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**Research Paper**

# Effects of climate change on apple farming in kashmir valley

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**ABSTRACT**

The effects of climate change on apple farming in the Kashmir valley are becoming increasingly significant. The region's erratic weather patterns, including unpredictable temperature fluctuations, changes in precipitation, and extreme weather events, have a profound impact on apple cultivation. Rising temperatures contribute to increased pest and disease incidence, affecting the health and productivity of apple orchards. Changes in flowering time disrupt pollination and fruit development, leading to potential yield losses. Additionally, water availability and irrigation challenges pose significant risks to apple farming, as reduced snowfall and changing precipitation patterns affect water supply and irrigation practices. The vulnerability of apple orchards to extreme events, such as heavy rains, hailstorms, and unseasonal snowfall, results in physical damage and disrupts transportation and market access. The suitability of certain cultivation areas may shift due to climate change, requiring farmers to adapt their practices and explore new varieties or crop diversification. Mitigation and adaptation strategies, such as climate-resilient farming practices and supportive policies, are necessary to safeguard the sustainability and productivity of apple farming in the Kashmir valley in the face of climate change.

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## 1. INTRODUCTION

The Kashmir valley in India is renowned for its apple orchards and the high-quality apples it produces. However, the region is not immune to the impacts of climate change, which pose significant

challenges to apple farming. Climate change is altering the environmental conditions necessary for successful apple cultivation, affecting the yield, quality, and overall sustainability of apple orchards in the Kashmir valley [1].

In recent years, the Kashmir valley has experienced shifts in weather patterns, including increased temperature variability, changes in precipitation, and a rise in extreme weather events. These changes have profound implications for apple farmers who rely on stable and favorable climatic conditions for successful cultivation. The effects of climate change on apple farming in the region manifest through multiple interconnected factors, including pest and disease incidence, flowering time, water availability, and vulnerability to extreme weather events.

One of the key concerns is the increased prevalence of pests and diseases in apple orchards due to rising temperatures. Warmer conditions create a more conducive environment for pests and diseases, such as apple scab and codling moth, which can significantly reduce yields and compromise fruit quality. Additionally, changes in flowering time, driven by climate change, disrupt the synchrony between the blooming of apple trees and pollinators, leading to reduced pollination rates and subsequent impact on fruit development and yield [2].

Water availability and irrigation pose additional challenges for apple farmers in the Kashmir valley. Changes in precipitation patterns and reduced snowfall affect the availability of water for irrigation, potentially leading to water scarcity and stress on apple trees. Insufficient water supply can negatively impact tree health, fruit development, and overall productivity [3].

Furthermore, the vulnerability of apple orchards to extreme weather events, such as heavy rains, hailstorms, and unseasonal snowfall, poses significant risks. These events can cause physical damage to the orchards, including broken branches and uprooted trees, leading to crop losses and difficulties in transportation and market access [4].

Addressing the effects of climate change on apple farming in the Kashmir valley is crucial for the sustainability and economic well-being of farmers and the entire region. Effective mitigation and adaptation strategies are needed to enhance the resilience of apple orchards, promote sustainable agricultural practices, and ensure the continued productivity of the apple industry in the face of changing climatic conditions [4].

In this study, we aim to examine in detail the specific impacts of climate change on apple farming in the Kashmir valley, including changes in pest and disease dynamics, flowering patterns, water availability, and vulnerability to extreme weather events. By understanding these effects, we can develop strategies and recommendations to support farmers in adapting to the challenges posed by climate change and promoting sustainable apple cultivation in the region [5].

### 1.1 Objectives

To study the Constraints of Climate Change on Apple Farming

## 2. METHODOLOGY

The samples from the present study were collected from Kulgam district of Union territory of Jammu and Kashmir [6]. The total samples for the present study were collected from 125 respondents on random basis. All the respondents were Apple cultivators [7].

### 2.1 Date Collection

Primary data were used in the present Study, the primary data were collected through well-structured Questionnaire and sampling method used in present study is simple random sampling [8].

## 3. RESULTS AND DISCUSSIONS

Table 1. Demographics of Respondents

| Description | Male | Female | Total Respondents |
|---|---|---|---|

| | | | |
|---|---|---|---|
| No. of Respondents | 125 | 0 | 125 |
| Percentage | 100% | 0% | 100% |

Table 2. Constraints in Apple Farming Due to Climate Change

| S.No. | Constraints | Fairly Disagree | Disagree | Neutral | Agree | Strongly Agree | Total Percentage of Respondents |
|---|---|---|---|---|---|---|---|
| 1. | Increased Pest and Disease Incidence | 0% | 1% | 10% | 41% | 48% | 100% |
| 2. | Changes in Flowering Time | 2% | 2% | 15% | 29% | 52% | 100% |
| 3. | Water Availability and Irrigation Challenges | 0% | 1% | 12% | 30% | 43% | 100% |
| 4. | Vulnerability to Extreme Weather Events | 1% | 3% | 21% | 25% | 50% | 100% |
| 5. | Shifts in Suitable Cultivation Areas | 3% | 2% | 11% | 40% | 44% | 100% |
| 6. | Low productivity | 2% | 2% | 22% | 31% | 43% | 100% |
| 7. | Huge losses in Apple Business | 2% | 1% | 14% | 33% | 50% | 100% |

### 3.1 Findings

- **Increased Pest and Disease Incidence:** Rising temperatures associated with climate change create a more favorable environment for pests and diseases in apple orchards. The present study has shown an increase in the prevalence of pests like apple scab, codling moth, and aphids, which can cause significant damage to apple trees and reduce fruit quality and yield.
- **Changes in Flowering Time:** Climate change affects the timing of apple tree flowering, leading to alterations in pollination and fruit development. Present study indicated that shifts in flowering periods due to warming temperatures, which can result in mismatches with pollinators and decrease fruit set and overall yield.
- **Water Availability and Irrigation Challenges:** Changes in precipitation patterns and reduced snowfall impact water availability for apple farming. Present studies have highlighted the importance of adequate water supply for apple tree growth and development. Reduced water availability can lead to water stress, affecting tree health, fruit quality, and yield.
- **Vulnerability to Extreme Weather Events:** The Kashmir valley is susceptible to extreme weather events influenced by climate change, including heavy rains, hailstorms, and unseasonal snowfall. These events can cause physical damage to apple orchards, such as broken branches and uprooted trees, resulting in crop losses and difficulties in transportation and market access.
- **Shifts in Suitable Cultivation Areas:** Climate change may alter the suitability of certain regions within the Kashmir valley for apple cultivation. Rising temperatures and changing precipitation patterns can impact the optimal conditions required for apple trees to thrive. This may lead to shifts in suitable cultivation areas, requiring farmers to adapt their practices and explore new varieties or crop diversification. In present study low productivity of Apple cultivation were reported in Kulgam district

due to climate change [9]. Huge losses in Apple business were also explored by the present study, due to changing climate patterns

### 3.2 Suggestions

The effects of climate change on apple farming in the Kashmir valley present several challenges that need to be addressed. Here are some suggestions to mitigate and adapt to these effects:

- **Research and Monitoring:** Continual research and monitoring are essential to understand the specific impacts of climate change on apple farming in the Kashmir valley. This will help identify patterns, trends, and vulnerabilities, allowing for targeted mitigation and adaptation strategies.
- **Climate-Resilient Varieties:** Explore and develop apple varieties that are more resilient to the changing climatic conditions in the region [10]. Breeding programs can focus on traits such as tolerance to heat, drought, and pest and disease resistance.
- **Crop Management Techniques:** Implement climate-smart agricultural practices that optimize resource use and minimize the negative impacts of climate change. This includes improved water management, soil conservation, integrated pest management, and precision agriculture techniques [11].
- **Irrigation Infrastructure:** Improve irrigation infrastructure and water storage facilities to ensure reliable access to water for apple orchards. This can involve the construction of reservoirs, rainwater harvesting systems, and efficient irrigation methods like drip irrigation.
- **Weather Information and Advisory Services:** Enhance the dissemination of accurate and timely weather information to farmers. This can help them make informed decisions regarding planting, harvesting, pest and disease management, and other farm operations.
- **Farmer Training and Capacity Building:** Provide training and capacity-building programs to educate farmers about climate change impacts and equip them with the knowledge and skills to implement climate-resilient practices. This can be done through farmer field schools, workshops, and extension services.
- **Financial Support and Insurance:** Ensure access to credit, insurance, and financial support mechanisms for apple farmers. This can help them cope with climate-related risks and recover from crop losses caused by extreme weather events or pest and disease outbreaks.
- **Market Diversification:** Encourage market diversification and value addition for apple farmers to reduce their dependence on a single market or product. This can involve promoting local processing, storage, and marketing initiatives, as well as exploring export opportunities [12].
- **Policy Interventions:** Develop and implement policies that support climate adaptation and resilience in the agriculture sector. This can include incentives for adopting climate-smart practices, promoting sustainable farming techniques, and integrating climate change considerations into agricultural planning and decision-making processes.
- **International Collaboration:** Foster collaboration and knowledge exchange with international organizations, research institutions, and other regions facing similar climate challenges in apple farming. This can facilitate learning from best practices and experiences to develop effective adaptation strategies.

Implementing these suggestions requires a multi-stakeholder approach involving farmers, government agencies, research institutions, industry associations, and local communities [13]. By addressing the effects of climate change on apple farming in the Kashmir valley proactively, the region can enhance its resilience, safeguard farmers' livelihoods, and sustain the apple industry for future generations.

## 4. CONCLUSION

In conclusion, climate change poses significant challenges to apple farming in the Kashmir valley, impacting various aspects of orchard management and productivity. The effects of climate change, including increased pest and disease incidence, changes in flowering time, water availability, and

vulnerability to extreme weather events, have far-reaching consequences for apple farmers and the sustainability of the industry.

The rising temperatures associated with climate change have led to an upsurge in pests and diseases, jeopardizing the health and productivity of apple orchards. Changes in flowering time disrupt the essential pollination process, resulting in reduced fruit set and yield. Moreover, alterations in precipitation patterns and reduced snowfall affect water availability, leading to water stress and hindering tree growth and development. Extreme weather events, such as heavy rains, hailstorms, and unseasonal snowfall, pose additional risks to apple orchards. These events can cause physical damage to trees, resulting in crop losses and transportation difficulties. Furthermore, the suitability of certain cultivation areas may shift due to changing climatic conditions, necessitating adaptive strategies such as exploring new varieties or crop diversification.

To mitigate the effects of climate change on apple farming in the Kashmir valley, farmers and policymakers need to adopt resilience-building measures. This includes implementing climate-smart agricultural practices, such as integrated pest management, efficient irrigation techniques, and orchard management strategies that account for changing climatic conditions. Improving access to credit, insurance, and other support systems can also enhance the resilience of farmers against climate risks.

Continued research, monitoring, and collaboration between scientists, farmers, and policymakers are essential to understanding the evolving impacts of climate change on apple farming and developing effective adaptation strategies. By prioritizing climate resilience, the Kashmir valley can sustain its apple industry and support the livelihoods of farmers, ensuring the long-term prosperity of the region's agriculture sector in the face of a changing climate.

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## Author Contributions Statement

| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dr. Bilal Ahmad Sheikh | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | |
| Dr. S.H. Baba | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ |

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

## Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

## Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

### Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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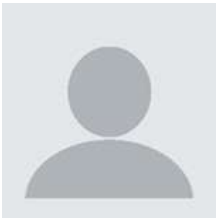
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