Chapter 10
Predicting Ecological Consequences of Invasive Alien Plants in Kashmir Himalayas With Artificial Intelligence

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ABSTRACT

Invasive alien species (IAS) of plants are one of the key drivers of loss of ecosystem diversity, especially in ecologically sensitive regions like the Kashmir Himalayas. The present paper discusses the impact of IAS plants on native biodiversity and ecosystem functions in terraced farming fields and natural ecosystems of the region. The data were collected during 2024 Kharif season from Majhkhet Village, Uttarakhand, such as climatic conditions, distribution of species, and ecosystem factors. After preprocessing, Particle Swarm Optimization (PSO) was applied to determine the most important features influencing invasion dynamics. An Artificial Neural Network (ANN) model was then built to predict the effect of invasive species on ecosystem diversity. The ANN showed good predictive performance, recovering intricate nonlinear interactions and offering valuable insights into patterns of invasion under varying environmental conditions.

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INTRODUCTION

The Himalayas of Kashmir are a biodiversity hotspot with distinctive flora and fauna that are well adapted to varying climatic and topographic environments. Ecosystem diversity in this area supports key ecological processes like nutrient cycling, water flow, and provision of habitats for endemic species. The region is also an important provider of livelihood opportunities for local residents who are dependent on ecosystem services such as medicinal plants, pastures, and agriculture. Yet, accelerating environmental modifications, instigated by climate change and human activities, jeopardize these vulnerable ecosystems. The impacts of invasive alien plants are necessary to understand, as their occurrences commonly distort native vegetation cover and modify habitat forms. Preserving ecosystem diversity in Kashmir is essential for ecological stability and socio-economic health. It is hence important to study the impacts of invasive species to learn how to maintain this ecological richness. It also makes a contribution to international conservation by maintaining genetic diversity and ecosystem resilience in a climate-vulnerable area. Lastly, this study assists in formulating well-informed planning for sustainable management as well as policy interventions specific to the distinctive Himalayan environment.

Invasive alien plants (IAPs) are plants introduced beyond their natural range that become established, rapidly invade, and cause ecological or economic damage. The Kashmir Himalayas have experienced a rise in IAPs as a result of globalization, commerce, tourism, and land use change patterns. The plants tend to dominate indigenous vegetation by taking exclusive use of resources like light, water, and nutrients. Their rapid development changes the composition of the habitat, resulting in loss of indigenous biodiversity and alterations in ecosystem functions. The necessity to investigate these impacts stems from a dearth of integrated data regarding IAP distribution and their ecological effects in the Himalayan region. Without knowledge of these processes, conservation would be in jeopardy, as invasive plants could compromise restoration and conservation measures. This study also seeks to determine priority invasive species impacting major ecosystems and suggest viable control strategies. In addition, research on IAPs in Kashmir will bridge knowledge gaps concerning mountain ecosystems, where invasive processes are different from lowland regions. Mitigating this menace is necessary to avert permanent ecological harm and ecosystem services loss.

One of the key reasons for conducting this study is to record the impacts of invasive alien plants on indigenous plant communities in Kashmir. IAPs frequently decrease native species richness and density through competition for resources or allelopathic suppression of growth. These modifications result in homogenization of vegetation communities, simplifying habitat structure and gene pool. Decline