domestic Industry, energy and other uses	605 billion cu. m 501 30 74
Per capita water availability	1730.6 cu.m

Higher temperatures and changing precipitation patterns will severely affect the production patterns of different crops. Agricultural productivity will also be affected due to increased carbon dioxide in the

atmosphere. All these changes will increase the vulnerability of the landless and the poor. Several recent analysis have concluded that the higher temperatures expected in coming years will disproportionately affect agriculture in the planet's lower latitudes where most of the world's poor live. In such a scenario, agriculture will need better management of natural resources like land, water and genetic resources to make it more resilient. India has made a National Action Plan on Climate Change which was unveiled in 2008. There are eight national missions that would form the core of the national plan.

These include national missions for solar energy, enhanced energy efficiency, sustainable habitat, conserving water, sustaining the Himalayan ecosystem, a "Green India", sustainable agriculture and strategic knowledge platform for climate change. However, there are some innovative responses by water utilities to address these climate change risks and it has resulted in pushing the frontiers in a number of areas. It includes desalination, re-use and storm water harvesting and aquifer

The climate change will have many impacts on Agriculture, especially on horticulture and a few examples are given below.

1. Production timing will change due to rise in temperature. Due to rise in temperature, photoperiods may not show much variation. As a result, photosensitive crop will mature faster.
2. The winter regime and chilling duration will reduce in temperate regions affecting the temperate crops.
3. The requirement of annual irrigation will increase and heat unit requirement will be achieved in much lesser time.
4. Higher temperatures will reduce tuber initiation process in potato, reduced quality in tomatoes and pollination in many crops. In case of crucifers, it may lead to bolting; anthocyanin production may be affected in apples and capsicum. Tip burn and blossom end rot will be the common phenomenon in tomatoes.
5. Coastal regions can expect much faster percolation of sea water in inland water tables causing more salinity.

III. Conclusion

Global climate change is not a new phenomenon. The effect of climate change poses many threats; one of the important consequences is bringing about changes in the quality and quantity water resources and crop productivity. It can be concluded that the Indian region is highly sensitive to climate change. Agriculture sector is the most prone sector as it will have a direct bearing on the living of 1.2 billion people. India has set a target of halving greenhouse gas emissions by 2050 [15]. There is an urgent need for coordinated efforts to strengthen the research to assess the impact of climate change on agriculture, forests, animal husbandry, aquatic life and other living beings.

The production of apple has gradually increased but the productivity has fallen from 10.8 to 5.8 t/ha (Awasthi et al., 2001). The reasons attributed to it are climate variability, soil, crop improvement etc. Among all the productivity reducing factors, climate is difficult to manage. The changes in climate in the form of erratic precipitation, increase in temperature, lesser days serving as the chilling period have started affecting the mountain agricultural production systems and ultimately the food security of the people.

References

- [1]. Awasthi, R.P., Verma, H.S., Sharma, R.D., Bhardwaj, S.P and Bhardwaj, S.V. (2001) Causes of low productivity in apple orchards and suggested remedial measures: Productivity of temperate fruits. Jindal, K.K. and Gautam, D.R. (Eds), 1-8.
- [2]. Bose, T.K., and Mitra, S.K. (1996) Fruits: Tropical and Subtropical. *Nayaprakash*, Kolkata, India.
- [3]. Bray, E.A., (2002) Absciscic acid regulation of gene expression during water-deficit stress in the era of the Arabidopsis genome. *Plant Cell Environ* 25: 153-161.
- [4]. Erickson, A.N. and Markhart, A.H., (2002) Flower developmental stage and organ sensitivity of bell pepper (*Capsicum annuum* L) to elevated temperature. *Plant Cell Environ* 25:123-130.
- [5]. FAO (2004) Impact of climate change on agriculture in Asia and the Pacific. Twentyseventh.
- [6]. FAO Regional Conference for Asia and the Pacific. Beijing, China, 17-21 May 2004.
- [7]. Hazra P and Som MG (1999) Technology for Vegetable Production and Improvement.
- [8]. *NayaProkash*, Kolkata, India.
- [9]. Gautam H R (2009) Preserving the future. In: Joy of Life- The Mighty Aqua". Bennett, Coleman & Co. Ltd.,
- [10]. The Times of India, Chandigarh. 4. Christensen JH, Hewitson B, Busuioac A, Chen A, Gao X, et al. (2007)
- [11]. Regional Climate Projections. In: Climate Change 2007:
- [12]. The Physical Science Basis. Cambridge University Press. Cambridge, United Kingdom..
- [13]. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.
- [14]. Mall RK, Gupta A, Singh R, Singh RS, Rathore LS (2005) Water resources and climate change: An Indian perspective.