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Distribution, use, and governance of wild mango stands in north-eastern Pakistan

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Abstract

Mango (*Mangifera indica* L.) is an important commercial fruit crop in Pakistan providing a substantial income source for farmers. Mango trees are cultivated on large scale commercial farms, and the stands consist mainly of modern varieties. Despite much research on the genetic diversity of mango trees and on effects of management practices on their yield and quality, there is, to date, little information on the ancient belt of wild mango stretching along the foothills of the Karakoram/Himalayan Mountains in the districts of Gujrat and Bhimber (Kashmir) of north-eastern Pakistan. Exploring these old landraces helps in generating a basis map for further genetic distribution mapping. This study therefore aims at identifying the extension and use of these wild mango stands. To do so, the geographic coordinates of individual trees were collected between August and September 2025 using a handheld Global Positioning System (GPS) and were integrated in a Geographical Information System (GIS) to analyse the geo-morphological determinants of the stand density. A manual classification of the trees was done in QGIS using Google Earth satellite image. In addition to that, we conducted a questionnaire to collect data on the age and use of the trees. As a result of the classification, a total of 2,747 trees were mapped. These were located in the eastern part of the Bhimber district, across 128 km^2, and an elevation gradient between 290 to 890 m above sea level (m a.s.l.) whereby the majority (68 %) was found in the lower areas (360 to 460 m a.s.l.). Primary results furthermore reveal that the majority of the trees (78 %) are over 100 years old and are under communal ownership and use. Together with the crops cultivated by farmers, the trees form an agroforestry system and their management is strongly linked to cultural and religious beliefs. Further classification work will target the automation of the process using deep learning models and a larger area, covering both districts, where we expect a total number of >26,000 trees. Future research will also focus on the analysis of ecological determinants of the stand density.

Keywords: Fruit crops, GIS, indigenous varieties, Kashmir, traditional knowledge

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