



# Livelihood & Climate Change Implication of *In-situ* Conservation Strategies for *Punica granatum* and *Syzygium cumini* in Sunni Tehsil, Shimla H. P. India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Sustainably harvesting and selling wild fruits can offer rural communities an economical source of income while concurrently safeguarding ecosystems. This study aims for the global promotion of wild edible fruits (WEFs) in the rural areas of Sunni Nagar Panchayat, located in the Shimla district of Himachal Pradesh. This study primarily focuses on comprehensively documenting the utilization of wild edible fruits by local inhabitants through a structured survey and in-depth interviews. Employing a multistage random sampling technique, five villages—Ambari, Kadog, Kamla dugri, Kalwi, and Basantpur—were chosen based on the prevalence of *Punica granatum* and *Syzygium cumini*. This research underscores the economic advantages of collecting WEFs for rural communities, providing them with affordable and easily accessible food sources. Additionally, it

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promotes public awareness, community-based management, and research on indigenous fruits to diversify diets and contribute to the overall well-being of these communities.

Pomegranate and Jamun (local names referring to the botanical species of *Punica granatum* and *Syzygium cumini*, respectively) trees play crucial roles in ecological conservation by offering habitat, shelter, and promoting biodiversity, while also combating soil erosion. However, escalating threats such as population growth, forest fires, urbanization, and timber extraction endanger this rich biodiversity. To counter plant extinction risks, a strategic approach to forest conservation is imperative, emphasizing sustainable collection and trade of underutilized species beneficial for food, medicine, and income. Climate change poses challenges to pomegranate production, impacting orchards with temperature fluctuations, altered precipitation, extreme weather, and pests. Adaptation measures, including irrigation, pest management, and diversification, are crucial. Preserving wild pomegranate and Jamun demands habitat protection, restoration, and sustainable agriculture through agroforestry research, community engagement, and supportive policies. Integrating traditional knowledge with modern conservation ensures a comprehensive approach, actively preserving genetic diversity, ecological balance, and cultural relevance through multi-dimensional conservation efforts for Pomegranate and Jamun.

**Keywords:** *Climate change; livelihood; Punica granatum; Syzygium cumini; wild edible fruits; conservation.*

## 1. INTRODUCTION

Wild edible fruit plants (WEFs) refer to fruit plants growing in their natural habitat [1]. The wild edibles of many plant species have served as nutritional supplement and medicine for thousands of years, particularly in the tribal and rural areas of the Himalayas. Wild edible fruits (WEFs) refer to edible fruit species which are not cultivated but are collected from their natural habitats. WEFs are mainly consumed during off-season periods of cultivated fruits and vegetables, predominated by food shortage. Local communities are known to possess extensive knowledge about the use of local plants as food and for other purposes [2]. In recent times, these WEFs have been threatened by overexploitation, land-use changes, and biodiversity loss.

Historically, edible wild fruits played a crucial role in supplementing people's diets, although reliance on them has diminished with the introduction of exotic fruits. However, in tribal areas, these fruits still serve as supplements to basic food needs, some being preserved for dry periods or sold in rural markets. Despite a recent decrease in popularity, wild fruits offer various advantages, including potential medicinal properties, and find use in treating ailments. Wild Edible Fruits (WEFs) have diverse applications, such as in cosmetics, crafts, fiber, and fuel. Nutrition and pharmaceutical literature extensively recognizes WEFs as rich sources of antioxidants, minerals, and vitamins. Adhering to the definition of fruit as any part of the reproductive structure of angiosperms, any

undomesticated product from wild or managed landscapes is considered wild. These fruits, with nutritional value providing essential minerals, are resilient to diseases and frequently incorporated into different formulations of 'Ayurveda' in Indian Folk-medicine.

By recognizing the economic value of wild edible fruits and developing sustainable practices for their utilization, these fruits can contribute to rural development, poverty alleviation, and preservation of traditional knowledge and ecosystems. These wild fruits are conserved through in situ conservations. In situ conservation means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. The main purpose of in-situ conservation is to enable biodiversity conservation within the same ecosystem it belongs to. In-situ management approaches can either be targeted at populations of selected species (species-centered) or whole ecosystems (ecosystem-based).

The wild edible fruit species documented in India from the Himalayas are more than 675 species. 118 species from Arunachal Pradesh, 12 species from Uttara Kannada district of Karnataka. 150 species from Orissa, 132 species from Assam and 80 species from Chhattisgarh [3]. India is blessed with a wide variety of wild edible fruits that grow across different regions of the country. Here are some of the popular wild edible

fruits found in India: Jamun (*Syzygium cumini*), Amla (*Phyllanthus emblica*), Ber (*Ziziphus mauritiana*), Bael (*Aegle marmelos*), Karonda (*Carissa carandas*), Wood Apple (*Limonia acidissima*), Phalsa (*Grewia asiatica*), Mulberry (*Morus spp.*), Mahua (*Madhuca longifolia*), and Ceylon Olive (*Elaeocarpus serratus*).

*Syzygium cumini* L., (syn. *Eugenia jambolana*, *Eugenia cumini* and *Syzygium jambolana*) a polyembryonic species (family Myrtaceae), is a tropical fruit tree of great economic importance. The fruit is commonly known as Jamun (Hindi), Java plum, jambul and Indian blackberry. Jamun (*Syzygium cumini*) is the medicinally important indigenous fruit tree of India belongs to the family, Myrtaceae. The Jamun fruit is small and round, similar in size to a plum, with a purplish-black skin and a sweet and tangy flavor. It is rich in nutrients and is considered to have various health benefits. The fruit is typically consumed fresh, and it is also used in the preparation of jams, jellies, juices, and desserts [4-9].

Apart from its culinary uses, Jamun is also valued in traditional Ayurvedic medicine for its medicinal properties. Different parts of the Jamun tree, such as the bark, leaves, and seeds, are used in various herbal remedies for conditions like diabetes, digestive disorders, respiratory ailments, and more [10-13]. The fruit is available during the summer season in India, and it is enjoyed by people of all ages. It is often eaten as a refreshing snack, and its juice is popular as well. Jamun is also an important ingredient in traditional Indian cuisine and is used in dishes like pickles, chutneys, and desserts [14,15].

The Jamun tree, a large evergreen native to the Indian subcontinent, stands 25-30 meters tall with oblong, opposite leaves emitting a turpentine smell. Widely distributed in India, Sri Lanka, Malaysia, and Australia, it is cultivated for its edible fruits. Introduced to southern Africa, it blooms annually in March-April, yielding fruits in June-July. Flowering occurs on branches aged 5-12 months [16-19]. Despite only 15-30% of fruits reaching maturity, the tree is versatile, with almost all parts serving various purposes. In Himachal Pradesh, wild Jamun is prevalent in pockets across districts like Bilaspur, Hamirpur, Una, Kangra, Mandi, Shimla, and Sirmour. The ripe fruits are juicy, nearly odorless, with a pleasantly slightly bitter, astringent taste [20].

Wild pomegranate (*Punica granatum* L.), native to Central Asia and belonging to the Punicaceae family, thrives in the forests from northern India

to Iran. In India, it's found in the outer Himalayan region, particularly in Himachal Pradesh, Jammu and Kashmir, and Uttarakhand. Acknowledging its nutritional value, the industrialization of wild pomegranate is crucial for cost-effective bio-active components [21-30]. This unique fruit, rich in anthocyanins and flavonoids, not only offers antioxidant benefits but also exhibits diverse colors. Some varieties in the foothills of Himachal Pradesh are suitable for anardana production. Distributed across districts like Solan, Sirmour, Mandi, Shimla, Kullu, and Chamba in Himachal Pradesh, the wild pomegranate is the sole commercial fruit crop in the mid hills of the Himalayas (Bhrot, 1998). This research aims to harness local wisdom for economic development, exploring trade dynamics and assessing the impact of on-farm conservation interventions on farmer livelihoods and biodiversity, promoting sustainable agriculture.

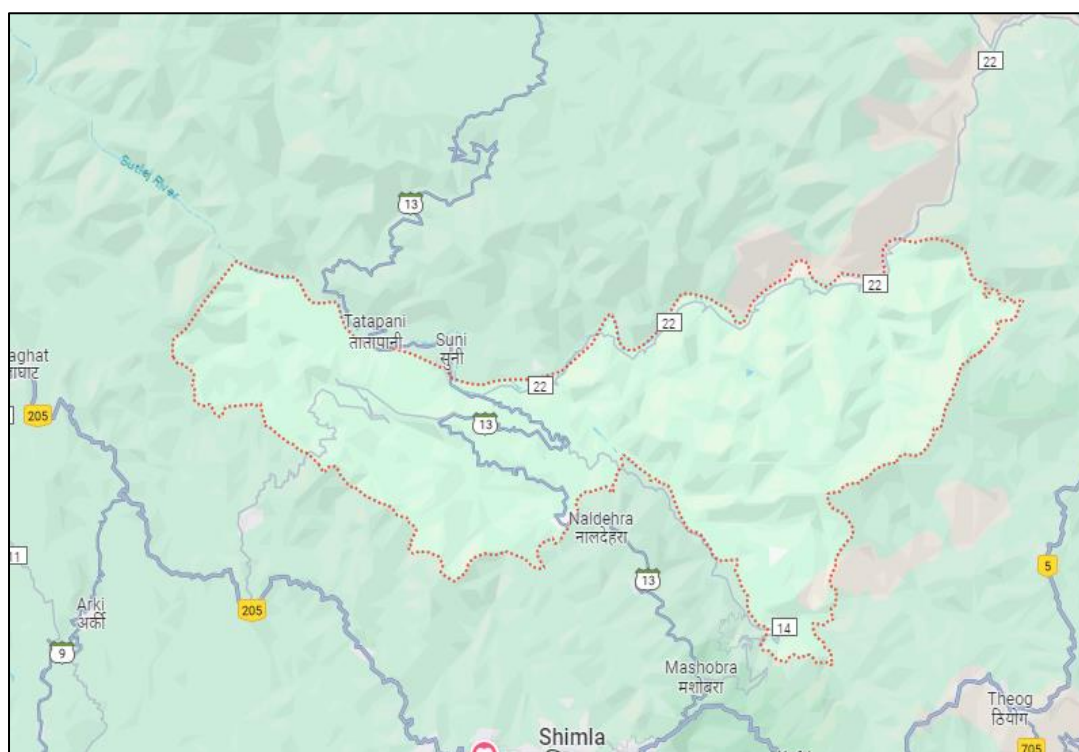
## 2. MATERIALS & METHODS

### 2.1 Study Area

Himachal Pradesh, situated in the Western Himalayas, is a state in the northern part of India. It is known for its stunning landscapes, snow-covered mountains, and rich cultural heritage. The state shares borders with the union territories of Jammu and Kashmir and Ladakh to the north, and the states of Punjab to the west and Haryana to the southwest. Himachal Pradesh became a state of India on January 25, 1971.

Shimla district is situated in the northwestern Himalayan Agro climatic region of Himachal Pradesh. It is located in the southern part of Himachal Pradesh at an altitude of 2206 meters above mean sea level. The district is surrounded by Kullu and Kinnaur districts to the northeast, Sirmour and Dehradun districts of Uttarakhand to the southeast and west, and Solan and Mandi districts to the northwest. Shimla is positioned at the last traverse spur of the Central Himalayas, south of the Sutlej River.

Sunni is a town, Nagar panchayat, and Tehsil located in Shimla district, Himachal Pradesh, India. It was formerly the capital of the Bhajji princely state, which was one of the states under the Punjab States Agency. The town is situated at coordinates 31.24°N and 77.12°E, with an average elevation of 670 meters (2198 feet). Fig. 1 depicts a geographical map outlining the Sunni area. The visual aids in understanding the spatial distribution and layout of the Sunni region.



**Fig. 1. Map of Sunni area**  
(Source:www.himachaltourism.com)

## 2.2 Data Collection

The primary aim of the study is to collect, identify and document the wild edible fruits used by the local inhabitants. Local knowledge was gathered through a structured survey and in-depth interviews. The data for this study were collected using multistage random sampling technique. Use a random sampling method to select participants from the population. One way to achieve this is by assigning each member of the population a unique number and using a random number generator or a random selection method to choose participants. Five villages, namely Ambari, Kadog, Kamla dugri, Kalwi and Basantpur were selected on the basis of area under *Punica granatum* and *Sygzium cumini*. 20 farmers from each village were selected randomly forming a sample of a hundred farmers with varying basic socio-demographic factors such as age, age group, education, and marital status. The interviews were conducted face to face and lasted between 20 and 30 minutes, involving a total of 402 respondents. A semi-structured questionnaire, encompassing vernacular names, uses, parts used, and economic value, was employed for data collection.. Farmers' names and income sources were also included. The questionnaires are

designed to meet the objectives of the study, tested in the field and standardized for the purpose. The secondary data was collected from research journals and various records and project reports of the forest department and Panchayat ghar.

The forest region of Basantpur Panchayat is situated in a sub-tropical zone, characterized by the presence of dry deciduous forests and lower moist broad-leaved forests. These forests harbor a diverse range of deciduous tree species, including: Maple (*Acer spp* Horse Chestnut (*Aesculus indica*): Sal (*Shorea robusta*): Bihul (*Grewia optiva*): Kachnar (*Bauhinia variegata*): These deciduous tree species contribute to the ecological diversity, provide habitats for various wildlife, and support the overall health and functioning of the forest ecosystem in the Basantpur region.

## 3. RESULTS & DISCUSSION

Pomegranate cultivation in the study area is sustainable with minimal water and pesticides. Encouraging eco-friendly practices can enhance sustainability and foster economic growth. Anardana offers promising income opportunities through cultivation, processing, and

marketing. This can lead to economic development, agricultural diversification, and improved nutrition, contributing to a sustainable industry.

Jamun cultivation requires suitable conditions and proper processing techniques for income generation. Investing in Jamun brings various benefits, including resilience in diverse climates, contributing to overall sustainability.

The demographic structure of selected villages of Basantpur Panchayat (Ambari, Kadog, Kamla dugri, kalwai and Basantpur) is presented below. The data represents that total population is 1579 out of which 783 are males and 796 are females. Number of females is more than males. The total number of families are 402 (73 families in Ambari,76 in Kadog, 26 in Kamla digri,26 in Kalwi and 201 families in Basantpur).

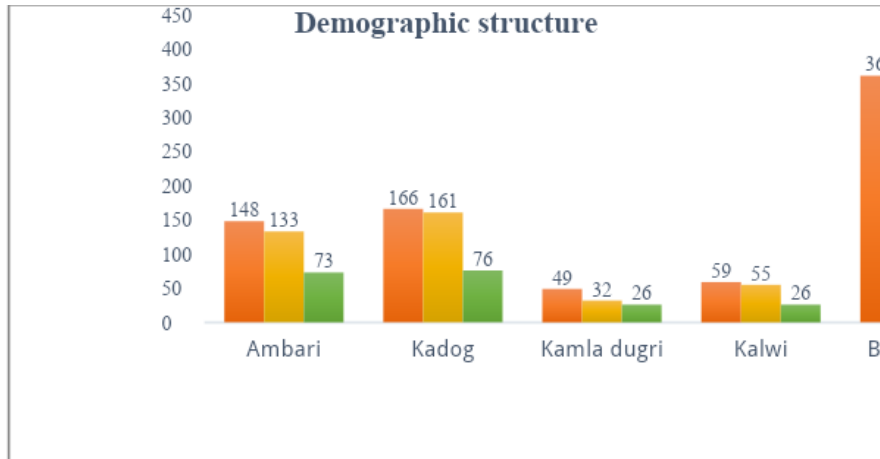


Fig. 2. Demographic structure of studied villages

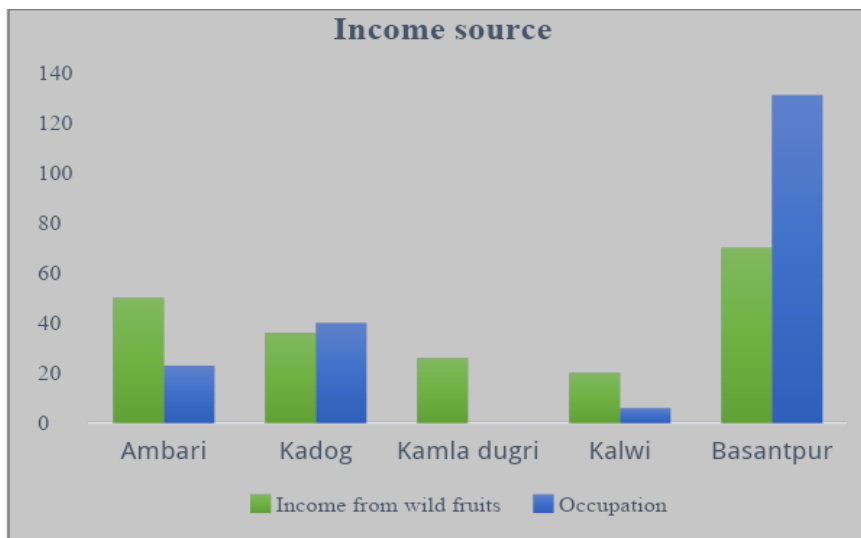


Fig. 3. Showing the income source of the villagers

Table 1. Income status and occupation of villagers of studies area

Village	Income from wild fruits	occupation	Total families
Ambari	50	23	73
Kadog	36	40	76
Kamla dugri	26	0	26
Kalwi	20	6	26
Basantpur	70	131	201

Wild fruit income is crucial for sustaining livelihoods in various villages. In Ambari, 50 out of 73 families rely on wild fruit sales, while Kadog has 36 families dependent on this income source out of 76 households. Kamla Dugri stands out, with all 26 families solely dependent on wild fruit sales. Kalwi has 20 families engaged in wild fruit sales out of 26, and in Basantpur, 70 out of 201 families depend on wild fruits.

In Basantpur Panchayat, around 75% of villagers rely on anardana, and 15% on Jamun. Kamla Dugri exclusively depends on anardana due to its ideal land area, providing favorable conditions for high-quality *Punica* cultivation. Despite having fewer families, Kamla Dugri specializes in anardana cultivation, recognizing its economic potential and advantages.

In Ambari, families typically have 8 to 10 *Punica* trees, totaling around 500 trees. Kadog averages 20 to 30 trees per family, with about 450 trees. Kamla Dugri has 20 to 35 trees per family, totaling around 600 trees. Kalwi sees 10 to 15 trees per family, totaling about 300 trees, and Basantpur averages 20 to 25 trees per family, with about 700 trees.

The highest average number of *Punica* trees is in Basantpur Village (700), while Kamla Dugri stands out with a range of 20 to 35 trees per family, suggesting larger family-owned orchards (600 trees). About 95% of *Punica* trees are on villagers' farms, emphasizing active community engagement in cultivation. Around 5% are in forest areas, contributing to local ecological diversity. Harvesting typically occurs from August to October, aligning with ripe fruit availability.

The average sale price of Anardana, also known as Pomegranate seeds, can vary in different villages, typically ranging from 300 to 800 rupees per kilogram. These rates represent the value at which Anardana is sold or traded within each village. However, it is important to note that the actual rates may fluctuate due to various factors such as supply, demand, quality, and local market conditions.

In the village of Kamla Dugri, Anardana is sold at a higher rate of 700 to 800 rupees per kilogram. The reason for this higher price is attributed to the superior quality of Anardana produced in this particular village compared to other selected villages. The superior quality may be a result of favorable growing conditions, cultivation

techniques, or other factors that contribute to the overall quality of the pomegranate seeds.

On the other hand, the rates of Jamun, or Black Plum, remain relatively consistent across the selected villages, ranging from 100 to 120 rupees per kilogram. This suggests that the market for Jamun is relatively stable, with little variation in prices observed between different villages. Factors such as supply and demand, as well as the quality of the fruit, may influence the pricing of Jamun in these areas.

In the Ramban district and its surrounding areas, *Punica granatum*, or Pomegranate, is not only sold in international markets but also purchased by local commission agents who work for traders in Jammu, Amritsar, or Delhi. The Pomegranates are then sold in local markets for prices ranging between 300 and 400 rupees per kilogram [31]. This highlights the importance of the Pomegranate trade in this region, with both local and international markets being targeted for sales.

Additionally, some farmers from the neighboring areas bring their produce to the Ramban market, where it is auctioned off in public. This allows farmers to access a wider market and potentially secure better prices for their Pomegranates. The auction system provides a platform for buyers to competitively bid on the produce, which can influence the final selling price.

In the Basantpur Panchayat, farmers have the advantage of selling their Anardana at nearby markets without incurring additional costs for labor or transportation. This benefits the farmers, as they can sell their produce at a competitive price, without the added expenses associated with transportation to distant markets.

In Basantpur Panchayat villages, Jamun trees' average numbers range from 2 to 8, with Basantpur having the highest count, emphasizing the fruit's economic and cultural significance in the community. Handling the fruit requires care due to factors affecting its market value. The adaptability and hardiness of Jamun trees make them favorable for local farmers. Economic importance is evident in household consumption and trade at nearby markets, contributing to community livelihoods.

Local communities provided valuable insights into enhancing wild edible fruit (WEF) production. They emphasized the need for government

intervention to increase the market value of WEF, addressing the financial challenges faced by growers. The locals also highlighted a lack of awareness regarding the nutritional and health benefits of these fruits. They suggested conducting more research and raising awareness to encourage greater cultivation. Addressing these concerns could contribute significantly to boosting WEF production and fostering conservation efforts.

#### 4. CONCLUSION

This research sheds light on the vital role played by wild edible fruits, specifically *Punica granatum* (Pomegranate) and *Syzygium cumini* (Jamun), in the rural communities of Sunni Tehsil, Shimla, Himachal Pradesh, India. The study emphasizes the economic significance of wild fruit harvesting for rural livelihoods, offering an affordable and easily accessible source of income for communities in the region. Pomegranate and Jamun trees are not only essential for economic prosperity but also contribute significantly to ecological conservation by providing habitat, shelter, and promoting biodiversity. However, the rich biodiversity supported by these trees faces threats such as population growth, forest fires, urbanization, and timber extraction. To counteract these challenges and ensure sustainable practices, a strategic approach to forest conservation is imperative, emphasizing the sustainable collection and trade of these underutilized species. Climate change poses additional challenges to pomegranate production, impacting orchards with temperature fluctuations, altered precipitation, extreme weather, and pests. Adaptation measures, including irrigation, pest management, and diversification, are identified as crucial for the preservation of these economically valuable fruit crops. In the context of the demographic structure of the studied villages, the research highlights the dependence of a significant portion of the population on the income generated from wild fruits, particularly Anardana (Pomegranate seeds) and Jamun. The economic impact extends beyond individual families, contributing to the overall well-being of the community. The study also reveals the importance of in-situ conservation strategies for preserving the genetic diversity, ecological balance, and cultural relevance of *Punica granatum* and *Syzygium cumini*. Engaging local communities through agroforestry, economic incentives, and educational programs fosters a sense of ownership and responsibility, contributing to sustainable conservation

practices. Furthermore, the economic dynamics of Anardana and Jamun sales in local and international markets are explored, emphasizing the potential for economic growth and market competitiveness for farmers in the Basantpur Panchayat region. The research underscores the significance of preserving traditional knowledge and integrating it with modern conservation practices for a comprehensive and effective approach. Overall, this study advocates for the global promotion of wild edible fruits, encouraging public awareness, community-based management, and research on indigenous fruits. By recognizing the economic, ecological, and cultural value of *Punica granatum* and *Syzygium cumini*, this research contributes to the development of sustainable agriculture, economic diversification, and the overall well-being of rural communities in the region.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Shava S. Research on indigenous knowledge and its application: A case of wild food plants in Zimbabwe. Southern Afr. J. Environ. Educ. 2005;22:73-86.
2. Sundriyal M, Sundriyal RC, Sharma E, Purohit AN. Wild edibles and other useful plants of Sikkim Himalayas, India. Oecologia Montana. 1998;7:43-54.
3. Neha CP, Abdussalam AK. diversity of underutilized wild edible fruits of kannur district, kerala, India. International Journal of Current Pharmaceutical Research. 2020;12(5):99-101.
4. Dhandar DG, Singh DB. Current status and future needs for the development of pomegranate. In: Programme and discussion papers, National Horticulture Conference, New Delhi. 2002;12.
5. Farooq S, Azam F. Food Security in the New Millennium. I: The Role of Agricultural Biodiversity. Pakistan Journal of Biological Sciences. 2002;5:1345-1351.
6. Jan Arnold, Stefan Minner. Financial and operational instruments for commodity procurement in quantity competition, International Journal of Production Economics. 2011;131(1):96-106.
7. Johnson AH, Frizano J, Vann DR. Biogeochemical implications of labile phosphorus in forest soils determined by

- the Hedley fractionation procedure. *Oecologia*. 2003;135:487–499
8. Kala, CP. Local preferences of ethnobotanical species in the Indian Himalaya: Implications for Environmental Conservation. *Current Science*. 2007;93:1828-1834.
  9. Khruomo N, Deb CR. Indigenous Wild edible fruits: Sustainable resources for food, medicine and income generation - A study from Nagaland, India. *Journal of Experimental Biology and Agricultural Sciences*. 2018;6(2):405-413.
  10. Adebooye OC, Phillips OT. Studies on seed characteristics and chemical composition of three Morphotypes of *Mucuna pruriens* (L.) *Medikus Fabacea*. *Food Chemistry*. 2006;95:658-663.
  11. Andersen TG, Bollerslev T, Diebold FX, et al. Modeling and Forecasting Realized Volatility. *Econometrica*. 2003;71:579-625.
  12. Anshu Sharma, Thakur NS. Influence of active packaging on quality attributes of dried wild pomegranate (*Punica granatum* L.) arils during storage. *Journal of Applied and Natural Science*. 2016;8(1):398-404.
  13. Asfaw Z, Tadesse M. Prospect for sustainable use and development of wild food plants in Ethiopia. *Economic Botany*. 2001;55:47-62.
  14. Beluhan S, Ranogajec A. Chemical composition and non-volatile components of Crotil wild edible mushrooms. *Food Chem*. 2010;124:1076–82.
  15. Chellaiah Muthu, Muniappan Ayyanar, Nagappan Raja, Savarimuthu Ignacimuthu J. Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India, *Ethnobiol Ethnomed*. 2006;2:43.
  16. Leakey RRB, Tchoundjeu Z, Schreckenber K, Shackleton ES, Shackleton CM. Agroforestry tree products:targeting poverty reduction and enhanced livelihood. *Int J Agric Sustain*. 2005;3:1–23.
  17. Leonti M, Nebel S, Rivera D, Heinrich M. Wild gathered food plants in the European Mediterranean: A Comparative Analysis. *Economic Botany*. 2006;60(2):130–142.
  18. Mabaya E, Jackson J, Ruethling G, Carter CM, Castle J. Wild fruits of Africa: Commercializing natural products to improve rural livelihoods in southern Africa. *Int Food Agribus Man*. 2014;17:69-74.
  19. Maikhuri RK, Rao Krishna KS, Saxena KG. Management conflicts in the Nanda Devi Biosphere Reserve, India, *Mountain Research and Development*. 2004;24(2).
  20. Misra RS, Bajpai PN. Studies on floral biology of Jamun (Java Plum) [*Syzygium cuminii* (L) Skeels]. *Indian J. Hort*. 1975;32(1&2):15-24.
  21. Morton J. *Fruits of Warm Climates*. J.F. Morton, Miami, Chapter Mango *Mangifera indica* L; 1987.
  22. Mwema CM, Mutai BK, Lagat JK, Kibet LK, Maina MC. Contribution of selected indigenous fruits on household income and food security in Mwingi, Kenya. *Curr Res J Soc Sci*. 2012;4(6):425-430.
  23. Rawat YS, Vishvakarma, SCR. Pattern of fodder utilization in relation to sustainability under indigenous agroforestry systems, North-Western Himalaya, India. *Environ. We Int. J. Sci. Tech*. 2011;6:1-13.
  24. Reddy S, Pattanaik C, Mohapatra A, Biswal AK. Phytosociological observations on tree diversity of tropical forest of Similipal Biosphere Reserve, Orissa, India C. *Taiwania*. 2007;52(4):352-359.
  25. Samant SS, Dhar U. Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. *International Journal of Sustainable Development and World Ecology*. 1997;4:179-191.
  26. Singh DB, Singh RS. Diversity of wild pomegranate in Himanchal Pradesh. *Progressive Horticulture*. 2006;38(1):49–52.
  27. Somnasang P, Moreno-Black G. Knowing, gathering and eating: Knowledge and attribute about wild food in an Asian village in North-eastern Thailand. *Journal of Ethnobiology*. 2000;20:197.
  28. Thakur NS, Dhaygude GS, Gupta A. Physico-chemical characteristics of wild pomegranate fruits in different location of Himachal Pradesh. *International Journal of Farm Sciences*. 2011;1(2):37-44.
  29. Thrupp, LA. Linking agricultural biodiversity and food security: The valuable role of agrobiodiversity for sustainable agriculture. *International Affairs*. 2000;76:265-281.
  30. Tilman D, Palosky S, Lehman C. Diversity, productivity and temporal stability in the economies of humans nature. *J Environ Econ Manag*. 2005;49:405–426.



31. Shah Murtaza, sajad Gangoo. Anardana (dehydrated wild pomegranate arils) as livelihood option for rural communities in Chenab valley of Jammu and Kashmir, Indian Journal of Horticulture. 2017;74(2): 306.

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