Identification and Classification of Medicinal Plants of Indian Himalayan Region Using Hyperspectral Remote Sensing and Machine Learning Techniques

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Abstract : The Indian Himalaya region harbours approximately 1748 plants of medicinal importance, and as per International Union for Conservation of Nature (IUCN), the 112 plant species among these are threatened and endangered. To ease the pressure on these plants, the government of India is encouraging its in-situ cultivation. The Saussurea costus, Valeriana jatamansi, and Picrorhiza kurroa have also been prioritized for large scale cultivation owing to their market demand, conservation value and medicinal properties. These species are found from 1000 m to 4000 m elevation ranges in the Indian Himalaya. Identification of these plants in the field requires taxonomic skills, which is one of the major bottleneck in the conservation and management of these plants. In recent years, Hyperspectral remote sensing techniques have been precisely used for the discrimination of plant species with the help of their unique spectral signatures. In this background, a spectral library of the above 03 medicinal plants was prepared by collecting the spectral data using a handheld spectroradiometer (325 to 1075 nm) from farmer's fields of Himachal Pradesh and Uttarakhand states of Indian Himalaya. The Random forest (RF) model was implied on the spectral data for the classification of the medicinal plants. The 80:20 standard split ratio was followed for training and validation of the RF model, which resulted in training accuracy of 84.39 % (kappa coefficient = 0.72) and testing accuracy of 85.29 % (kappa coefficient = 0.77). This RF classifier has identified green (555 to 598 nm), red (605 nm), and near-infrared (725 to 840 nm) wavelength regions suitable for the discrimination of these species. The findings of this study have provided a technique for rapid and onsite identification of the above medicinal plants in the field. This will also be a key input for the classification of hyperspectral remote sensing images for mapping of these species in farmer's field on a regional scale. This is a pioneer study in the Indian Himalaya region for medicinal plants in which the applicability of hyperspectral remote sensing has been explored.

Keywords : himalaya, hyperspectral remote sensing, machine learning; medicinal plants, random forests

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