Archives of Agriculture and Environmental Science 10(1): 175-181 (2025)
https://doi.org/10.26832/24566632.2025.1001025

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

REVIEW ARTICLE

Neglected and underutilized fruits in Nepal: Importance, Challenges and Conservation approaches

Barsha Mahato

Agriculture and Forestry University, Chitwan, Nepal
E-mail: mahatobarsha1014@gmail.com

ARTICLE HISTORY

Received: 01 December 2024
Revised received: 27 February 2025
Accepted: 08 March 2025

Keywords

Biodiversity
Conservation
Neglected and underutilized fruits
Nepal

ABSTRACT

This paper investigates the neglected and underutilized fruits (N&U fruits) of Nepal, aimed to explore the potential of N&U fruits in Nepal, examining their importance, challenges, and conservation strategies. The study employs a comprehensive review of N&U fruit species in Nepal, focusing on their ecological distribution, socio-economic significance, and barriers to conservation and utilization. Key findings indicate that certain indigenous fruits, grown at altitudes ranging from 60 m to 4700 m, have the potential to contribute up to 5-10% of local agricultural income and can significantly boost rural economies. These fruits also provide ecological benefits, such as soil erosion prevention and increased biodiversity, with deep root systems that stabilize soils, particularly in the hilly regions. Additionally, N&U fruits are highly nutritious, providing essential carbohydrates, proteins, vitamins, minerals, and bioactive compounds that aid in addressing malnutrition and preventing health issues such as cardiovascular diseases. Despite these advantages, challenges such as insufficient research, shifting preferences toward exotic varieties, and climate change hinder their cultivation and commercialization. Conservation strategies like on-farm, in-situ, and ex-situ methods have been implemented, with approximately 30% of local crop diversity being conserved through on-farm strategies. Strengthening research and improving market access could increase the utilization of these fruits by up to 50%, contributing to both economic development and environmental sustainability. This study highlights the urgent need for interdisciplinary research and the development of comprehensive conservation frameworks to ensure the sustainability of these valuable genetic resources for future generations.

Citation of this article: Mahato, B. (2025). Neglected and underutilized fruits in Nepal: Importance, Challenges and Conservation approaches. *Archives of Agriculture and Environmental Science*, *10*(1), 175-181, https://dx.doi.org/10.26832/24566632.2025.1001025

INTRODUCTION

Nepal's diverse agro-ecological zones, influenced by altitude, topography, and aspect, provide ample opportunities for growing various fruit species. The total cultivated area is approximately 3 million hectares, with fruits accounting for 4.79%. Horticulture contributes 15% of agriculture GDP, with fruits accounting for nearly half (Atreya & Manandhar, 2016). The physiographic situation of Nepal has given rise to diverse climatic conditions, resulting in a large biodiversity (Pradhan *et al.*, 2016). Nepal has 88 neglected and underutilized fruits (N&U fruits) from 32 families, with the highest diversity found in the Rosaceae and Rutaceae families (Atreya & Shrestha, 2020). The southern terai region is ideal for growing tropical fruits, while the mid-hills and high hills in the north are ideal for subtropical to warm and cold temperate fruit and nut species. Wild plants in Nepal include mandarin in Mangtewa and Sankhuwasabha, custard apple in Dhankuta, amala (Indian gooseberry) in Jasbire and Indrawati, citron in the mid-hills of the Central region, and olive in Dolpa, Humla, and Kalikot in the west (Pradhan *et al.*, 2016). Neglected and underutilized fruit has multiple uses, such as fodder, fuelwood, medicinal, religious, social, timber, etc. These fruits can also be used in breeding programs to improve fruit varieties to suit the local

environment (Regmi & Shrestha, 2005). Therefore, the use of neglected and underutilized fruit germplasm has a high potential for improving fruit quality, extending the harvesting season, and broadening the adaptation to microclimatic niches in Nepal (Gotame & Poudyal, 2014). Fruits such as pummelo (*Citrus maxima* Merr.) and citron (*Citrus medica* L.*)* are widely consumed during festivals like Tihar (festival of lights). The Newari community uses the wood apple (*Aegle marmelos* L. Correa) during Bel Bibah, a special type of marriage between pre-adolescent Newari girls and Bel (Kaini *et al*., 2016).

Wild fruits have many uses, but they are not being conserved or utilized scientifically. There is insufficient awareness regarding the nutritional benefits and cultivation practices of these fruits among local communities (Adhikari *et al*., 2017). Many neglected fruits, such as *Diospyros malabarica*, have not been thoroughly analyzed for their nutritional content, despite their local popularity (Shrestha *et al*., 2021). Research and development initiatives for these species are minimal, with only 15% of cultivated crops receiving adequate attention (Joshi & Gauchan, 2022). The Nepal Agriculture Research Council (NARC) and Department of Agriculture (DOA) have introduced and maintained exotic fruit varieties from abroad for research and demonstration purposes. However, inventory documentation, characterization, and evaluations of indigenous fruit species are still lacking. Identification and evaluation of neglected and underutilized fruit species is urgently needed (Atreya & Shrestha, 2020). The objective of this study was to gather the available information on neglected and underutilized fruit species along with their importance, challenges, and conservation approaches in Nepal.

METHODOLOGY

The methodology for this review paper included conducting a thorough literature search using academic databases such as Google Scholar and Scopus. Articles published between 2000 and 2024 were prioritized, with a focus on peer-reviewed journal articles, reports from international organizations, and government documents. The key search terms were "neglected fruits," "underutilized fruits," "indigenous fruits," and "agricultural biodiversity." The collected literature was analyzed to identify neglected and underutilized fruits in Nepal, as well as their nutritional, ecological, and socioeconomic value. Studies on local farming practices, market availability, and conservation efforts were also evaluated. The data was combined to provide an overview of current trends and challenges in promoting these fruits.

NEGLECTED AND UNDERUTILIZED FRUITS (N&U FRUITS) AVAILABLE IN NEPAL

Nepal's diverse climatic conditions, topography, and agro-ecological zones significantly impact the biodiversity of neglected and underutilized fruits (Atreya & Shrestha, 2020). The agro-ecological zones of Nepal (Terai, Mid-Hill, and High-Hill) experience a wide range of climates from subtropical to temperate, as well as alpine cold semi-desert, resulting in the evolution and maintenance of diverse fruit gene pools. Fruit cultivation takes place at altitudes ranging from 60 meters (Kechana Kalan, Jhapa) to 4700 meters (Joshi *et al*., 2023). While altitude and climate play important roles in shaping fruit biodiversity, there is a scarcity of quantitative data on the distribution and adaptability of these fruits at various elevations. There are research gaps in understanding how climate change will affect fruit production and genetic diversity.

IMPORTANCE OF N&U FRUITS

Economic importance

Neglected and underutilized fruits (N&U fruits) can have a significant impact on the rural and national economies. Consumers are always looking for new, delicious, nutritious, and visually appealing food products. The potential for processed products from minor fruits in the country remains untapped. Tapping into farmer's local knowledge of such lesser-known or underutilized crops has also been found to play an important role in the identification of such frequently overlooked natural resources for commercialization. These fruits primarily benefit thousands of poor farmers by allowing them to participate in markets (Dangol, 2002). Indigenous fruit species like sweet orange (Junar), Asian sand pear (Pharping Local), mandarin orange (Dhankuta Local), and acid lime (Kagati Lime) outperform exotic varieties in terms of economic value (Gotame, 2014). These species can significantly improve food security and income generation for the rural people (Shrestha *et al*., 2020). Although the economic potential of N&U fruits is acknowledged, there is a scarcity of comprehensive market research on their commercialization. Pricing, consumer demand, and supply chain inefficiencies are all still poorly understood. The integration of these fruits into formal markets, as well as research into the impact of value addition through processing, could be critical steps.

Nutritional importance

Indigenous fruits have high nutritional value and are commonly cultivated and gathered for consumption and sale in Nepal, especially in remote areas. Wood apple has a high protein content (7.10 mg/100 g pulp) and carbohydrate content (31.80 mg/100 g pulp), while tamarind is the richest source of iron (17.01 mg/100 g pulp) and carbohydrate (67.40 mg/100 g pulp). Amala (500-625 mg/100 g pulp) and ber (39-166 mg/100 g pulp) are high in vitamin C (Nandan & Bhardwaj, 2015). Similarly, figs (*Ficus carica*) and mahua (*Madhuca indica*) are reported to contain higher amounts of vitamin A (152 and 307 mg/100 g pulp). Bael (*Aegle marmelos*) and sitaphal (*Annona squamosa*) fruits are rich in vitamin B1 (0.07 mg/100 g pulp) and vitamin B2 (1.19 and 0.17 mg/100 g) (Gopalan *et al*., 2009). These foods contain essential nutrients such as carbohydrates, proteins, fats, vitamins, minerals, and bioactive compounds that promote dietary health (Hunter *et al*., 2019). Neglected and underutilized fruit species are crucial for poor people with limited access to major food crops, as they contribute to food, nutrition, and cultural diversity (Shrestha *et al*., 2020). These fruits are rich in

essential nutrients and bioactive compounds, which aid in the management of health issues such as malnutrition and cardiovascular disease (Deepika *et al*., 2024). Promoting the use of these species can combat malnutrition and improve the health of local populations due to their high nutrient content and proven medicinal properties (Dansi *et al*., 2012). The nutritional value of these fruits has been well documented, but there has been little research into their bioavailability and the effects of different processing methods on nutrient retention. Furthermore, clinical research into their health benefits is required, particularly in the management of diseases such as diabetes and cardiovascular disorders. More interdisciplinary research that combines nutrition science and indigenous knowledge would be beneficial.

Ecological importance

Fruits that are neglected or underutilized can produce high yields with minimal environmental impact (Shava, 2005). Their deep root system helps prevent landslides and soil erosion in Nepal's hilly regions. These fruit species have great potential to improve food, nutrition, and income security for rural communities in drought-prone areas (Chivenge *et al*., 2015). Fruit trees, including N&U, provide forage for bees. However, apple (Malus domestica), plum (Prunus domestica), and cherry (Prunus avium) trees are particularly attractive to bees (Painter, 2020). Birds and mammals consume fleshy fruits, which may not be digested and spread from the original tree. Uneaten fruits and nuts may germinate the following spring, leading to new trees. Some seeds are carried away by wind and germinate in new locations (CoAFE, 2020). Fruit trees provide numerous environmental benefits including reduced shipping, lower CO_2 emissions, lower energy costs, stormwater management, and green jobs. Fruit trees absorb CO_2, clean the air, and release oxygen into the atmosphere (Maier, 2020). While the ecological benefits of N&U fruits are apparent, their role in soil fertility and biodiversity conservation warrants further investigation. There have been few empirical studies on their carbon sequestration potential and climate resilience. More research is needed to determine how these fruits can be integrated into agroforestry systems to ensure sustainable land use.

Suitability in the adverse climate

Climate trends pose a higher risk of land degradation and biodiversity loss in Nepal's marginal farming areas. The use of indigenous fruit diversity in Nepalese farming, especially by smallholder farmers, is crucial for climate adaptation (Paudyal & Regmi, 2009). Indigenous fruit species can thrive in harsh climatic conditions through traditional farming methods (Atreya & Kaphle, 2020). They can be grown with low agricultural inputs on marginal lands (Thies, 2000). Seedlings grown through sexual propagation have a deep root system and are more resistant to climate change. Indigenous plant materials are more resilient to insects, pests, diseases, and extreme environmental stresses (Dangol, 2002). They are less susceptible to climate change and diseases than improved varieties (Jarvis *et al*., 2008). They contribute to global food production due to their ability to withstand harsh environmental conditions (Shava, 2005). Although the climate adaptability of these species is recognized, there is a need for quantitative studies measuring their yield stability under extreme weather conditions.

Genetic resources

Neglected and underutilized fruits (N&U fruits) are building blocks of new varieties and are used as genetic resources (Dangol, 2002). Nepal is abundant in wild and local fruit germplasm. It is also the origin of numerous fruit species. In many cases, indigenous fruit species outperform exotic varieties; e.g., 'pharping' (Asian sand pear), ‘junar’ (sweet orange), Dhankuta local mandarin, and 'kagati' (acid lime) are superior compared to exotic varieties. Conservation of these crops is one of the best options for genetic resources conservation, which is the main asset of marginality and poor community living in the remote parts of the country (Shrestha *et al*., 2020). There is ample scope for selecting promising clones from these existing wild relatives through evaluation and selection breeding (Shava, 2005). Some of these fruit species may be released or registered as landraces. Plants with high genetic diversity have the potential to enhance crop quality and resilience, making them useful for plant breeders to improve future crops (Mabhaudhi *et al*., 2019). Although genetic diversity is highlighted, there is a dearth of molecular research on these species. More research is needed to better understand their genetic variability and develop conservation strategies. Further research into genetic improvement via hybridization and selection breeding is required to improve yield and disease resistance.

CHALLENGES FOR N&U FRUITS

The challenges that neglected and underutilized fruits faced in Nepal are multifaceted, resulting from socioeconomic, environmental, and policy factors. Despite their ability to improve food security and nutrition, these fruits are frequently overlooked in agricultural practices and research. The sections that follow describe the major challenges that affect their cultivation and utilization.

Insufficient research and development

Neglected fruits receive minimal attention in formal research and development, limiting their potential benefits (Joshi *et al*., 2023). Only a small fraction of the 88 identified underutilized fruit species are actively researched, leading to a lack of improved varieties (Atreya & Shrestha, 2020). Limited investment in research and education regarding N&U fruits hampers their promotion and commercialization. A weak seed regulatory framework complicates the conservation and sustainable use of these species (Joshi & Gauchan, 2022). The role of modern biotechnological tools in improving N&U fruits has received little attention. There is a need to establish a strong framework for seed preservation and improve access to these fruits for commercial purposes. More funding and research programs aimed at the diverse applications of N&U fruits are required,

particularly in areas such as disease resistance and genetic improvements.

Shifting to exotic varieties

The introduction of high-yielding exotic varieties and monocropping trends has diminished the cultivation of local fruits. Also, shifts in consumer preferences towards more commercially popular fruits have reduced the demand for N&U fruits (Atreya & Shrestha, 2020). Farmers are increasingly shifting towards commercially viable crops, neglecting traditional varieties that are crucial for biodiversity (Joshi & Gauchan, 2022). The transition to exotic varieties causes a conflict between economic productivity and biodiversity conservation. This trend also indicates a lack of understanding about the long-term ecological and nutritional benefits of indigenous fruits. To balance commercial and ecological interests, more research into consumer behaviour and policy interventions promoting local fruits is required.

Climate change and environmental stress

Extreme weather conditions threaten the genetic diversity and survival of N&U fruits, exacerbating their decline. Urbanization and deforestation further exacerbate the decline of these species, reducing their availability and cultivation. Many underutilized fruits are resilient to climate change, but cultivation is declining due to changing climatic conditions and agricultural practices. The loss of traditional knowledge about these fruits exacerbates their decline because communities are less prepared to adapt to environmental changes (Tripathi, 2023). While the resilience of N&U fruits to climate change is recognized, research on how to cultivate these fruits in increasingly challenging climates is limited. More research should be conducted to investigate adaptive management strategies that combine indigenous knowledge with modern farming techniques to ensure the long-term survival of these species.

Socio economic barrier

There is insufficient integration of neglected fruits into national food and nutrition policies, which hampers their promotion. A lack of awareness regarding the nutritional value and economic potential of these fruits contributes to their decline (Adhikari *et al*., 2017). Smallholder farmers often lack awareness of the economic potential of these fruits, which limits their cultivation and commercialization (Tripathi, 2023). Despite the clear potential for N&U fruits to improve food security and income, research into their integration into national policy frameworks is limited. A significant gap in the research is the absence of large-scale policy analysis on how to scale up N&U fruits in agricultural and food systems. More extensive research involving the government, farmer cooperatives, and market actors is needed to develop actionable policy recommendations.

CONSERVATION APPROACHES FOR N&U FRUITS

The Nepal Agricultural Research Council (NARC) oversees the conservation of underutilized and wild fruits, as well as agro-biodiversity management through commodity programs and the National Agriculture Genetic Resources Center (Figure 1). Many germplasms are conserved in both government and private farms under DOA. Many underutilized fruit crops have been conserved through efforts by national botanical gardens, public and private farms, field gene banks, and horticultural research centres. Nepal conserves underutilized fruits using three methods (Thapa *et al*., 2021).

On-farm conservation

It is the dynamic preservation of traditional and locally adopted varieties and landraces in farming communities (Joshi *et al*., 2013). On-farm conservation involves farmers cultivating and managing diverse populations within agro-ecosystems. Nepal has over 14 organizations working on on-farm conservation across all 77 districts through direct, partnership, and joint presence. LI-BIRD and NARC are leading organizations in conserving and utilizing agro-biodiversity through on-farm conservation strategies. Approximately 30% of local crop diversity is being conserved through various on-farm strategies in the country. Effective on-farm conservation requires careful consideration of farming areas, farmers, and crop types. On-farm conservation focuses on non-commercial areas, particularly in remote farming communities and smallholder farmers. In areas with limited access to technology, on-farm conservation has proven effective. On-farm conservation efforts prioritize hotspot areas of agricultural biodiversity (Joshi & Upadhya, 2019). Although on-farm conservation benefits agricultural biodiversity, there is a lack of standardized monitoring mechanisms to assess its long-term sustainability. It is unclear to what extent climate change and socioeconomic shifts influence farmer conservation participation. Furthermore, the economic incentives for farmers to continue conservation practices must be investigated.

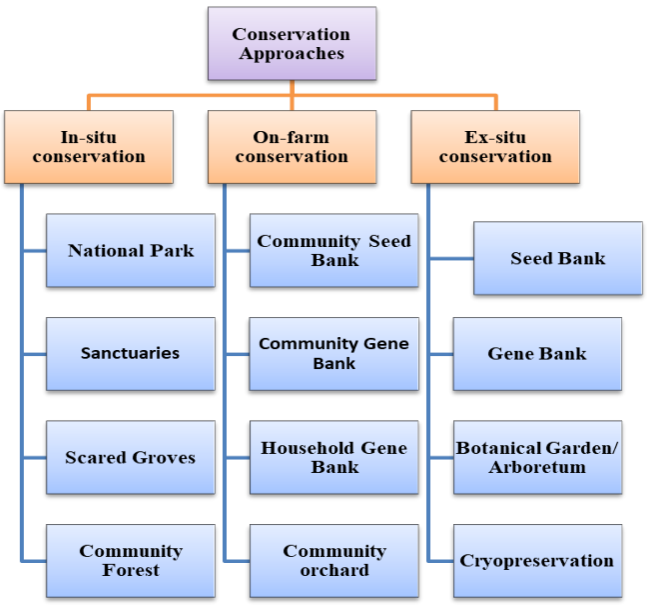

Figure 1. *Conservation approaches for neglected and underutilized fruits in Nepal.*

Table 1. Some neglected and underutilized fruits (N&U fruits) available in Nepal.

S. No.	Local name	Common name	Scientific name	Distribution
1.	Sariphaa, sitaaphal	Custard apple	*Annona squamosa* L.	Terai to Low-hills
2.	Kimbu	Mulberry black	*Morus alba*	Throughout Mid-hills
3.	Mayal	Wild pear	*Pyrus pashia*	Mid-hill region between 700- 2,000 masl
4.	Amla	Indian gooseberry	*Emblica officinalis* Gaertn.	Terai to Low-hills
5.	Jangali aaru	Peach	*Prunus prostrate* Labill. Hook. f.	Above 3000 m in Western region
6.	Bel	Wood apple or Bengal quince	*Aegle marmelos* (L.) Correa	Terai to Low-hills
7.	Bayar	Chinese date or Indian plum	*Zigyphus mauritiana* Lamk. *Z. incurve* Roxb. *Z. jujube*	Terai to Mid-hills
8.	Bhogate	Pummelo	*Citrus grandis* (L.) Osbeck	Low to Mid-hills
9.	Haluwabed	Persimmon	*Diospyros virginiana*	Terai to Mid-hills
10.	Jamun (Kalo)	Black plum	*Eugenia jambolana*	Terai to Low-hills
11.	Katush	Nepali Chestnut	*Castonopsis indica*	Throughout Mid-hills
12.	Khanayo	Ficus	*Ficus semicordata*	Low to Mid-hills
13.	Lapsi	Nepalese hog plum	*Choerospondias axillaris* (Roxb.)	Mid- to High-hills
14.	Rukh katahar	Jackfruit	*Artocarpus heterophyllus*	Terai to Low-hills
15.	Khurpani	Apricot	*Prunus armeniaca* L.	High-hills
16.	Kusum	Ceylon oak	*Schleichera oleosa* (Lour.) Merr.	Elevation ranging from 150-950m
17.	Imali	Tamarind	*Tamarindus indica* L.	Terai to Low-hills
18.	Chiuri	Butter tree	*Bassia butyracea* or *Aesandra butyracea* (Roxb.)	Mid-hills
19.	Chaksi	Sweet lime	*Citrus limettioides*	Mid-hills
20.	Bhalayo	Marking Nut tree	*Cotinus coggyria* Scop.	Terai to Low-hills
21.	Alubukhara	Plum	*Prunus salicina* Lindl.	Mid- to High-hills
22.	Kali Jyamir	Rough lemon	*Citrus junos* Tanaka	Eastern Mid-hills
23.	Bimiro	Citron	*Citrus medica*	Mid-hills
24.	Nemaro	Common fig	*Ficus carica* L.	Throughout Mid-hills
25.	Jangali naspati	Pear	*Pyrus serotina* Rehd.	Mid-hill region between 700- 2000 masl
26.	Nibuwa	Lemon	*Citrus limon* (L.) Burm. f.	Low to High-hills
27.	Jangali kera	Wild banana	*Musa acuminate* Colla	Terai region
28.	Dale chuk	Sea buckthorn	*Hippophae salicifolia* D. Don	High-hills of Mustang and Dolpa

Source: (Thapa *et al*., 2021).

In-situ conservation

It involves preserving ecosystems and natural habitats, as well as maintaining and recovering viable species populations in their natural environments (Joshi *et al*., 2017). Growing fruit trees in home gardens has been a tradition in Nepal for centuries. Fruits are typically grown in backyards or homestead gardens for specific uses. Local fruits can be found in public orchards in temple compounds, guthi (trust) land, and pilgrimage sites. Indigenous fruits such as amla, badahar, bel, kafal, katus (local chestnut), and lapsi are permitted to grow in public and community forests, riverbanks, and farmer's grasslands. It is grown in private home gardens, hedges, and upland fields for fodder, firewood, medicinal use, and timber. Wild fruit trees are protected in botanical gardens, national parks, community forests, and other protected areas (Aryal *et al*., 2009). While in-situ conservation is critical for biodiversity preservation, detailed ecological studies are required to determine the genetic diversity that exists in natural habitats. The effects of habitat fragmentation and land-use change on the survival of these species are largely unknown. Furthermore, the cultural and socioeconomic barriers to the expansion of in-situ conservation efforts should be investigated further.

Ex-situ conservation

It refers to maintaining fruit germplasms in the field due to the lack of alternative methods. Unethical use and lack of conservation are causing rapid genetic erosion of natural resources. NARC and farms under DOA are currently collecting and maintaining germplasms. Since 2016, NARC has maintained germplasms of APGRs, including underutilized and endangered fruit species, at each station and centre. Field gene banks can be used for future fruit breeding purposes (Thapa *et al*., 2021). Ex-situ conservation is often limited by funding constraints and the risk of genetic drift in stored germplasms. The viability and regeneration potential of stored seeds and plant material under long-term storage conditions require further research. Furthermore, there is a lack of integration of ex-situ and in-situ conservation strategies to ensure comprehensive biodiversity conservation.

The following plans, policies, and projects have been developed and implemented so far:

- The Horticulture Development Project (HDP), supported by the Japan International Cooperation Agency (JICA), began in 1985 with a project office at Kirtipur's Horticulture Centre. The project promoted pear, persimmon, and chestnut trees in Kathmandu, Bhaktapur, and Lalitpur, as well as sweet orange in Sindhuli and Ramechhap districts.
- The "One Village, One Product" campaign began in 2007 to promote fruits such as hog plum, wood apple, and kiwifruit.
- Agriculture Perspective Plan (1995-2015).
- National Agricultural Policy (2005).
- Agriculture Development Strategy (2015- 2035).
- Prime Minister Agriculture Modernization Project (2016-2026).
- Fruit Development Project (2017).
- Fruit Year (2018).
- Fruit Decade (2016/017-2025/2026) (Thapa *et al*., 2021).

Nepal's government is supporting fruit research and development through a variety of programs and projects funded by bilateral and multilateral donors. These programs/projects have contributed to the development of the fruit subsector by establishing farm stations, introducing germplasm, maintaining, characterizing, evaluating, and utilizing fruit. NARC is in charge of research, including horticulture, and the Department of Agriculture (DOA) is in charge of extension and development activities. The DOA and NARC operate numerous horticultural stations in Nepal's various agro-ecological regions for research and development purposes.

CONCLUSION

This study highlights the significant role of neglected and underutilized fruits (N&U fruits) in Nepal's agro-biodiversity, rural economy, and nutrition. These fruits, cultivated in various agro-ecological zones across the country, offer high potential for economic and nutritional improvement, particularly for rural and marginalized communities. The fruits, such as wood apple, tamarind, and amala, are rich in essential nutrients like vitamins, minerals, and bioactive compounds, contributing to better food security and health, especially in areas with limited access to conventional crops. Moreover, their ecological benefits, such as soil conservation and carbon sequestration, further strengthen their importance in sustainable farming practices. Future research should prioritize genetic characterization, policy integration, and sustainable commercialization strategies to maximize the potential of N&U fruits. Strengthening research initiatives, market linkages, and conservation efforts will be essential for ensuring the long-term sustainability of these fruit species and their contribution to Nepal's agricultural and economic development.

DECLARATIONS

Authors Contribution: Conceptualization and design: B.M.; Critical analysis and synthesis: B.M.; Writing and drafting: B.M.; Literature search and collection: B.M.; Editing and revising: B.M.

Conflicts of interest: The author declare that there are no conflicts of interest concerning the publication.

Ethics approval: This study did not include any animal or human participants, so ethical approval was not required.

Consent for publication: The author provided their consent to publish.

Data availability: Data will be made available on request.

Supplementary data: Not available.

Funding statement: There was no specific funding for this research from the public, commercial, or non-profit sectors. We are aware of no conflicts of interest related to this publication, and there has been no significant financial assistance for this work that could have influenced the results.

Additional information: No additional information is available for this paper.

REFERENCES

Adhikari, L., Hussain, A., & Rasul, G. (2017). Tapping the Potential of Neglected and Underutilized Food Crops for Sustainable Nutrition Security in the Mountains of Pakistan and Nepal. *Sustainability*, *9*(2), 291. https://doi.org/10.3390/su9020291

Aryal, K., Berg, Å., & Ogle, B. (2009). Uncultivated plants and livelihood support –a case study from the Chepang people of Nepal. *Ethnobotany Research and Applications*, *7*, 409. https://doi.org/10.17348/era.7.0.409-422

Atreya, P., & Manandhar, R. (2016). Fruit crop development in Nepal: Achievements and future strategy. Conference: Proceeding of the First International Horticulture Conference at: Kathmandu, Nepal. https://www.researchgate.net/publication/326543525

Atreya, P. N., & Kaphle, M. (2020). Visible evidence of climate change and its impact on fruit production in Nepal. *International Journal of Agriculture Environment and Food Sciences*, *4*(2), 200–208. https://doi.org/10.31015/jaefs.2020.2.10

Atreya, P., & Shrestha, J. (2020). Biodiversity of neglected and underutilized fruits of Nepal. *Fundamental and Applied Agriculture*, *0*, 1. https://doi.org/10.5455/faa.122860

Chivenge, P., Mabhaudhi, T., Modi, A., & Mafongoya, P. (2015). The Potential Role of Neglected and Underutilised Crop Species as Future Crops under Water Scarce Conditions in Sub-Saharan Africa. *International Journal of Environmental Research and Public Health*, *12*(6), 5685–5711. https://doi.org/10.3390/ijerph120605685

CoAFE. (2020). Ecological importance of fruits. Department of horticulture. College of Agriculture, Food and Environment (CoAFE). University of Kentucky, Lexington.

Dangol, D. R. (2002). Economic uses of forest plant resources in western Chitwan, Nepal. *Department of Forest Research and Survey (DFRS)*. https://www.researchgate.net/publication/232248522

Dansi, A., Vodouhè, R., Azokpota, P., Yedomonhan, H., Assogba, P., Adjatin, A., Loko, Y. L., Dossou-Aminon, I., & Akpagana, K. (2012). Diversity of the Neglected and Underutilized Crop Species of Importance in Benin. *The Scientific World Journal*, *2012*, 1–19. https://doi.org/10.1100/2012/932947

Deepika, Kumari, A., Kapoor, A., Saini, S., Saxena, S., & Sarita. (2024). Traditional underutilized fruits of Himalaya: A review. *Food and Humanity*, *2*, 100269. https://doi.org/10.1016/j.foohum.2024.100269

Gopalan, M., Ramashastri, B., Balasubramanian, S., & Rao, N. (2009). Nutritive value of Indian food. *National Institute of Nutrition, Indian Council of Medical Research.*

Gotame, T., & Poudyal, K. (2014). Status of fruit and nut genetic resource in Nepal; Indiginious and exotic varietal Inventory. Horticulture Research Division, Nepal Agricultural Research Council, Khumaltar, Lalitpur. https://www.researchgate.net/publication/295253665

Hunter, D., Borelli, T., Beltrame, D. M. O., Oliveira, C. N. S., Coradin, L., Wasike, V. W., Wasilwa, L., Mwai, J., Manjella, A., Samarasinghe, G. W. L., Madhujith, T., Nadeeshani, H. V. H., Tan, A., Ay, S. T., Güzelsoy, N., Lauridsen, N., Gee, E., & Tartanac, F. (2019). The potential of neglected and underutilized species for improving diets and nutrition. *Planta*, *250*(3), 709–729. https://doi.org/10.1007/s00425-019-03169-4

Jarvis, A., Upadhyaya, H., & Agrawal, P. (2008). Climate change and its effect on conservation and use of plant genetic resources for food and agriculture and associated biodiversity for food security. Thematic Background Study Rome, Italy: *Food and Agriculture Organisation of the United Nations (FAO)*. https://hdl.handle.net/10568/33384

Joshi, B., Ghimire, K., & Yadav, N. (2013). Agricultural plant genetic resources management and agriculture in Nepal. AFACI 1st International Training Workshop on Germplasm Management System (GMS) in Asia, 20-29 May 2013, Suwon, Korea. https://giwmscdnone.gov.np/media/app/public/75/posts/1685075589_65.pdf

Joshi, B. K., Acharya, A. K., Gauchan, D., & Bhatta, M. (2017). Agro-biodiversity status and conservation options and methods. Conservation and Utilization of Agricultural Plant Genetic Resources in Nepal. Proceedings of 2nd National Workshop, 22-23 May 2017, Dhulikhel; NAGRC, FDD, DoA and MoAD; Kathmandu, Nepal. https://www.researchgate.net/publication/321670533

Joshi, B. K., & Gauchan, D. (2022). Agrobiodiversity, and Neglected and Underutilized Species for Food, Nutrition, Livelihood, and Environmental Security in Nepal. Sustainable Development Goals Series. https://link.springer.com/chapter/10.1007/978-3-031-09555-9_7

Joshi, B. K., & Upadhya, D. (2019). On-farm Conservation Approaches for Agricultural Biodiversity in Nepal. *Journal of Agriculture and Natural Resources*, *2*(1), 14–35. https://doi.org/10.3126/janr.v2i1.26012

Joshi, T., Mainali, R. P., Bhandari, S., Acharya, P., & Ghimire, K. H. (2023). Neglected and Underutilized Crop Species of Nepal: Smart Foods for Uncertain Future. *Journal of Agriculture and Environment*, 187–196. https://doi.org/10.3126/aej.v24i01.58189

Kaini, B. R., Shrestha, G. P., & Manandhar, R. (2016). Horticulture in Nepal; Journey in the last six decades. In: Six decades of horticulture development in Nepal. Nepal Horticulture Society, Lalitpur, Nepal.

Mabhaudhi, T., Chimonyo, V. G. P., Hlahla, S., Massawe, F., Mayes, S., Nhamo, L., & Modi, A. T. (2019). Prospects of orphan crops in climate change. *Planta*, *250* (3), 695–708. https://doi.org/10.1007/s00425-019-03129-y

Maier, C. (2020). How do fruit trees help the environment?

Nandan, U., & Bhardwaj, R. (2015). Medicinal, nutritional and economic security of tribals from underutilized fruits in Aravali region of district Sirohi, Rajasthan. *Indian Journal of Traditional Knowledge*.

Painter, T. (2020). Trees with the best nectar and pollen for honeybees.

Paudyal, A., & Regmi, B. (2009). Climate Change and Agrobiodiversity in Nepal: Opportunities to include agrobiodiversity maintenance to support Nepal's National Adaptation Programme of Action (NAPA). *FAO and Bioversity International*. https://doi.org/10.13140/RG.2.2.21722.13765

Pradhan, S. B. N., Shrestha, P. P., & Thapa, P. K. (2016). Horticulture in Nepal: Journey in the last six decades. Nepal Horticulture Society, Lalitpur, Nepal. Six Decades of Horticulture Development in Nepal (Silver Jubilee Special), 36-53. https://horticulturenepal.org/chapter/horticulture-in-nepal-journey-in-the-last-six-decades

Regmi, H., & Shrestha, D. (2005). Horticulture Science (A Competition Guide). Horticulture Research Division, Nepal Agriculture Research Council. https://opac.narc.gov.np/opac_css/index.php?lvl=notice_display&id=2063

Shava, S. (2005). Research on indigenous knowledge and its application: A case of wild food plants of Zimbabwe. *Southern African Journal of Environmental Education*, *22(1):73-86*.

Shrestha, J., Shrestha, R., Joshi Bal, K., & Subedi, S. (2020). Future Smart Food Crops In Nepal: A Necessity For Future Food And Nutritional Security. *Natural Resources and Sustainable Development*, *10*(1), 46–56. https://doi.org/10.31924/nrsd.v10i1.043

Shrestha, R., Dawadi, P., Bhusal, S., & Bhatt, L. R. (2021). Nutritional value and antioxidant properties of Diospyros malabarica (Desr.) Kostel., fruit from midhills of western Nepal. *Nepal Journal of Science and Technology*, *20*(1), 113–125. https://doi.org/10.3126/njst.v20i1.43361

Thapa, M., Gotame, T., & Dhimal, S. (2021). Distribution of Underutilized Fruit in Nepal: Strategies for Conservation and Utilization. Nepal Horticuture Society. Proceeding Of 12th National Horticulture Seminar 2021.

Thies, E. (2000). Promising Underutilized Species: Crops and Breeds. *GTZ*.

Tripathi, P. C. (2023). Conservation and Use of Plant Genetic Resources of Underutilized Fruits. In P. E. Rajasekharan & V. R. Rao (Eds.), *Fruit and Nut Crops* (pp. 1–9). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-1586-6_22-1