Chapter 11
Deep Learning–Based Forecasting of Invasive Plant Spread Across Regions

Usharani Bhimavarapu
https://orcid.org/0000-0002-0246-1420
Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, India

ABSTRACT

This study explores the Geographic Variation in Growth Patterns of Invasive Plants by integrating ecological field data, advanced feature selection techniques, and deep learning methods. Invasive plant species pose serious threats to biodiversity and agriculture, especially when their growth patterns vary across regions due to environmental and human-influenced factors. Focusing on major spice-growing districts such as Guntur and Krishna, the dataset includes records of species like cinnamon, coriander, cumin, black pepper, turmeric, and chili, along with environmental attributes like soil composition, temperature, and rainfall. After rigorous preprocessing, Particle Swarm Optimization (PSO) was employed to extract the most relevant features influencing invasive species richness. A Gated Recurrent Unit (GRU) model was developed to predict the temporal and spatial growth patterns, capturing complex dependencies across multiple time steps.

DOI: 10.4018/979-8-3693-8724-5.ch011

INTRODUCTION

Invasive plants invade native ecosystems through competition with native vegetation, alteration of soil chemistry, and modification of wildlife habitats. Geographic variation in development makes it feasible for ecologists to know how invasive plants develop in diverse environments. Seeing differences enables them to forecast their progress and level of damage. Some regions might have maximum growth due to climate or soil compatibility, whereas others will slow down growth. This data is critical to invasion management and ecosystem function. It also points to sensitive regions where intervention is timely. In the absence of knowledge of geographic growth variation, invasion management can be misleading or wrong. In addition, regional differences can account for invasive species change over the long term following colonization into new habitats. Geographic variation knowledge is therefore central to ecological rehabilitation. Effective invasive plant management is conducted locally because of varying geographic growth patterns.

Hot-growth zones may need intensive eradication or control. Low-growth zones, however, may be subjected to monitoring and preventive treatments. Knowledge of the patterns facilitates resource allocation to focus efforts and investment on high-risk zones. It also determines what invasive species are most critical locally. Geographic knowledge can inform policy decision-making, such as quarantine zones or public advertising. It can even plan rehabilitation processes by predicting where native vegetation will be able to compete favorably. Without this, management will become diluted and less successful. An understanding of geographic variation makes it possible to initiate specialized effort that raises levels of success. This is beneficial to the agriculture, forestry, and conservation sectors in general. Climate change alters temperature, precipitation, and seasonality, which impacts invasive plant growth patterns. Geographic variation studies allow scientists to model the manner in which these species will expand or contract their ranges under future climates.

Increased temperatures may increase vulnerabilities in some regions but decrease them in others. What is known regarding current climate variations helps to generate effective predictive models. Predictions guide anticipatory measures in order to avert invasions in newly vulnerable regions. It guides the creation of refugia where native cover can persist. In the absence of geographical variation consideration, the effects of climate on invasives will be oversimplified by necessity. It is critical in planning for long-term ecosystem resistance. It is also useful in farm planning to avoid invasive attack on crops. It is basically a dynamic model to predict and manage possible invasion threats in the future. Restoring an invaded ecosystem would entail awareness of which among the native flora has the ability to compete or co-occur with the invader growth. Geographic variations in invader growth identifies where restoration will succeed or fail. Where invasive growth is thriving lusciously in an