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Role of Polyhouse Technology in Mitigating Climate Risks for Floriculture

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Abstract

Climate change poses significant challenges to agricultural productivity, particularly in sectors like floriculture that rely heavily on favorable environmental conditions. In this context, polyhouse technology emerges as a promising solution for mitigating climate risks faced by floriculture farmers. Polyhouses provide a controlled environment that shields crops from extreme weather events, temperature fluctuations, and excessive rainfall, thereby reducing the vulnerability of floriculture production to climate variability. This paper reviews the role of polyhouse technology in climate risk mitigation for floriculture farmers. It examines how polyhouses help in maintaining optimal growing conditions, including temperature, humidity, and light intensity, throughout the year. By regulating these environmental factors, polyhouses enable year-round cultivation of high-value flower crops, offering farmers a stable income stream despite external climate fluctuations. Furthermore, the study explores the economic and environmental benefits associated with polyhouse-based floriculture systems. It analyses the cost-effectiveness of polyhouse construction and operation, considering factors such as energy consumption, water usage, and crop yield. Additionally, the environmental sustainability of polyhouse technology, including its potential to reduce pesticide and fertilizer usage, is discussed. The paper also highlights the challenges and limitations of adopting polyhouse technology in floriculture farming, including initial investment costs, technical expertise requirements, and market access issues. Strategies for overcoming these barriers, such as government subsidies, capacity building programs, and market linkages, are proposed. The polyhouse technology can play a climate-resilient solution for floriculture farmers, offering opportunities for increased productivity, income stability, and environmental sustainability in the face of climate change.

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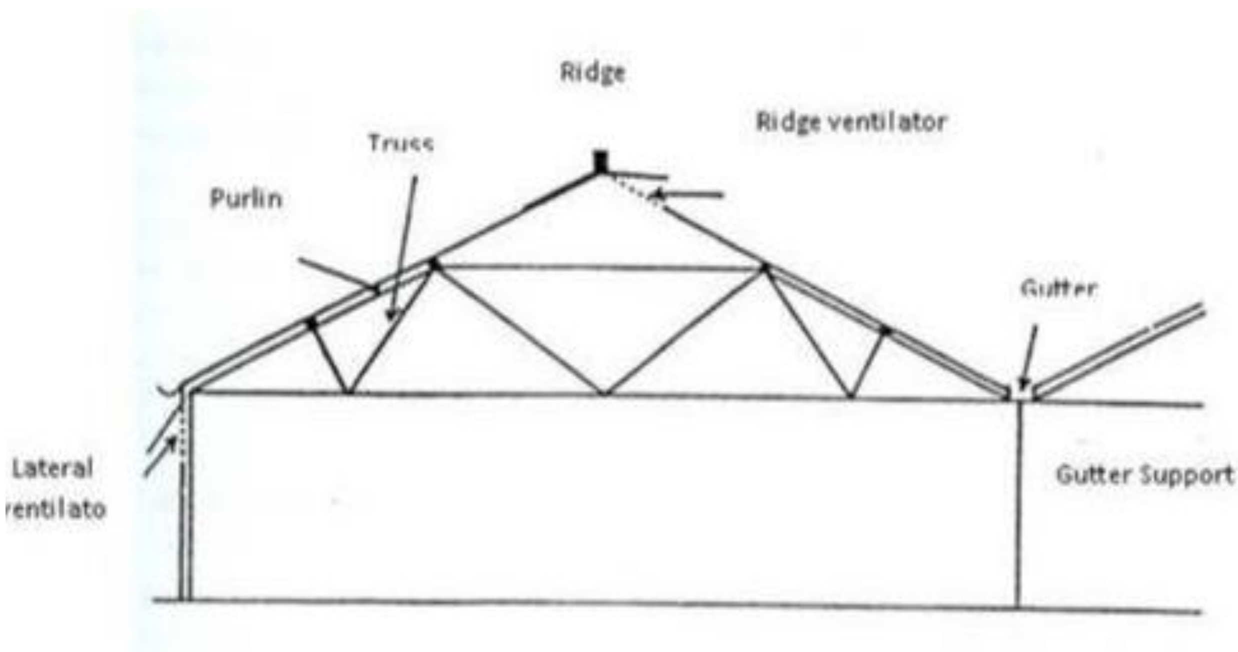
Keywords: Polyhouse, Floriculture, climate-resilient solution, environmental sustainability, PubMed, stress management.

INTRODUCTION:

A structure made up of polythene where plants are grown is called a polyhouse. Poly houses are frequently used for growing flowers, fruits, vegetables, and tobacco plants. These house control fundamental elements that affect plant growth include sunlight, soil moisture content, temperature, etc. Polyhouse farming is the process of growing crops in an environment where the temperature, humidity, and fertilizers are all controlled by automated equipment.

These polyhouse systems are further divided into three subcategories.

1. Low-tech or inexpensive polyhouse.
2. Polyhouse of medium cost or medium technology.
3. A high-end or expensive polyhouse.



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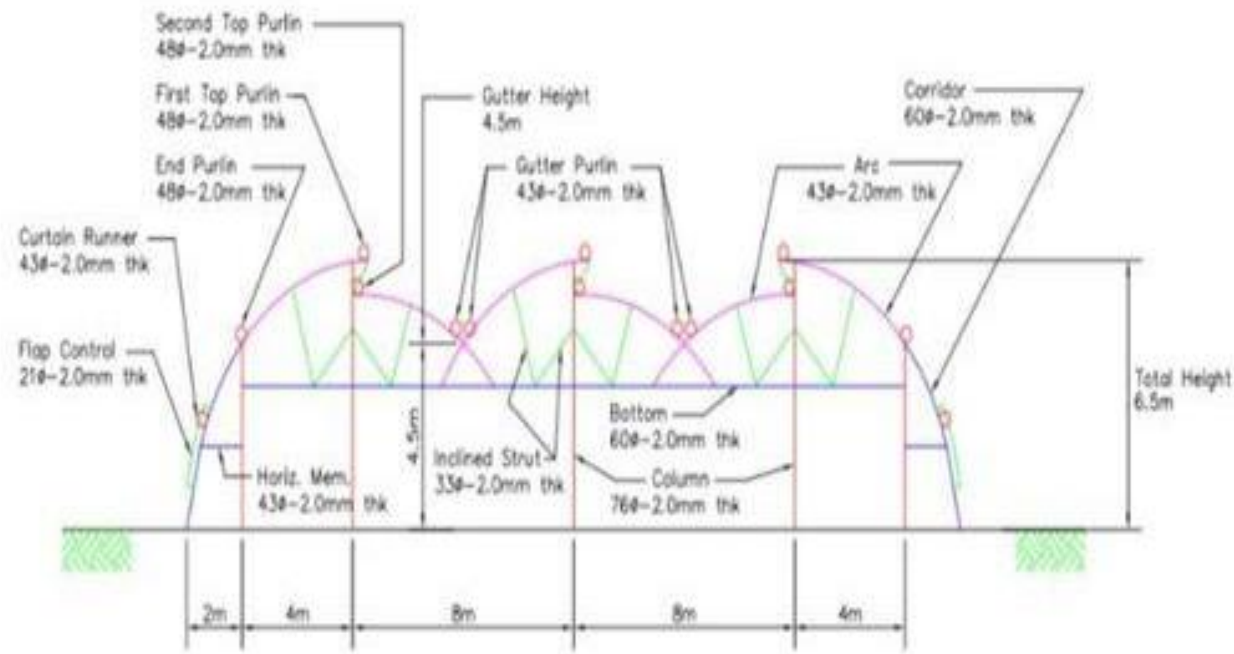

Prototype of a polyhouse

Materials and Methods:

A comprehensive review of scientific literature, research articles, technical reports, and relevant publications was conducted to gather insights into the role of polyhouse technology in mitigating climate risks for floriculture farmers. Databases such as PubMed, Google Scholar, and agricultural research repositories were searched. Case studies from different regions where polyhouse technology is widely adopted for floriculture were analyzed to understand its practical implications in mitigating climate risks. Data on crop performance, yield stability, and economic outcomes were collected from these case studies to provide empirical evidence of the benefits of polyhouse technology. Data collected from literature review, case studies, interviews, and field surveys were analyzed using qualitative and quantitative methods. Statistical analysis was performed to compare crop performance metrics, economic indicators, and environmental variables between polyhouse-based and open-field floriculture systems. Qualitative data analysis techniques such as thematic coding was employed to identify key themes

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and patterns related to the role of polyhouse technology in climate risk mitigation.

Review of Literature:

Numerous studies have highlighted the adverse effects of climate change on floriculture, including changes in temperature, precipitation patterns, and extreme weather events. Shifts in climatic conditions have led to yield losses, crop failures, and increased susceptibility to pests and diseases in open-field floriculture systems. Polyhouse technology, also known as greenhouse or protected cultivation, involves the use of structures covered with transparent materials such as polyethylene or glass to create a controlled microclimate for crop production. It was observed that in Haryana 17,71,21 m2 area was found under poly house farming with the involvement of 1956 farmers. It was calculated that the cost of constructing poly house under 100 m2 is 62,740/- including irrigation and labor, out of which 43,416/- is pay off by government as subsidy. Findings reveled that at the cost of 8926 of plantation, a farmer can earn 45,000 in only three months (Dahiya & Singh, 2018). Polyhouses offer advantages such as temperature regulation, humidity control, and protection from adverse weather conditions, making them suitable for mitigating climate risks in floriculture. Several studies have demonstrated the positive impact of polyhouse technology on crop performance and yield stability in floriculture. Polyhouses provide optimal growing conditions, allowing for year-round cultivation of high-value flower crops irrespective of external climatic fluctuations. Improved crop quality, increased marketable yield, and extended harvesting seasons are reported benefits of polyhouse cultivation. Research indicates that polyhouse technology enhances resource use efficiency by reducing water consumption, minimizing nutrient losses, and optimizing energy utilization. Controlled irrigation systems, fertigation techniques, and energy-efficient heating and cooling systems contribute to resource conservation and environmental sustainability in polyhouse-based floriculture. Economic assessments of polyhouse-based floriculture systems have shown promising results in terms of profitability and return on investment. Despite higher initial capital costs associated with polyhouse construction and operation, the potential for increased yields, premium pricing for quality flowers, and reduced production risks contribute to

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long-term economic viability. While polyhouse technology offers numerous benefits for climate risk mitigation in floriculture, challenges such as high investment costs, technical complexity, and limited access to market opportunities pose barriers to adoption, especially for small-scale farmers. Additionally, concerns regarding energy consumption, greenhouse gas emissions, and plastic waste management require attention for sustainable polyhouse farming practices.

OBSERVATIONS:

Polyhouse technology plays a crucial role in mitigating temperature risks for floriculture farmers in several ways like temperature regulation, season extension, protection from frost and freezing, heat stress management, risk reduction for high-value crops and energy efficiency.

Polyhouse technology in mitigating temperature

Polyhouses provide farmers with the ability to regulate the internal temperature, creating a controlled environment suitable for the optimal growth of flowers. This is particularly important in regions with extreme temperature fluctuations, where polyhouses offer insulation against both cold and heat stress. Polyhouses allow farmers to extend the growing season beyond the natural climatic limitations of their region. By controlling the temperature inside the structure, floriculturists can start planting earlier in the spring and continue growing later into the fall, thus maximizing their production window and revenue potential. In colder climates, polyhouses serve as a barrier against frost and freezing temperatures, protecting delicate flower crops from damage. By trapping heat during the night and preventing rapid temperature drops, polyhouses help maintain warmer conditions conducive to plant growth, ensuring the survival of sensitive floral varieties. In hot climates, polyhouses provide shade and reduce solar radiation, mitigating the risk of heat stress on flowers. By controlling the amount of sunlight and ventilation, farmers can prevent excessive heat buildup inside the structure, thereby protecting their crops from wilting, dehydration, and sunburn. Polyhouses enable farmers to create tailored microclimates suited to the specific requirements of different flower varieties. By adjusting parameters such as temperature, humidity, and light intensity, growers can mimic the ideal growing conditions for each

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type of flower, ensuring optimal growth and quality throughout the cultivation cycle. For high-value flower crops, such as orchids or certain exotic varieties, temperature fluctuations pose a significant risk to crop quality and market value. Polyhouses offer a reliable solution by providing a stable and controlled environment, minimizing the likelihood of temperature-related damage and ensuring consistent quality that meets market standards. Modern polyhouse designs incorporate energy-efficient technologies such as thermal screens, insulation materials, and climate control systems, allowing farmers to regulate temperatures more effectively while minimizing energy consumption. This not only reduces operating costs but also contributes to sustainability by lowering carbon emissions associated with heating and cooling.

Polyhouse technology in mitigating precipitation risks

Polyhouses provide a sheltered environment that shields flowers from the damaging effects of heavy rainfall, including soil erosion, waterlogging, and physical damage to delicate blooms. The structure acts as a barrier, reducing the impact of rainfall on the crops and preserving their quality and market value. Excessive rainfall can lead to waterlogging in open fields, which can suffocate plant roots and cause root rot, ultimately affecting plant health and productivity. Polyhouses, with proper drainage systems in place, help prevent waterlogging by allowing excess water to drain away efficiently, maintaining optimal soil moisture levels for plant growth without the risk of water stagnation. Polyhouse technology enables precise control over irrigation practices, allowing farmers to regulate the amount and timing of water application according to plant needs and prevailing weather conditions. By implementing drip irrigation or other efficient irrigation methods, floriculturists can minimize water wastage and ensure that plants receive adequate moisture without relying solely on unpredictable rainfall. Hailstorms pose a significant threat to open-field crops, causing physical damage to flowers and foliage. Polyhouses offer protection against hail damage by providing a solid structure that deflects hailstones and reduces their impact on the crops inside. This helps minimize crop losses and ensures the continuity of flower production even during periods of inclement weather. Heavy rainfall

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can trigger soil erosion in open fields, leading to nutrient loss and degradation of soil fertility over time. Polyhouse cultivation helps mitigate this risk by preventing soil erosion through the use of mulching materials and ground cover crops, as well as by maintaining a stable soil structure within the enclosed environment. In regions prone to erratic precipitation patterns due to climate change, polyhouses offer a means of adaptation for floriculture farmers. By providing a controlled environment that is less susceptible to weather fluctuations, polyhouses enable farmers to maintain consistent flower production regardless of changes in precipitation levels or distribution. Polyhouse technology allows for year-round cultivation of flowers, independent of seasonal variations in precipitation. This ensures a steady supply of flowers to meet market demand, reducing the reliance on seasonal rainfall patterns for crop production and providing greater stability and resilience to floriculture enterprises.

Polyhouse technology in mitigating susceptibility to pest and disease damage risks

Polyhouse technology plays a significant role in mitigating susceptibility to pest and disease damage risks for floriculture farmers in several ways: Polyhouses act as physical barriers that limit the entry of pests and pathogens into the growing area. The enclosed structure helps to prevent airborne pests such as aphids, whiteflies, and mites from reaching the crops, reducing the likelihood of infestations. By isolating the cultivation environment from external sources of contamination, polyhouses help reduce the introduction of pests and diseases from neighboring fields or natural habitats. This isolation minimizes the risk of cross-contamination and spread of pathogens, particularly those transmitted through wind, water, or insects. Polyhouse cultivation lends itself well to integrated pest management (IPM) practices, including the use of biological control agents such as beneficial insects (e.g., ladybugs, parasitic wasps) and microorganisms (e.g., predatory fungi, bacteria). These natural enemies of pests can be introduced and managed more effectively within the controlled environment of polyhouses, helping to keep pest populations in check without the need for chemical pesticides. Polyhouses enable farmers to reduce their reliance on chemical pesticides and fungicides, which can have detrimental

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effects on human health, beneficial organisms, and the environment. By implementing preventive measures such as crop rotation, sanitation, and cultural practices within the polyhouse, farmers can minimize the need for chemical interventions and adopt more sustainable pest and disease management strategies. Polyhouse cultivation promotes better crop hygiene practices, such as removing and disposing of diseased plant material promptly, sanitizing equipment and tools, and maintaining clean growing media. These measures help prevent the buildup of pest and disease reservoirs within the polyhouse, reducing the likelihood of outbreaks and protecting crop health.

Polyhouse technology in maintaining optimal growing conditions

Polyhouse technology empowers floriculture farmers to maintain optimal growing conditions year-round, regardless of external weather fluctuations. By providing a controlled environment that can be fine-tuned to meet the specific needs of different flower varieties, polyhouses enhance productivity, quality, and profitability in the floriculture industry.

Polyhouses offer precise temperature regulation through various mechanisms such as natural ventilation, shade nets, and climate control systems. Ventilation systems allow for the adjustment of airflow to prevent overheating during the day and maintain warmth during cooler periods. Shade nets or curtains can be employed to reduce solar radiation and prevent temperature spikes. Additionally, heating and cooling systems can be installed to maintain temperatures within the ideal range for specific flower varieties, regardless of external weather conditions. Polyhouses provide the flexibility to control humidity levels, which is crucial for maintaining plant health and preventing diseases. Humidity can be regulated through proper ventilation to facilitate air exchange and reduce moisture buildup. Additionally, misting systems or fogging techniques can be utilized to increase humidity levels during dry periods or to create microclimates for humidity-sensitive plants. Conversely, dehumidifiers can be employed to lower humidity levels and prevent fungal growth during periods of high moisture. Polyhouses allow for the manipulation of light intensity to meet the needs of different flower species. Shade nets or curtains can be adjusted to modulate the amount of sunlight reaching the crops,

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protecting light-sensitive varieties from excessive radiation. Supplemental lighting systems, such as LED grow lights, can be installed to provide additional illumination during cloudy days or short winter days, ensuring consistent photosynthetic activity and promoting healthy growth throughout the year. Polyhouses enable growers to customize the spectral composition of light to optimize plant growth and flowering. Advanced lighting technologies allow for the manipulation of light wavelengths to mimic natural sunlight or to target specific physiological processes such as flowering induction. By providing the right combination of red, blue, and far-red light, polyhouses can enhance photosynthesis, promote vegetative growth, and regulate flowering cycles, resulting in improved crop yields and quality.

Polyhouses create microclimates that can be tailored to the specific requirements of different flower varieties. By controlling temperature, humidity, and light intensity within the structure, growers can create ideal growing conditions that maximize plant productivity and quality. This level of precision enables floriculturists to cultivate a diverse range of flowers with varying environmental preferences, extending their product offerings and market competitiveness

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Polyhouse model for Floriculture

Polyhouse gaseous exchange system (Dev Khara Flowers near KVR hospital Kashipur U.S. Nagar, U.K.)

Polyhouse showing internal support system (Dev Khara Flowers near KVR hospital Kashipur U.S. Nagar, U.K.)

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Polyhouse floriculture with internal support system and drainage/irrigation system

Polyhouse showing drainage system (Dev Khara Flowers near KVR hospital Kashipur U.S. Nagar, U.K.)

CONCLUSION:

Polyhouse technology plays a pivotal role in mitigating climate risks for floriculture farmers by providing a controlled environment that safeguards crop from various environmental stressors. By

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regulating factors such as temperature, humidity, and light intensity, polyhouses offer a range of benefits that enhance the resilience and productivity of floriculture operations. Polyhouses enable precise control over temperature, protecting crops from extreme heat or cold and extending the growing season in regions with adverse climatic conditions. They provide shelter from heavy rainfall, hailstorms, and strong winds, reducing the risk of physical damage and preserving crop quality. The enclosed environment of polyhouses limits pest and disease infestations, allowing for more sustainable and chemical-free pest management practices. Polyhouse technology facilitates efficient water management, minimizing water wastage and ensuring optimal soil moisture levels through techniques like drip irrigation and hydroponics. Polyhouses support the cultivation of high-quality flowers with consistent characteristics, resulting in higher yields and improved marketability. By promoting sustainable farming practices and minimizing chemical inputs, polyhouses help conserve natural resources and reduce the environmental footprint of floriculture operations. Polyhouse technology offers floriculture farmers a reliable solution to climate risks, enabling them to overcome environmental challenges and achieve greater stability, productivity, and profitability in their operations. As climate change continues to pose threats to agricultural systems, the adoption of polyhouse technology becomes increasingly crucial in ensuring the long-term sustainability and resilience of the floriculture industry.

REFERENCES

1. Chakraborty, U., & Chakraborty, B. (2019). Climate change and its impact on floriculture. *Environmental and Experimental Botany*.
2. Dahiya, P., & Singh, K. Polyhouse farming: A new concept of agriculture. *Bhartiya Krishi Anusandhan Patrika*, *33*(1), 109–112. https://doi.org/10.18805/BKAP97
3. Krishna, S. K., Patel, K. K., & Yadav, D. S. (2011). Vegetable production under protected conditions in NEH region [ENVIS bulletin]. *Himalayan Ecology*, *12*(2) (pp. 21–24).
4. Kumar, A., Kumari, A., ., A., & ., L. (2019). Design and economic

@2024 International Council for Education Research and Training
ISSN: 2959-1376
2024, Vol. 03, Issue 04, 34-46
DOI: https://doi.org/10.59231/SARI7745

evaluation for the precision farming of tomato crop at Pusa (Bihar). *International Journal of Chemical Studies*, 7(3), 5123–5128. https://doi.org/10.22271/chemi.2019.v7.i3ce.6312

5. Mahajan, G., & Singh, M. (2019). Polyhouse: A boon for sustainable agriculture. *Journal of Pharmacognosy and Phytochemistry*.
6. Roy, D., & Singh, V. (2019). Polyhouse technology and its role in Indian agriculture: A review. *International Journal of Agricultural Science and Research*.
7. Thakur, S., Yadav, R., & Verma, R. (2017). Impact of polyhouse technology in horticulture development: A review. *International Journal of Current Microbiology and Applied Sciences*.

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