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Article *in* International Journal of Science and Research (IJSR) · December 2023

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International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

The Impact of Climate Change on Agriculture and Horticultural Crops in Jammu & Kashmir

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Abstract: ***Disruption has been brought about by climate change everywhere. Despite having major economic ramifications, agriculture and horticulture are among the few industries impacted by it and are, hence getting less attention. Horticultural and agricultural crops are still being impacted by the increasing temperatures. Different crops have been affected in different ways: some are more expensive to raise, the quality of the soil deteriorates, the temperature changes, etc. The output of agriculture and horticulture crops has been impacted by climate change and several contributing variables, including drought, hailstorms, and excessive or insufficient rainfall. Crops like walnuts, saffron, apples, and others that need a certain climate to thrive and be cultivated have recently suffered in Jammu and Kashmir. In this research, we address the crops used in horticulture and agriculture in Jammu & Kashmir that have not been significantly impacted by climate change. The influence of climate change on agricultural and horticulture crops in Jammu & Kashmir was examined in this study using secondary sources from important research studies, publications, and journals. A particular emphasis was placed on the production of saffron and walnuts.***

Keywords: Climate Change, Horticulture, Agriculture, Jammu and Kashmir, Production

1. Introduction

The negative implications of climate change include rising temperatures, more frequent extreme weather events, shifting borders between agroecosystems, invasive crops and pests, and weather unpredictability. Climate change is causing animal production to decline, agricultural yields to decline, and the nutritional value of farm - grown primary grains to deteriorate (The World Bank). Every horticulture crop has unique climate needs. Stress from unfavourable weather and climate circumstances leads to agricultural cultivation and output. Temperature regulates photosynthesis, respiration, enzymatic activity, blooming, root growth, quality, and other physiological processes.

Since low light levels might result in crop output of poor quality, light becomes another factor in the cultivation of these crops. Each plant has a specific light requirement that influences fruit set and pollen viability. Both the length and intensity of the light are crucial for crop growth and development. Rainfall has a crucial role in the growth and quality of these horticultural crops since it gives the plants' structural integrity, which is made up of over 80per cent water. Water is the most important growth component for plants and determines crop yield and quality. It is also needed in huge quantities for plant growth.

Water acts as a solvent for minerals and nutrients, aiding in the germination of seeds. Rainfall plays an important role in the growth of these crops, providing protection from low temperatures (frost), making it easier to harvest subsurface crops in dry soils, and regulating the temperature of the leaves during respiration. The cultivation and harvesting of crops in the J&K area have been negatively impacted throughout time by storms, droughts, and water logging.

Crops used in horticulture are wind - and soil - tolerant, with a variety of needs. These are the things that would increase the productivity of these crops, coupled with a few biotic socioeconomic requirements. Climate change will affect the growth patterns and blooming and fruiting capacities of many annual and perennial horticultural plants. It is predicted that in some regions, altered seasonal conditions affecting hibernation, acclimation, and the ensuing flowering and fruiting may cause serious issues for perennial fruit harvests. In other places, these crops could profit from climate change because of shortened growing seasons and less damage from cold (Dixon and Bhattacharya, 2019; Padder & Mathavan, 2018).

Global warming is having an impact on agricultural productivity; this has implications for food security. Numerous horticultural crops may be cultivated worldwide in a variety of agro - ecological zones with different soil types and temperatures. A sizable amount of the world's agricultural output is composed of fruits, vegetables, flowers, and other decorative plants; medicinal and aromatic plants; spices, condiments; plantation crops; and mushrooms. (Datta, S.) Emerging primary hazards to horticulture include rising temperatures in the atmosphere, altered precipitation patterns, excessive UV radiation, and an increase in the frequency of extreme weather events including heat waves, salt waves, droughts, and floods. Several horticultural crops have been impacted by the temperature increase (Hussain Padder, n. d.).

The Intergovernmental Panel on Climate Change (IPCC, 2009) predicted that weather extremes, droughts, floods, desertification, and rising temperatures will have a major effect on agriculture, especially in developing nations. The confluence of climate change will affect the security of food supplies worldwide.

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2. Regional Context

Numerous agricultural products are abundant in Jammu and Kashmir, where they also constitute the main economic sector and employ close to 80per cent of the workforce. The three agroclimatic zones are Jammu, Kashmir, and Ladakh; each has distinct geoclimatic variables that affect cropping patterns and production (J&K Development Report). Significant changes in climate have also been brought about in the quality and productivity of these crops as well as in the lives of the farmers who depend on their products. In the Government of Jammu and Kashmir's Annual publication 2013–14, the Directorate of Economics and Statistics states that the output of important crops including rice, maize, wheat, barley, pulses, oilseeds, and other fruits has been impacted by climate change. The harsh weather has a negative impact on these blossoming crops. The quality and quantity of apples and other fruits were recently ruined by floods in several areas of the state. The research showed that the current climate is making it harder for people to make a living. The Kashmiri people depends heavily on fruits like apple, saffron, and walnut for their livelihood, which has forced many of them to the verge of quitting farming or transferring to another line of work (Wani & Bhatt, 2015).

Horticultural crops have been impacted by the high temperatures in Kashmir and the moderate temperatures in Jammu. Plant agriculture that deals with garden plants, such as fruits, vegetables, and decorative plants, is known as horticulture crops. Production in horticulture in J&K has been negatively impacted by climate change. Its impact is seen in the decline in agricultural yield, crop quality, and crop market in recent years. According to data from the Department of Agriculture and Farmers Welfare in Jammu and Kashmir, 3, 912.910 tonnes were recorded in 2020. Compared to the previous figure for 2019, which was 3, 936.230 Ton, this represents a decline. A decrease in value has been seen in the valley's horticultural crops, such as apples, walnuts, and saffron, as a result of climate change, the importation of less expensive crop varieties, and inadequate irrigation (Padder & Hussain, 2021) .

3. Impact of Climate Change on Horticulture Crops

The production and market for horticultural crops have decreased because of the high temperatures and little precipitation brought on by climate change. The output of agricultural products like wheat, maize, and rice as well as horticultural crops like saffron, walnuts, and apples has declined in the Jammu and Kashmir areas. Due to the loss and shift brought about by climate change, many communities and farmers who were completely relied on horticultural crops as well as towns known for agricultural production have been put under pressure. Below is a thorough examination of two such crops: walnuts and saffron.

Saffron – The little village of Pampore, dubbed the "saffron town/capital" of India, has suffered greatly because of climate change. Both the output of saffron and produce in general has declined. Rainfall is a necessary condition for saffron output to increase. The main factor affecting the saffron crop in Kashmir is precipitation. Rainfall throughout the pre - flowering and sprouting stages promotes optimal blooming and good saffron output (Ganaie and Singh, 2019). The state's production is at its lowest point in the previous two to three decades because of insufficient rainfall. It was noted that during the state's severe drought that lasted from 1999 to 2003 (Alam, 2007), production decreased from 3.12 kg/ha to 1.57 kg/ha. Nonetheless, favourable rainfall in 2004–05 increased output to 2.96 kg/ha as well. Like the winter months, snow blankets the saffron fields, giving the corms constant hydration until the next spring, during which time they are unaffected and continue to grow. Corms need the right amount of moisture throughout the winter (dormant) season to avoid infection and failure to create the outgrowth. The soil is aerated when the first hoeing is done in the spring, and the fields need intermittent rain showers until they blossom. The valley's hilly areas have seen a sharp drop in precipitation (10.3 mm/year). The foothills and Karewa have a moderate rate of decline of 6.3 and 5.8 mm/year, respectively, whereas flood plains have demonstrated a considerably lower rate of decrease of 3.6 mm/year (Shafiq et al.2018). According to Dr. Amjad Hussaini, a scientist at SKAUST, "drought - like conditions, irregular rainfall, and minimal irrigation are the main reasons for the decline in saffron yield. " He also noted that climate change has a significant influence on rainfall patterns.

Due to the poor quality, inconsistent production, and low yield of saffron, many farmers have chosen to pursue alternative livelihoods, either by changing to a different crop or changing their job entirely. The Department of Agriculture Kashmir reports that throughout the past 20 years, the output of saffron from Kashmir has dropped by 65 per cent, from 16 metric tonnes to 5.6 metric tonnes. As a result, stakeholders can see the reduction, and secure saffron cultivation calls for quick and decisive action. To safeguard these crops and the cities that depend on them, measures must be taken, starting with drawing people's attention to the problem and its effects and ending with the efficient application of laws governing the production and cultivation of the crop.

Walnuts: Due to the threat posed by climate change, farming communities are searching for high - value substitute cropping systems for established ones like walnuts. The primary state in India for walnut production is Jammu and Kashmir; however, because of the high temperatures and little rainfall in the area, walnut output has declined. For best development and productivity, walnuts require a cold climate with 800 mm of yearly rainfall. "Walnut production benefits from a temperate climatic structure; otherwise, its trees are destroyed in the harsh winters and bloom blossoming with young nuts wounded owing to spring frosts, " per research by Mir &Kottaiveeran (2018). The most well - known apple and walnut grower in India is Jammu and Kashmir, whose average per centage of the nation's output is rising. With 92 per cent of the world's walnut production coming from Jammu & Kashmir, India ranks seventh in the world for walnut production. The special status of the state as a producer of walnuts, pears, and almonds, among other products, is advantageous. More

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than 75per cent of the temperate fruits in India are produced in this state. Over 61, 723 hectares, Jammu and Kashmir produced 86, 263 tonnes of walnuts, of which 92per cent were exported.

The export of fruits is the main source of income for Jammu and Kashmir. As of 2015, the state held a 7 per cent global market share and was the top producer and exporter of walnuts (Department of Horticulture). Despite Kashmir's stronghold on walnut production, unfavourable circumstances are becoming more prevalent by the day, according to data from the Directorate of Horticulture Jammu & Kashmir. As a result, trust in the growth and improvement of the walnut sector has declined recently. The Kashmir valley, which includes the Ladakh districts of Leh and Kargil, had an output share of 82.92 per cent in 2007–08, whereas Jammu had an output share of 34.63 per cent (Table 1). But the same Kashmir region reduced its lead to 65.36 per cent in 2016–17.

The average mean temperature of the state has increased from 1.45^0C to 2.32^0C over the past 20 years at this high altitude, affecting the cultivation and production of high - chill fruits like walnut (Mir &Kottaiveeran, 2018). Additionally, climate change is causing droughts, glacier depletion, increased temperatures, changes in rainfall patterns, and heavy snowfall, which calls for immediate action.

Table 1: Area and Production of Walnut

Region	Area		Growth Rate	Production		Growth Rate
	2007 - 08	2016 - 17		2007 - 08	2016 - 17	
Jammu	33259 (40.53)	38318 (42.89)	15.21	25067 (17.07)	92227 (34.63)	267.92
Kashmir	48786 (59.46)	51021 (57.10)	4.58	121712 (82.92)	174054 (65.36)	43
Jammu & Kashmir	82045	89339	8.89	146779	266281	81.41

Source: Directorate of Horticulture Jammu and Kashmir (2017)

4. Policymaking Suggestions & Measures

With its enormous potential to increase the quantity, quality, and productivity of horticultural products like walnuts and saffron, Jammu & Kashmir may serve as a driving force behind the growth of these crops in India. Jammu & Kashmir can act as a catalyst for the expansion of horticultural crops in India, such as saffron and walnuts, given its immense potential for their productivity, quality, and dissemination. The outcomes would not only help these agricultural production sectors, but they might also act as a template for other regions of the world to follow in terms of adapting to climate change through the adoption of appropriate policies and practises in cultivation and production to mitigate its effects. In addition to helping fruit growers produce higher - quality fruit, a thorough understanding of the causes and management techniques for various physiological disorders in tropical and subtropical fruits will also assist researchers in developing novel control strategies through breeding techniques, biotechnological interventions, or understanding the physiological basis to overcome these disorders. Considering this, it is important to understand the physiological causes of these illnesses, which are obstructing our nation's ability to produce high - quality goods and export them, as well as the necessity of using a distinct management strategy for each disorder, as this chapter explains (Kumar & Kumar, 2017).

- Initiatives to raise awareness and sensitise the local community and farmers about climate change, how it is impacting the crops in their locations, and what steps they may do to minimise the harm.
- Utilising water - saving best practises, such sprinkler irrigation.
- Agricultural cultivation that takes climate change into account
- State/central strategies for agricultural production and climate change that are implemented effectively and efficiently, with participation from the local farmer community, such as the National Saffron Mission.
- Engagement of stakeholders: To effectively safeguard these crops, collaboration with all parties involved in the sector and participation from all societal groups should be prioritised.
- Presenting Knowledge, Attitude, and Practice in Areas Affected by Climate Change and Global Warming on Crops and Agricultural Production.
- Experts and cultivators in horticulture should get together often to resolve issues in the sectors of production.
- Allocating limited resources in an appropriate and timely manner (Mir &Kottaiveeran, 2018)
- We must prioritise research topics from farmers, policy planners, scientists, trade, and industry, fill in knowledge gaps, and develop a solid action plan to better prepare for climate change. Visualizing the expected developments over the next 50–100 years is crucial. The Central Institute of Temperate Horticulture (CITH), the state's agricultural universities (SKUAST - J & SKUAST - K), and horticulture departments are already collaborating in this area. With their efforts, the state is hoped to lead the way in horticulture toward wealth and advancement, which is the goal.
- "A full evaluation of agricultural patterns and shift to fruits and vegetables is necessary, " the Jammu & Kashmir Development Report states. For instance, Punjab introduced a strategy for crop diversification, and several cultivation and diversification strategies are being adopted globally and must be done so locally as well.

Innovative agricultural research techniques, such as the creation of heat - tolerant cultivars and modifications to production system management, can mitigate the threat posed by climate change (Singh 2018, Malhotra & Srivastava 2014). Climate change has brought forth several problems and issues for the agricultural industry. Anything from increased public knowledge and sensitization to cutting - edge research and technology can assist overcome these issues and restore lost crop quality and productivity.

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5. Conclusion

The three elements of knowledge, attitude, and practise are essential for getting the desired outcome. The ability to understand, retain, and apply information is known as knowledge. It is a combination of comprehension, experience, judgement, and skill. An individual's tendency to perceive and understand events based on preconceived notions, respond to situations in a particular manner, or arrange their thoughts into logical and cohesive frameworks is referred to as their attitude. By "practise, " we mean using guidelines and information to guide action. Good practise is an art that is connected to the advancement of technology and knowledge. Bano, (Rafia, 2013). All parties involved, from the local community to legislators, adopt a certain appreciation attitude when information is acquired and shared. After that, all parties concerned would practise adjusting to new developments and introducing fresh approaches used to mitigate or lessen the impact of climate change harm on these crops.

Recognizing the antagonistic impact of climate change on agricultural output ought to be the initial move in surmounting the obstacles. We will be in a better position to provide the solutions after we have identified the discrepancies. By drawing stakeholders' attention to the escalating problems, policies and actions may be established that, when carried out skilfully and successfully, can lead to the desired outcomes. The greatest techniques, such establishing heat - tolerant measures and greenhouse technology, may be able to save horticulture and agriculture. However, before implementing these strategies, it is crucial to recognise the problems and difficulties brought about by climate change.

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