

Impact of Climate Change on the Growth and Productivity of Medicinal Plants

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DESCRIPTION

Climate change has emerged as one of the most significant environmental challenges of the twenty-first century, affecting ecosystems, biodiversity, agriculture, and human health on a global scale. While much attention has focused on staple food crops, the impact of climate change on medicinal plants has received comparatively less consideration. This issue deserves far greater attention because medicinal plants are essential not only for traditional healthcare systems but also for pharmaceutical development, biodiversity conservation, and rural livelihoods. The changing climate threatens the growth, productivity, and medicinal quality of numerous plant species, potentially affecting millions of people who depend on plant-based medicines.

Medicinal plants are particularly sensitive to environmental conditions because their growth and production of bioactive compounds are closely linked to temperature, rainfall, soil characteristics, and seasonal variations. Climate change is altering these environmental factors in unprecedented ways. Rising temperatures, shifting precipitation patterns, prolonged droughts, floods, and extreme weather events are increasingly disrupting the natural habitats and cultivation systems of medicinal plant species. As a result, many plants are experiencing reduced growth rates, altered phenology, and declining productivity.

One of the most concerning consequences of climate change is the geographical shift in medicinal plant distribution. Many species have evolved under specific climatic conditions and possess limited adaptability to rapid environmental changes. As temperatures rise, suitable habitats for certain medicinal plants may move to higher elevations or different latitudes. This migration process is often slow and may not keep pace with the rate of climate change. Consequently, some species may face local extinction, particularly those with restricted distributions or specialized ecological requirements. The loss of these plants represents not only a threat to biodiversity but also a loss of valuable genetic resources and traditional medicinal knowledge.

Climate change also affects the quality and therapeutic value of medicinal plants. Unlike conventional crops that are primarily

valued for yield, medicinal plants derive their importance from secondary metabolites such as alkaloids, flavonoids, terpenoids, and phenolic compounds. These bioactive substances are responsible for their pharmacological activities. Environmental stress caused by drought, heat, and elevated carbon dioxide concentrations can significantly influence the synthesis and accumulation of these compounds. While moderate stress may sometimes enhance the production of certain metabolites, excessive or prolonged stress often reduces overall plant vigor and negatively affects phytochemical composition. This variability raises concerns regarding the consistency, efficacy, and safety of herbal medicines.

Another issue that deserves attention is the increasing vulnerability of medicinal plants to pests and diseases. Climate change creates favorable conditions for the spread of insects, pathogens, and invasive species into new geographical regions. Warmer temperatures and altered humidity levels can increase pest populations and disease outbreaks, placing additional pressure on medicinal plant cultivation. Farmers may be forced to rely on greater pesticide use, which could compromise the quality and purity of medicinal products. Sustainable pest management strategies will therefore become increasingly important in the years ahead.

In my view, the medicinal plant sector must proactively adapt to these emerging challenges. Research efforts should focus on identifying climate-resilient species and developing improved cultivation practices capable of maintaining productivity under changing environmental conditions. Biotechnology, molecular breeding, and conservation programs can contribute significantly to preserving valuable medicinal plant genetic resources. Additionally, controlled cultivation systems such as greenhouses, shade-net structures, and precision agriculture technologies may help mitigate some of the adverse effects of climate variability.

Conservation should also become a central priority. Many medicinal plants are still harvested from wild populations, which are already under pressure from habitat loss and overexploitation. Climate change compounds these threats, making both in situ and ex situ conservation strategies essential. Seed banks, botanical gardens, tissue culture repositories, and

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protected natural habitats can play critical roles in safeguarding medicinal plant diversity for future generations.

Furthermore, policymakers should recognize medicinal plants as strategic biological resources. Investment in climate adaptation research, sustainable cultivation programs, and biodiversity conservation initiatives will be necessary to protect both public health and economic interests. Collaboration among scientists, farmers, traditional healers, conservationists, and policymakers can strengthen resilience across the medicinal plant value chain.

Climate change poses substantial risks to the growth, productivity, distribution, and phytochemical quality of medicinal plants. In my opinion, these impacts have significant implications for healthcare, biodiversity, and sustainable development. Addressing these challenges requires immediate attention, innovative research, and coordinated conservation efforts. By investing in adaptive strategies today, society can help ensure that medicinal plants continue to provide therapeutic benefits and ecological value in an increasingly uncertain climate future.