Original Research Article

Livelihood&Climate Changeimplication of*in situ* conservation strategies for*Punica granantum* and *Syzygiumcumim* in Sunni tehsil, Shimla H.P. India

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 *Syzygiumcumini*. This research underscores the economic advantages of collecting WEFs for rural communities, providing them with affordable and easily accessible food sources. Additionally, it 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 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 counteract 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 granantum, Syzygiumcumim*

1.INTRODUCTION

Wild edible fruit plants (WEFs) refer to fruit plants growing in their natural habitat (Shava 2005). 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. Wild plants form an important part of the human diet; almost 75,000 plant species are known to be edible (Diamond,2002; Leonti *et al*.,2006). These plants are generally grown in different habitats such as forests, cultivable fields, and even anthropogenically disturbed areas such as roadsides and wastelands (Beluhan& Ranogajec, 2010). WEFs have played a significant role in the livelihoods of rural communities in developing countries (Mwema *et al*., 2012; Mabaya, *et al*., 2014; Khruomo& Deb., 2018) due to their nutritional and medicinal value. Local communities are known to possess extensive knowledge about the use of local plants as food and for other purposes (Sundriyal *et al*., 1998). Local people should enjoy continuous access to their natural habitats so that they maintain and improve their knowledge of the collection and preparation of food from wild edible plant resources (Somnasang&MorenoBlack, 2000). In recent times, these WEFs have been threatened by overexploitation, land-use changes, and biodiversity loss.

From the past, edible wild fruits have played a very vital part in supplementing the diet of the people. The dependence on these fruits has gradually declined as more exotic fruits have been introduced. But many people in tribal areas still use them as a supplement to their basic need for food. Some of them are preserved for use in dry periods or sold in rural markets. But the popularity of these wild forms has recently decreased. Apart from their traditional use of food, potentially they have many advantages and some may also possess medicinal properties, and are therefore used in treatment of ailments. WEFs are used for a range of other purposes, such as cosmetics, crafts, fiber, and fuel. In the nutrition and pharmaceutical literature, WEFs have been widely studied and recommended as rich sources of antioxidants, minerals, and vitamins. We adhere to the definition of the term fruit as any part of the reproductive structure of angiosperms and consider any undomesticated product extracted from wild or managed landscapes as wild. They are edible and have nutritional value, which provides the minerals like sodium, potassium, magnesium, iron, calcium, phosphorus etc. They are immune to many diseases and often used in different formulations of ‘Ayurveda’ in Indian Folk- medicine.

Food and nutritional security are key concerns the world over as low food intake and poor access to food in underdeveloped countries remain unresolved issues (Andersen *et al*., 2003; Adebooye and Phillips, 2006). Feeding more than 800 million undernourished people depends not only on the increased productivity of the limited number of domesticated crops of the modern world but also on the use of underutilized wild species (Farooq and Azam, 2002). Plants for human consumption account for ~5% of the total plant species of the world (Asfaw & Tadesse, 2001). Wild edible fruit plants (WEFs) as one of the wild plant resources have played a crucial role in improving nutritional security across developing countries, especially the nutritional value they are very essential for the livelihoods of local people of a particular region, not only as a source of food supplements, balanced nutrition, medicines, feed, and fuel but also for the development of resource management strategies, which may be essential for the conservation of several indigenous species.

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.

In situ conservation is the on-site conservation of genetic resources in natural populations of plants or animal species such as forest genetic resources, in natural populations of tree and animal species. The process of protecting an endangered plant or animal species in its natural habitat is commonly known as in situ conservation, and preserving ecosystems and natural habitats, as well as ensuring the sustainability and restoration of viable populations of species in their native environments. For domesticated or cultivated species, this involves safeguarding them in the environments where they have evolved and expressed their unique characteristics.It is a convenient and cheap way of conserving biological diversity. A large number of species are protected and maintained by this process. In-situ conservation refers to the preservation of animals in its native environment. Using a network of protected areas, such as biosphere reserves, national parks, and animal sanctuaries, this strategy aims to safeguard the natural habitat. These protected areas for the preservation of wildlife occupy 4.7 percent of the Indian landmass.

More than 7000 species of WEPs are documented worldwide. About 1000 species were identified in the Americas, 1200 species in Africa and 800 species in Asia 1.4 billion people depend directly on forest products for some portion of their livelihoods and household consumables (World Bank, 2008)—and thousands of tree species are instrumental to global diets, health, shelter, fuel and incomes of the world's poor (Arnold *et al*., 2011). In some areas, products from forests account for a higher proportion of livelihood and income benefits than does agriculture (Leakey *et al*.,2005).The sustainable use of the genetic resources is widely considered to be the key source of the technological innovations in agriculture (including forestry): numerous studies have indicated productivity gains in the agriculture and

forestry sectors, resulting from crop and tree genetic improvement (Johnson *et al*., 2003; Tilman *et al*., 2005) while genetic erosion increases household vulnerability to pedoclimatic stresses and to fluctuations of price and production, especially in developing countries (Thrupp, 2000; Arnold *et al*., 2011). 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 (Abdussalam *etal*.,2020). 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 (*Syzygiumcumini*), Amla (*Phyllanthus emblica*), Ber (*Ziziphus mauritiana*), Bael (*Aegle marmelos*),Karonda (*Carissa carandas*),Wood Apple (*Limoniaacidissima*), Phalsa (*Grewia asiatica*),Mulberry (*Morus spp*.), Mahua (*Madhuca longifolia*), and Ceylon Olive (*Elaeocarpus serratus*).

Himalayan region covers approximately 5,91,000 sq. km, which is only 11% of the country's geographical area and is one of the 12 mega-biodiversity countries of the World and it accounts for more than 50% of the country's forest cover with 40% of the endemic species (Ignacimuthu*et al.,* 2006; Anonymous, 2010). The Himalayas, one of the biodiversity-rich areas, supports over 675 species of wild edible plants (Samant & Dhar, 1997). The diversity of wild edible plants in the Indian Himalayan Region (IHR) has traditionally been known to play significant role in meeting the nutritional, minerals and antioxidant requirements of indigenous communities (Andola*et al*., 2008, Maikhuri*et al*., 2004, Rawat *et al*., 2011). Himachal Pradesh in India is blessed with diverse topography with latitude ranging from 30o 22' 40" N to 33o 12' 40" N and longitude from 75o 45' 55" E to 79o 04' 20" E. The sea level height ranging from 350 meters to 6975 meters give it vivid climatic conditions (Himachal Forest Statistics, 2013). All these factors make this state a home of 675 species of wild food plants (Kala, 2007; Reddy *et al*., 2007; Samant and Dhar, 1997).Himachal Pradesh is a small Northwestern Himalayan state of India. The total forest cover of the state is around 26.4% and is a shelter for varieties of edible plants. The state is famous for the cultivation of temperate fruits. Besides the use of cultivated fruits, the practice of harvesting and consuming the seasonal wild fruits and nuts is also common in this hilly state. There are about 1532 edible wild food species available in India out of these 675 species are found in the Himalayan region (Kala CP; 2007, Reddy *et al*.,2007).

Himachal Pradesh, located in the northern part of India, is known for its rich biodiversity and diverse flora. The region is home to various wild edible fruits. Sea buckthorn (*Hippophaerhamnoides*),Wild Strawberry (*Fragaria* spp.), Himalayan Blackberry (*Rubus fruticosus*). Raspberry (*Rubus* spp.), Wild Apple (*Malus sylvestris*), Wild Apricot (*Prunus armeniaca*), Wild Cherry (*Prunus cerasus*), Wild Blueberry (*Vaccinium* spp.), Himalayan Mulberry (*Morus serrata*), Himalayan Elderberry (*Sambucus* spp.).These are

just a few examples of wild edible fruits in Himachal Pradesh. It is important to exercise caution and ensure proper identification of these fruits before consumption. Sunni is a town, Nagar panchayat and Tehsil in Shimla district in the Indian state of Himachal Pradesh. Located at 31.24°N 77.12°E. It has an average elevation of 670 meters (2198 feet). The Number of wild edible fruits are present in Sunni like Galgal (Khate or Big-Lemon) Kala Hisalu/ Kale Aakhe, Anjeer (Fig), and Kafal but our main focus is on wild pomegranates (*Punica granatum*) and Jamun (*Syzygium cumin*) and their contribution to sustainable rural development and income generation.

*Syzygiumcumini*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 (*Syzygiumcumini*) 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.

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. 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.

It is a large, common, evergreen tree of the Indian subcontinent. The tree is 25 m to 30 m tall, with oblong, opposite leaves that are smooth and glossy with a turpentine smell. It is a large, evergreen widely distributed forest tree of India, Sri Lanka, Malaysia and Australia which is also cultivated for its edible fruits. The tree was introduced from India and tropical Asia to southern Africa for its edible and attractive fruits, Jamun tree flowers once in a year during the month of March-April and fruiting come during the month of June-July. Flowers borne both terminal and axillary inflorescences on about five months to one year-old branches. In Jamun, only 15-30% of fruits reach maturity and fruit drop starts just after fruit set which continues up to fruit maturity (Mishra and Bajpai, 1975). Almost all parts of the tree are used for various purposes. Ripe fruits are very juicy, almost odorless, with a pleasant, slightly bitter, astringent taste.in HP (Himachal Pradesh) only wild Jamun is widely distributed in certain pockets of various districts like Bilaspur, Hamirpur, Una, Kangra, Mandi, Shimla and Sirmour

Wild pomegranate (*Punica granatum* L.) is an emerging wild fruit of Central Asia that belongs to the family Punicaceae and genus Prunus. The pomegranate is native in the region from northern India to Iran (Morton, 1987) with its wild shrubs found in the forests of these areas. In India, wild forms of pomegranate are widely distributed in drier and sub marginal land of outer Himalaya at an elevation of

900 to 1800 m above mean sea level covering the mid hill belts of Himachal Pradesh, Jammu and Kashmir and Uttarakhand states (Thakur *et al*. 2011). Considering the nutritional and nutraceutical properties of the wild pomegranate, its industrialization in the form of different commercial processed products is very important in fulfilling the nutrient requirements of the people in developing countries particularly as a cheaper source of bio-active components as compared to cultivated one. Wild pomegranate is the only commercial fruit crop of mid hills of Himalaya with different types of phyto-nutrients in the form of anthocyanins, phenolics and flavonoids that impart antioxidant properties in addition to color (Sharma and Thakur, 2016) Some wild types pomegranate also found in foothills of Himachal Pradesh which can be exploited for anardana purpose (Singh and Singh, 2006). In Himachal Pradesh, it is spread evenly in Solan, Sirmour, Mandi, Shimla, Kullu and Chamba districts (Bhrot, 1998). The research endeavors to discover and nurture indigenous edible fruits found in the wild, harnessing the wisdom of local communities to stimulate economic development. The assignment involves documenting the trade of anardana and Jamun to improve rural livelihoods by comprehending socio-economic factors. Additionally, it includes assessing on-farm fruit conservation interventions, analyzing their influence on farmer livelihoods, and evaluating their impact on species diversity to promote sustainable agriculture

2. MATERIALS & METHODS

This section addresses the following topics: 1. Study Area 2. Methodology used for data collection.

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).Figure 1 depicts a geographical map outlining the Sunni area. The visual aids in understanding the spatial distribution and layout of the Sunni region.

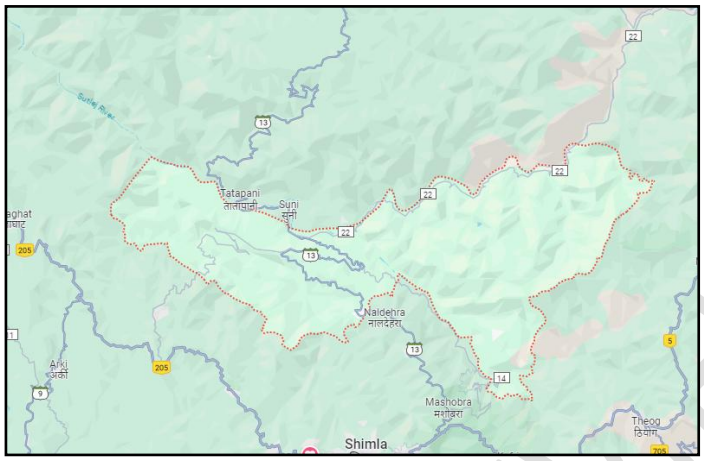


Fig 1: Map of Sunni area (Source:www.himachaltourism.com)

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 *Punicagranatum* and *Sygizumcumini*. 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, and a semi-structured questionnaire including vernacular names, uses, parts use, and economic value was used. 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 variegate):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.

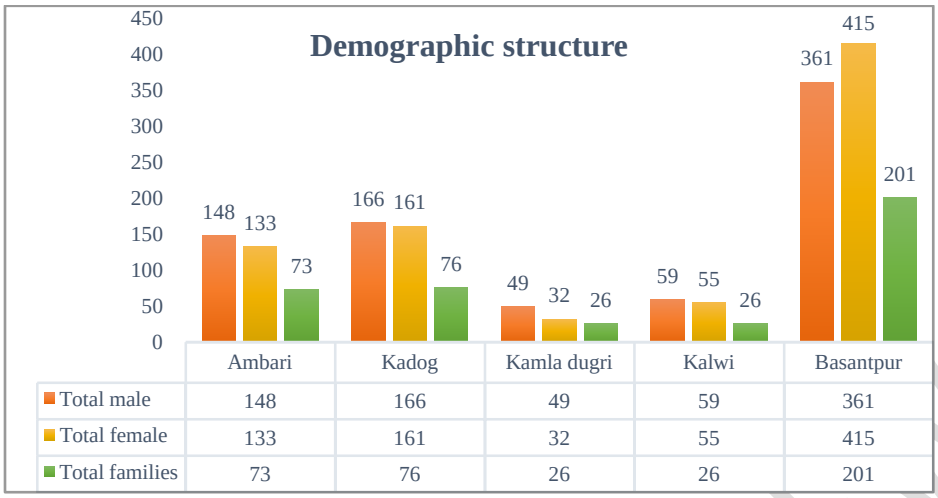
3. RESULTS & DISCUSSIONS

Fruits that naturally grow in the wild without human cultivation are referred to as wild edible fruits. They can be found in mountains, fields, woods, and other types of natural environments. When compared to their cultivated cousins, these fruits are frequently smaller and have a wider range of flavors. While some wild fruits could seem like well-known cultivated fruits, others might have distinctive qualities and flavors. Wild edible fruits (WEFs) are fruit species that are harvested from their natural environments rather than being grown. When food is scarce and off-season for grown fruits and vegetables, WEFs are mostly consumed.

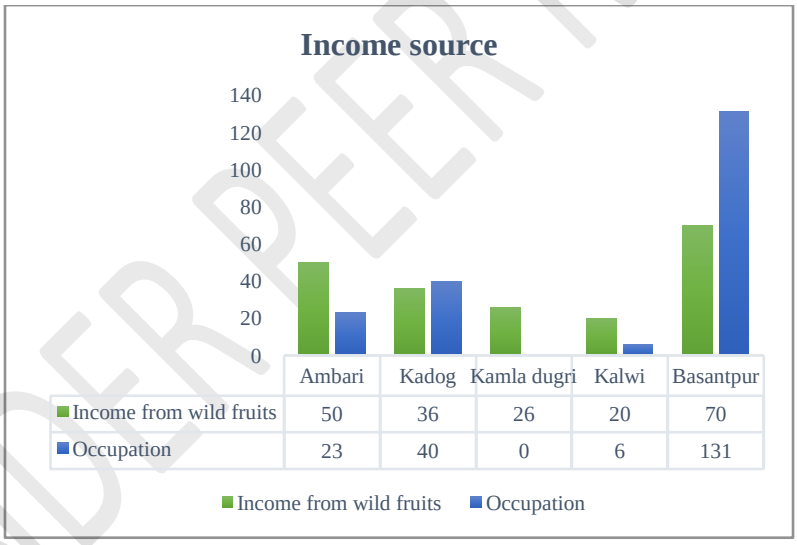
The study area shows that Pomegranate cultivation is relatively sustainable, requiring less water and fewer pesticides compared to other crops. Promoting eco-friendly farming practices can further enhance sustainability. Anardana presents a promising income source with its diverse applications, market demand, and entrepreneurial opportunities. Cultivating, processing, and marketing Anardana can lead to economic growth, agricultural diversification, environmental sustainability, and enhanced nutrition. By recognizing the potential of Anardana and investing in its development, individuals, communities, and businesses can harness its benefits and contribute to a thriving and sustainable industry.

Jamun cultivation involves growing trees in suitable climatic conditions. The tree requires well-drained soil, sufficient sunlight, and regular watering. After the tree matures, it bears fruit, which ripens during the summer season. Once harvested, the fruits are processed through various methods, such as juicing, drying, or converting them into value-added products like jams, jellies, and beverages. Proper processing techniques ensure the preservation of Jamun's flavor and nutritional properties. Investing in Jamun as an income source brings several benefits and contributes to sustainability: Jamun trees are known for their resilience and ability to grow in diverse climatic conditions. Promoting sustainable farming practices and preserving natural ecosystems contribute to environmental 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).



Graph: 1. Demographic structure of studied villages



Graph No.2. Showing the income source of the villagers

Table No.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

Income from wild fruits refers to the revenue generated by individuals or communities through the collection, harvesting, and sale of fruits that grow naturally in the wild. Income from wild fruits represents a vital source of income for many communities, enabling them to sustain their livelihoods while benefiting from the abundance of nature's bounty. In the village of Ambari, there are a total of 73 families. Out of these, 50 families depend on the sale of wild fruits as their source of income, while the remaining 23 families earn money through various means such as businesses, private jobs, and government positions.

In Kadog village, there are a total of 76 families. Among these, 40 households' economy is based on their occupation, indicating that they derive their income from their chosen profession. Additionally, 36 families in Kadog depend on the sale of wild fruits for their livelihood.Moving on to Kamla Dugri, all 26 families in this village depend solely on the sale of wild fruits for their income. This suggests that wild fruit harvesting is the primary source of livelihood for the families in Kamla Dugri. In Kalwi village, there are a total of 26 families. Among them, 20 families make money by selling wild fruits, while the remaining 6 families depend on other forms of income.Finally, in Basantpur village, there are a total of 201 families. Out of these, 70 families depend on wild fruits for their income, whereas 131 families have alternative sources of livelihood.

In several villages within the Basantpur Panchayat, approximately 75% of the inhabitants depend on anardana (pomegranate seeds) as a source of income, while 15% depend on Jamun (Black plum). Notably, the village of Kamla Dugri is entirely dependent on anardana for generating income.

A recent study conducted by Mushtaq and Sajad Ahmad Gangoo (2017) highlights the significance of anardana in the net income of households in the Chenab Valley of Jammu & Kashmir. Although the study focuses specifically on the role of anardana in the livelihood of the people of Ramban, it can be inferred that anardana plays a significant role in the state's economy as a whole. The state is home to a diverse range of non-timber forest products (NTFPs), which are collected by the local population for personal use or sold in small quantities to contribute to their annual income.

Overall, the study suggests that anardana contributes approximately 48.78% to the net income of each household in the Chenab Valley. While the study's scope is limited to Ramban, it implies that anardana's economic importance extends beyond this region, impacting the economy of the entire state.

The village of Kamla Dugri stands out as unique among the mentioned villages because all families in this village solely depend on anardana (pomegranate seeds) as their source of income. This exclusive dependency on anardana is due to the ideal land area of Kamla Dugri, which is particularly well-suited for growing *Punica*(dried pomegranate seed). Situated at a slightly higher elevation than the other villages, Kamla Dugri benefits from favorable environmental conditions that contribute to the higher quality of anardana produced in this village compared to the other selected villages. The elevation likely provides better climatic conditions, soil characteristics, or other factors that enhance the quality of the anardana crop. It is worth noting that Kamla Dugri has a smaller number of families compared to the other villages mentioned, indicating a smaller population or land area in this village. Despite having fewer families, the exclusive focus on anardana cultivation suggests that the village has recognized the economic potential and advantages of specializing in this particular crop. In summary, Kamla Dugri stands out as a village where all families rely entirely on anardana as their source of income.

The typical number of *Punica* trees per family in the village of Ambari is between 8 and 10. Ambari has about 500 *Punica* trees on average. In Kadog, each family typically has between 20 and 30 Punica trees. Kadog has about 450 Punica trees on average. Punica trees per family in Kamla Dugri range from 20 to 35 trees. Kamla Dugri has about 600 Punica trees on average. The typical number of Punica trees per family in Kalwi is between 10 and 15. Kalwi has about 300 Punica trees on average and in Basantpur village there are 20 to 25 trees per family. Basantpur has about 700 Punica trees on average.

The overview of the average number of Punica trees per family and the average number of trees in each hamlet. By examining this information, we can gain insights into the distribution of Punica trees among different families in various villages, as well as the total number of Punica trees in each village. Punica trees are naturally found growing in the wild across the Ramban, Rajouri, Doda, and Udhampur districts. These trees tend to thrive in large clusters on exposed dry hillsides, creating striking patches of vegetation. Murtaza Mushtaq and Sajad Ahmad Gangoo's(2017) research paper provides valuable insights into the natural habitat and growth patterns of Punica trees in these regions. According to Dhandar and Singh (2002), the harvesting of ripe Punica fruits typically commences in August and continues until October. This suggests that the villagers in these areas engage in fruit harvesting activities during this period to make use of the ripe fruits.

The highest average number of Punica trees is found in Basantpur Village. On average, there are approximately 700 Punica trees in Basantpur because maximum numbers of families are there. However, when considering the average number of trees per family, Kamla Dugri stands out. The typical range of Punica trees per family in Kamla Dugri spans from 20 to 35, which is higher compared to other villages. With an average of 600 Punica trees in Kamla Dugri, this suggests that each family in the village has a relatively larger number of trees on their farms.

It is worth noting that the majority, around 95%, of Punica trees in these villages are located on the farms of the villagers. This indicates that the local community actively engages in Punica cultivation, emphasizing its importance as a valuable crop for the villagers' livelihoods.On the other hand, around 5% of the Punica trees are situated in forest areas. These trees likely grow naturally in the wild, contributing to the overall presence of Punica trees in the region. The forests serve as a natural habitat for these trees, adding to the ecological diversity and richness of the area.

Basantpur Village stands out with the highest average number of Punica trees, while Kamla Dugri showcases a higher average number of trees per family. The majority of Punica trees are found on villagers' farms, highlighting the significance of Punica cultivation for the local communities. Additionally, a small portion of these trees is scattered across forest areas, contributing to the natural diversity of the region.

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 (Murtaza Mushtaq and Sajad Ahmad Gangoo's(2017) 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.

The rates of Anardana and Jamun can vary in different villages based on factors such as quality, supply, demand, and local market conditions. The superior quality of Anardana from Kamla Dugri justifies the higher price range of 700 to 800 rupees per kilogram. Farmers in Basantpur Panchayat benefit from selling their Anardana at nearby markets without incurring additional costs.

The average number of Jamun trees in the wild can vary depending on the specific region and habitat. Jamun trees tend to grow naturally without human intervention. The density of Jamun trees in the wild can vary greatly, with some areas having a higher concentration of trees while others may have fewer. The number of Jamun trees in different villages of Basantpur Panchayat varies, ranging from 2 to 8 trees on average. Among these villages, Basantpur village has the highest number of Jamun trees. It is worth noting that these trees are not typically found on farmlands but are scattered throughout the villages. The trees can reach impressive heights, typically growing between 10 to 30 meters tall.

The presence of a significant number of Jamun trees in the villages suggests that Jamun fruit is a common sight and likely plays a significant role in the local economy or household consumption. The abundance of these trees indicates that the cultivation and harvest of Jamun is well-established and integrated into the community's daily life.

Jamun trees thrive in well-draining soil that is rich in nutrients, with a pH range of 6.5 to 7.5. Ideally, loamy soil with a small amount of sand is considered optimal for the growth of Jamun plants. These trees exhibit hardiness and can withstand waterlogged and saline conditions, making them adaptable to a variety of environments. The Indian Subcontinent, with its subtropical and tropical climate, provides an ideal habitat for the Jamun tree to flourish. However, it is important to note that during the flowering and fruiting stages, the plants may benefit from a drier temperature. Early rains can be particularly beneficial for the growth of Jamun trees.

One challenge associated with Jamun trees is their height, which can make handling the fruit somewhat difficult. When collecting the fruits, considerable care must be taken, as the rate of Jamun depends on the texture of the fruit's epidermis. Factors such as the smoothness, firmness, and overall appearance of the fruit's skin can influence its market value and consumer preference.Given the prevalence of Jamun trees in the villages of Basantpur Panchayat, it can be inferred that the local

community is well-versed in the cultivation and care of these trees. The adaptability of Jamun trees to different soil and climatic conditions, coupled with their hardiness, makes them a favorable choice for farmers in the region.

The economic importance of Jamun in the local economy is evident, as the fruit is likely consumed by households and also sold or traded in nearby markets. The availability of Jamun trees provides a valuable resource for both subsistence and commercial purposes, contributing to the overall livelihood and well-being of the community.

In conclusion, the villages of Basantpur Panchayat have varying numbers of Jamun trees, with Basantpur village having the highest count. The widespread presence of these trees indicates the significance of Jamun fruit in the local economy and household consumption. The adaptability of Jamun trees to different soil and climatic conditions, as well as their hardiness, allows them to thrive in the subtropical and tropical climate of the Indian Subcontinent. However, care must be taken when handling the fruit due to its texture, which can impact its market value. Overall, the cultivation and harvest of Jamun in these villages contribute to the livelihood and economic well-being of the community.

In different villages, the average amount of Anardana (Pomegranate seeds) and Jamun harvested or collected can vary significantly. For example, in Kamla Dugri village, the maximum amount of Anardana collected per family is around 35 kilograms. On the other hand, Basantpur village collects the maximum quantity of Jamun, with an average of 800 kilograms.

A recent study conducted by Murtaza Mushtaq and Sajad Ahmad Gangoo (2017) surveyed various villages, including Ganote, Dharam, Gool, Farmoot, Sangaldan, Gundi, Maha Kund, and Chaderkot. The study revealed that each household in these areas collects approximately 400 to 500 kilograms of dried Anardana seeds annually. In the Kanga village of Ramban, the average annual collection of dry Anardana seeds per household reaches about 550 to 625 kilograms. It is noteworthy that the collection of Anardana seeds not only meets domestic needs but also contributes an average of Rs. 60,000 to the annual income of each household. This highlights the significant economic impact of wild-collected Anardana seeds in these areas. The annual production of Anardana in the surveyed regions amounts to approximately 1,100 tonnes, valued at Rs. 38 crores based on the current market price.

In selected villages of Basantpur Panchayat, around 75% of the villagers depend on Anardana, while 15% rely on Jamun as a source of income. Both of these wild fruits are sold at nearby local markets, with Anardana prices ranging from 500 to 800 rupees per kilogram, depending on the quality, and Jamun prices ranging from 100 to 120 rupees per kilogram. The annual production in Basantpur Panchayat is estimated to be around 110 kilograms of Anardana and 22 quintals (2,200 kilograms) of Jamun.

The revenue generated from the sale of 5% of the Anardana collected from forest areas is utilized by the Panchayat house for organizing cultural programs and maintenance purposes. This revenue allocation demonstrates the importance of Anardana collection for the local economy and the utilization of resources for community development.

During discussions with respondents, it was found that Punica granatum (Pomegranate) and Syzygiumcumini (Jamun) are the most preferred fruit species in the region. This preference is attributed to their sweet and sour taste and fragrant aroma, which are highly valued by the local population.

In conclusion, the average amount of Anardana and Jamun collected or harvested can vary in different villages. Kamla Dugri village collects approximately 35 kilograms of Anardana per family, while Basantpur village harvests around 800 kilograms of Jamun. The survey conducted in various villages revealed the substantial annual collection of Anardana seeds per household, contributing to both domestic needs and an additional income of approximately Rs. 60,000. In Basantpur Panchayat, a significant percentage of villagers depend on Anardana and Jamun for their livelihoods, with these wild fruits being sold at local markets. The revenue generated from the sale of Anardana collected from forest areas is utilized for community purposes. The preference for *Punica granatum* and *Syzygiumcumini* is attributed to their delightful taste and fragrance. Overall, the collection and sale of Anardana and Jamun have a considerable impact on the rural economy of the surveyed regions.

Information about the average amount of Anardana (Pomegranate seeds) in kilograms and the average amount of Jamun in quintals (100 kilograms) in different villages; Kamla Dugricollect maximum amount of anardana around 35 kg per family and Basantpur collect maximum Jamun 800 kg.

These Figures represent the average availability of Anardana and Jamun in each village. They provide an indication of the quantity of these fruits that can be harvested or traded in the respective villages. Recent study of Murtaza Mushtaq and Sajad Ahmad Gangoo surveyed various villages (Ganote, Dharam, Gool, Farmoot, Sangaldan, Gundi, Maha kund, Chaderkot) and area revealed that each household in these areas collects 400-500 Kg of dried seed, with per household annual collection of dry seeds touching about 550-625 Kg in Kanga village of Ramban.It may be noted that in addition to fulfilling the bonafide for domestic needs, each household engaged in collection of ‘anardana’ adds an average of Rs. 60,000 to its annual income. About 1100 tonnes of Anardana is produced annually valued at Rs. 38 crores at current market price.

These are just examples to highlight the importance of wild collected Anardana in the state and their impact on the rural economy. In selected villages of Basantpur panchayat about 75% villagers depend on anardana, and 15% are dependent on Jamun. Both the wild fruits are sold at nearby local market rate of anardana varies from 500-800 Rs/kg depending on the quality and Jamun @ 100-120 Rs/kg. About 110 kg of Anardana and 22 Quintal of Jamun is produced annually by Basantpur Panchayat. Revenue which is obtained by 5% Anardana from forest areas is used by Panchayat house

for organizing any cultural programme and for maintenance purposes. During the discussions, the respondents stated that *Punica granatum* and *Syzygiumcumini* are the most preferred fruit species because of their sweet and sour taste and fragrant smell.

The cultivation of Jamun (*Syzygiumcumini*) on community land demonstrates an example of in situ conservation of this species. In situ conservation refers to the conservation of biodiversity within its natural habitat. When Jamun trees are grown on community land, it not only ensures the preservation of the species but also highlights the importance of sustainable utilization and cultural significance.

Jamun holds significant religious value in many communities. A substantial portion of the harvested Jamun fruits is used for religious purposes, such as offerings in temples and during religious ceremonies. This practice not only preserves the cultural traditions associated with the fruit but also promotes its sustainable use within the community.

Additionally, the wood obtained from Jamun trees is utilized for the maintenance of temples and serves as firewood during religious functions. By using the wood of the Jamun tree for these purposes, communities are practicing a sustainable approach to resource utilization. This sustainable harvesting ensures the availability of wood for religious activities while also promoting the conservation of Jamun trees.

It strengthens the connection between communities and their natural environment, fostering a sense of responsibility towards the conservation of Jamun trees and their habitats.

In conclusion, the cultivation of Jamun on community land showcases an excellent example of in situ conservation. The utilization of Jamun fruits for religious purposes and the sustainable use of Jamun wood in maintenance and religious functions highlights the harmonious coexistence of cultural practices and biodiversity conservation. By valuing and conserving Jamun within its natural habitat, communities contribute to the preservation of this species, its associated ecosystems, and the cultural heritage it represents.

In-situ conservation is a crucial approach for preserving biodiversity and maintaining the integrity of ecosystems. When it comes to conserving Punica trees, such efforts must encompass the management of entire ecosystems. This requires a deep understanding of the ecological interactions that occur within these habitats, as well as the mechanisms for maintaining their balance. Conserving Punica trees involves various strategies to ensure the long-term viability of their ecosystems. One such strategy is the control of invasive species, which can outcompete and threaten the native flora and fauna. By monitoring and managing invasive species, we can protect the ecological niche of Punica trees and promote their survival. Additionally, effective in-situ conservation of Punica trees requires sustainable management of water resources. As water is a vital component for the growth and survival of these trees,

implementing practices that promote efficient water use, such as irrigation techniques and watershed management, can contribute to their conservation.

Furthermore, engaging local communities in in-situ conservation efforts is essential. By involving communities living near Punica tree habitats, a sense of ownership and responsibility can be fostered. This can be achieved by promoting agroforestry techniques that integrate Punica trees into agricultural landscapes, providing economic incentives for conservation, and facilitating educational programs to raise awareness about the ecological and cultural importance of these trees. Additionally, supporting and preserving traditional knowledge associated with Punica tree conservation can enhance community involvement and contribute to sustainable practices.

In conclusion, effective in-situ conservation of Punica trees requires a comprehensive ecosystem management approach. This involves understanding ecological interactions, controlling invasive species, managing water resources sustainably, and actively involving local communities. By implementing these strategies, we can ensure the preservation of Punica trees and the ecosystems they inhabit, promoting biodiversity conservation and sustainable practices for future generations.

4. CONCLUSION

This study aims the promotion of wild edible fruits abundant in rural areas on regional, national, and global scales, aiming to diversify the diminishing food sources mankind has traditionally relied on. Acknowledging the pressure these plants face from anthropogenic activities, the study emphasizes the necessity for public awareness and community-based management. Furthermore, it advocates research on indigenous fruits to enhance dietary diversity, considering their sustainable use for future generations. Focusing on Anardana production, the study explores the impact of climate change on this South Asian spice derived from pomegranate seeds. Climate-induced temperature fluctuations disrupt pomegranate tree cycles, affecting fruiting and reducing Anardana production. Changes in precipitation patterns and extreme weather events lead to water stress, orchard damage, and increased pests and diseases, impacting fruit quality and quantity. Climate change also influences the geographic distribution of suitable pomegranate cultivation regions, necessitating adjustments in agricultural practices. The study underscores the urgency of understanding and mitigating these climate-related challenges to ensure the continued availability of Anardana and the preservation of diverse, sustainable food sources. To address the challenges posed by climate change on anardana (dried pomegranate seeds) production, adaptation strategies are crucial. These include the implementation of irrigation systems for sufficient water supply, adoption of pest and disease management practices, utilization of shade structures to regulate temperature, and diversification of pomegranate varieties for increased resilience. Preserving wild pomegranate populations demands a comprehensive approach involving habitat protection, restoration, sustainable agricultural practices, research, community engagement, and policy support. Implementing these strategies safeguards genetic diversity, ecological value, and the long-term survival of wild

pomegranates. Similarly, in-situ conservation efforts for Jamun, a fruit-bearing tree native to the Indian subcontinent, are essential. Establishing protected areas like national parks provides legal safeguards and allows monitoring and management of Jamun populations. Identifying and conserving natural habitats, preventing degradation, and restoring areas through reforestation are critical. Promoting sustainable land management practices, such as agroforestry, supports both ecological and economic benefits. Research on Jamun's biology and engaging local communities in awareness programs are crucial components. Integrating traditional knowledge into conservation efforts, fostering collaboration among various stakeholders, and implementing supportive policies and regulations are necessary for effective in-situ conservation of both pomegranate and Jamun. These strategies collectively contribute to the preservation of genetic diversity, ecological value, and cultural significance of these important fruit species.

REFERENCES

Adebooye, O.C. and Phillips, O.T. (2006) Studies on Seed Characteristics and Chemical Composition of Three Morphotypes of Mucuna pruriens (L.) MedikusFabacea. *Food Chemistry*, 95, 658-663.

Andersen, T.G., Bollerslev, T., Diebold, F.X., et al. (2003) Modeling and Forecasting Realized Volatility. *Econometrica*, 71, 579-625. http://dx.doi.org/10.1111/1468-0262.00418.

Anshu Sharma&N. S. Thakur2016 Influence of active packaging on quality attributes of dried wild pomegranate (*Punica granatum* L.) arils during storage*, Journal of Applied and Natural Science* 8(1):398-404.

Asfaw, Z. and Tadesse, M. (2001) Prospect for Sustainable Use and Development of Wild Food Plants in Ethiopia. *Economic Botany*, 55, 47-62.

Beluhan S, Ranogajec A. 2010. Chemical composition and non-volatile components of Crotial wild edible mushrooms. Food Chem 124:1076–82.

Chellaiah Muthu, MuniappanAyyanar, Nagappan Raja, and Savarimuthu Ignacimuthu J 2006 Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India, *EthnobiolEthnomed*. 2006; 2: 43.

Dhandar, D.G. and Singh D.B. 2002. Current status and future needs for the development of pomegranate. *In: Programme and discussion papers, National Horticulture Conference, New Delhi* p12.

Diamond J. 2002. Evolution, consequences and future of plant and animal domestication. *Nature* 418:700–707.

Farooq, S. and Azam, F. (2002) Food Security in the New Millennium. I: The Role of Agricultural Biodiversity. *Pakistan Journal of Biological Sciences*, 5, 1345-1351.

Jan Arnold & Stefan Minner 2011 Financial and operational instruments for commodity procurement in quantity competition, *International Journal of Production Economics* 131(1):96-106.

Johnson AH, Frizano J, Vann DR. 2003. Biogeochemical implications of labile phosphorus in forest soils determined by the Hedley fractionation procedure. *Oecologia* **135**: 487–499.

Kala, C.P. (2007) Local Preferences of Ethno-Botanical Species in the Indian Himalaya: Implications for Environmental Conservation. *Current Science*, 93, 1828-1834.

Khruomo N, Deb CR. 2018. Indigenous Wild edible fruits: sustainable resources for food, medicine and income generation - A study from Nagaland, India. *Journal of Experimental Biology and Agricultural Sciences* 6(2): 405-413.

Leakey RRB, Tchoundjeu Z, Schreckenberg K, Shackleton ES, Shackleton CM (2005) Agroforestry tree products:targeting poverty reduction and enhanced livelihood. *Int J Agric Sustain* 3:1–23.

Leonti M, Nebel S, Rivera D, Heinrich M. 2006. Wild Gathered Food Plants in the European Mediterranean: A Comparative Analysis. *Economic Botany* 60(2): 130–142.

Mabaya E, Jackson J, Ruethling G, Carter CM, Castle J. 2014. Wild fruits of Africa: Commercializing natural products to improve rural livelihoods in southern Africa. *Int Food Agribus Man* 17: 69-74.

Maikhuri, R. K., Rao, Krishna, K.S., & Saxena, K. G., (2004). Management Conflicts in the Nanda Devi Biosphere Reserve, India,*Mountain Research and Development*. Vol. 24 No 2.

Misra, R. S. and Bajpai, P. N. 1975. Studies on Floral Biology of Jamun (Java Plum)[SyzygiumCuminii (L) Skeels]. *Indian J. Hort.,* 32(1&2): 15-24.

Morton, J. (1987) Fruits of Warm Climates. J.F. Morton, Miami, *Chapter Mango Mangifera indica L.*

Mwema CM, Mutai BK, Lagat JK, Kibet LK, Maina MC. 2012. Contribution of selected indigenous fruits on household income and food security in Mwingi, Kenya. *Curr Res J Soc Sci* 4 (6): 425-430.

Neha C.P. & Abdussalam A.K (2020) diversity of underutilized wild edible fruits of kannur district, kerala, India.*International journal of current pharmaceuticalresearch* Vol 12, Issue 5, 99-101.

Rawat, Y. S. ; Vishvakarma, S. C. R., 2011. Pattern of fodder utilization in relation to sustainability under indigenous agroforestry systems, North-Western Himalaya, India. *Environ. We Int. J. Sci. Tech*., 6: 1-13

Reddy S, Pattanaik C, Mohapatra A, Biswal AK (2007). Phytosociological Observations on Tree Diversity of Tropical Forest of Similipal Biosphere Reserve, Orissa, India *C. Taiwania 52(4): 352-359.*

Samant, S.S., Dhar, U. (1997). Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. *International Journal of Sustainable Development and World Ecology* 4: 179-191.

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

Shava S (2005). Research on indigenous knowledge and its application: A case of wild food plants in Zimbabwe. *Southern Afr. J. Environ. Educ*., 22: 73-86.

Singh D B and Singh R S. 2006. Diversity of wild pomegranate in Himanchal Pradesh. *Progressive Horticulture* 38(1): 49–52.

Somnasang P, Moreno-Black G. 2000. Knowing, gathering and eating: knowledge and attribute about wild food in an Asian village in North-eastern Thailand. *Journal of Ethnobiology* 20: 197.

Sundriyal M, Sundriyal RC, Sharma E, Purohit AN. 1998. Wild edibles and other useful plants of Sikkim Himalayas, India. *Oecologia Montana* 7: 43-54.

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.

Thrupp, L.A. (2000) Linking Agricultural Biodiversity and Food Security: The Valuable Role of Agrobiodiversity for Sustainable Agriculture. *International Affairs*, 76, 265-281.

Tilman D, Palosky S, Lehman C (2005) Diversity, productivity and temporal stability in the economies of humans nature. *J Environ Econ Manag.* 49:405–426.