

Indigenous uses and marketing potential of *Oroxylum indicum* in District Mandi Himachal Pradesh North Western Himalayas.

Unlocking the Economic and Medicinal Potential of *Oroxylum indicum* in Mandi, Himachal Pradesh.

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Abstract:

This study delves into the untapped economic and medicinal potential of *Oroxylum indicum* (Shyonak) in Mandi district, Himachal Pradesh. Native to the Western Himalayas, this multipurpose plant has long been valued for its diverse medicinal applications in Ayurvedic practices. However, its full potential remains largely underutilized in the region. While the Kinnauri tribes use its fruits and seeds for cultural rituals and cap manufacturing, unsustainable harvesting practices threaten its natural population. Through interviews with 50 local stakeholders, the study reveals that *O. indicum* locally known as arlu holds immense cultural significance (90%) and medicinal value (60%), but its use has significantly declined in recent years ($UV_{past} = 0.9$, $UV_{current} = 0.1$). The growing interest in its ethnopharmacological and cultural benefits presents a unique opportunity for large-scale domestication and commercialization. Promoting sustainable harvesting practices and cultivating *O. indicum* can drive rural prosperity, preserve traditional knowledge, and unlock new markets for this valuable plant.

Keywords: Multipurpose plant, Potential, Sustainable utilization, Cultural significance, Herbal medicine

I. Introduction:

Oroxylum indicum, commonly known as the Indian trumpet tree or midnight horror, is a fast-growing, deciduous tree that thrives up to an altitude of 1200m. Belonging to the Bignoniaceae family, it is locally called *Arlu* or *Tath* in Mandi and *Mindochampa* in Kinnauri culture. The tree produces long, curved fruits that hang from its bare branches, resembling the wings of a large bird or dangling sickles, earning it the common name "tree of Damocles." Rich in phytochemicals such as flavonoids, alkaloids, steroids, terpenoids, and phenolic compounds, *O. indicum* is recognized for its pharmacological properties. Its various parts are key ingredients in popular Ayurvedic formulations like Dasamula, Amartarista, Dantadyarista, Narayana Taila, Dhanawantara Ghrita, Brahma Rasayana, and Chyawanprash (Balkrishna, 2005; Kumar et al., 2009; Anonymous, 1998). These compounds contribute to its inclusion in mental health formulations (Laupattarakasem et al., 2003; Gupta et al., 2008). The plant's seeds are winged and lightweight, aiding in anemophilous seed dispersal. Due to this, *O. indicum* is often found growing singly or in small groups, rarely forming dense communities. It prefers warm areas, thriving in the plains and foothills of the region. In high-altitude zones, its fruits are worshipped by the Kinnauri and Buddhist tribes, and its seeds are integral to the making of Kinnauri caps, giving the plant significant commercial value. However, unsustainable harvesting practices have drastically reduced the natural population of this valuable plant. This underscores the urgent need for raising awareness about sustainable harvesting practices and promoting the domestication of *O. indicum*. The present study aims to assess the current status, challenges, and opportunities in the domestication of *O. indicum* in Mandi district, Himachal Pradesh, in the North Western Himalayas.

II. Research Gap:

Despite the recognized medicinal and cultural significance of *O. indicum*, there are notable research gaps that hinder its sustainable utilization and domestication, particularly in regions like Mandi, Himachal Pradesh. Although the plant is extensively used in Ayurvedic formulations (Balkrishna, 2005; Kumar et al., 2009), studies on its ecological sustainability and cultivation practices are scarce. The plant's natural population has been adversely affected by unsustainable harvesting (Gupta et al., 2008), yet comprehensive studies on the impact of these practices and the specific ecological requirements for its growth remain limited. Moreover, while *O. indicum* has substantial cultural and economic value, particularly in the Kinnauri and Buddhist communities

(Anonymous, 1998), research on its commercial potential, including seed dispersal, value chain development, and sustainable trade practices, is lacking.

There is also a gap in understanding how to cultivate *O. indicum* on a larger scale, with minimal environmental impact. Current literature predominantly focuses on the plant's medicinal uses and ethnopharmacological properties (Laupattarakasem et al., 2003), without sufficient exploration of its agronomic aspects, such as domestication, agroforestry integration, and the development of cultivation techniques suited for the region's climatic conditions. Furthermore, while *O. indicum* is recognized for its diverse pharmacological benefits (Gupta et al., 2008), research on its integration into sustainable agroforestry systems, particularly in the North Western Himalayas, is scarce. Addressing these gaps is crucial for ensuring the long-term conservation of *O. indicum* and maximizing its economic potential for local communities.

III. Methodology:

3.1 Study Area:

Mandi (31°42' 29.4" N latitudes and 76° 55' 52.92" E longitudes) Himachal Pradesh a part of North West Himalaya covers approximately 3,950 km² area and comprises 469 panchayats. 3374 villages and 2, 19, 145 households. The total human populations of study area is 9, 99,777 and livestock population is 67355. Altitudinal range of study area varies from 500-4034 m. It is known for diverse habitats, species, communities and ecosystems. The vegetation is mainly of sub- tropical and temperate types. It is mostly dominated by broad leaved deciduous, evergreen and coniferous types (Fig.1). (District Economic and Statistical Department, Mandi, H.P)

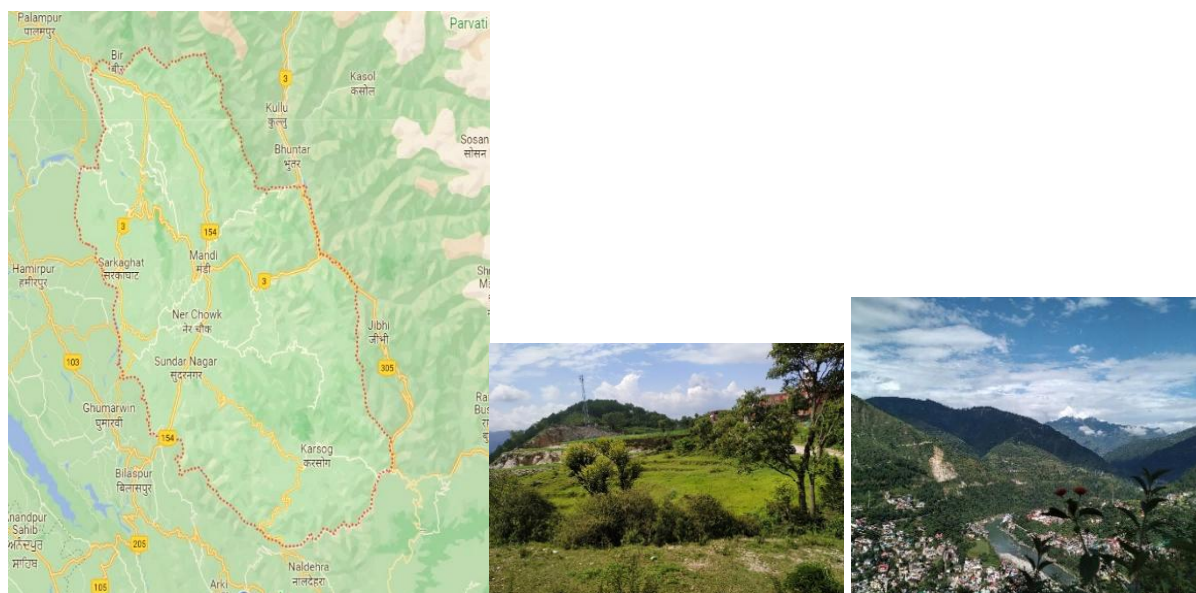


Fig: 1 Showing Goggle map and Study area of Mandi Distt (Source: Author Compilation).

3.2 Method:

The present study focused on the survey and sampling of *O. indicum* across altitudes ranging from 500 to 4034 meters above sea level in Mandi, Himachal Pradesh, conducted from July 2021 to September 2022. The plant's identification was confirmed using local floras (Chowdhury and Wadhwa, 1984; Dhaliwal and Sharma, 1999; Singh, 1918). Information was gathered from knowledgeable individuals in the study area and Kinnaur district, who are involved in the harvesting, selling, and purchasing of *O. indicum*. Interviews were conducted with local experts to obtain insights on the plant's altitudinal range, habitat, harvesting methods, seasonality, market value, and utilization patterns.

Use Value Index of *O. indicum* was calculated using formula: $UV = \frac{\sum U_i}{N}$. Where U_i is the number of use reports mentioned by each informant (i) and N is the total number informants interviewed for a given plant species (Sen and Thakur, 2021). A total of 50 individuals, including farmers, children, traders, shopkeepers, vaidyas, and Tibetan residents of Rewalsar, were interviewed using a structured questionnaire to explore the plant's diverse uses across different regions (Table.1).

Table: 1 Use Value Index of *Oroxylum indicum*

Plant Name	No. of citation by informants (Informants mentioning the plant)	Total no. of Citation	Uv (Used Value)	
			Current	Past
<i>O. indicum.</i>	45	50	0.1	0.9

(Source: Author Compilation).

IV. Result & Discussion:

4.1 Morphology, nativity, distribution & utilization pattern:

4.1.1. **Morphology:** *O. indicum* is a short-lived, deciduous tree that typically grows up to 8 meters tall. It has slender, straight branches and features large, opposite leaves that can reach 1-2 meters in length. The leaves are pinnate, with opposite pinnae, and a stout, cylindrical rachis. The leaflets are stalked, broadly ovate or elliptic, measuring 7-14.5 cm long, acuminate, entire, and glabrous.

The tree produces numerous, large, fleshy, dull-purple flowers arranged in erect, stout, terminal racemes, emitting a characteristic fetid odour. The calyx is leathery, oblong-campanulate, while the corolla is fleshy and campanulate, ranging from 5-7 cm in length, with irregularly toothed lobes. The flowers have five stamens, one of which is shorter than the others.

The fruit is a woody, red-brown capsule, septicidal dehiscent with two valves, measuring 40-70 cm by 5-8 cm. The seeds are winged all around, except at the base, allowing for efficient dispersal (Fig.2).



Fig.2 Morphology, Habit & Habitat (a, b) *O. indicum* young plant (c, d) Mature tree, (e) Tree bearing fruits.

4.1.2 **Nativity:** *O. indicum* is native of Regional Himalayas.

4.1.3. Distribution

In study area, *O. indicum* is commonly found in forest margins, roadsides, and open woodlands, where the climate is warm and the soil is well-drained at elevations between 500 to 1200 meters above sea level (Singh, 1918). It prefers sunny areas, making it an ideal species for cultivation in regions with moderate rainfall and warm temperatures (Chowdhury & Wadhwa, 1984). The plant is often seen in scattered patches, as it is typically found growing singly due to its anemophilous seed dispersal method (Kumar et al., 2009).

4.1.4. Utilization Pattern:

UVI score revealed that 85% of participants reported cultural and religious uses of the entire plant, particularly its winged seeds, followed by medicinal uses (60%), fodder (16%), food (10%), wood (12%), and ornamental purposes (5%). These findings underscore the multifaceted value of *O. indicum* in the local communities, highlighting its cultural, medicinal, and economic significance (Table.1,2,3; Fig.3,4,5.).



Fig.3 Edible Uses: (a-b)Harvesting *O. indicum* leaves, (c-e) *O. indicum* harvesting seeds. (f) *Parantha*, (g) *Rayata* (h) *Kachuri*, (i) *Pakor*as, (j) *Chilla-Kachru*. (Source: Author Compilation).



Fig.4 Cultural Uses: (a-c) *O. indicum* seeds adorning a *Kinnauri Cap* (d) Seeds in handcrafted decorative items, (e) Seeds for Decoration and Worship. (Source: Author Compilation)

4.2. Cultivation Practice:

Despite its significant medicinal, cultural, and economic value, *O. indicum* is not yet widely cultivated, and its natural populations are often threatened by unsustainable harvesting practices (Balkrishna, 2005). While the tree is commonly found in the wild, there is growing interest in cultivating it in controlled environments to ensure the sustainability of its population and provide economic opportunities for local communities. For successful cultivation, *O. indicum* requires loamy, well-drained soils, a warm climate, and ample sunlight (Gupta et al., 2008). It is primarily propagated through seeds, which should be soaked for 12–24 hours before sowing in nursery beds or polybags. Seedlings are transplanted during the monsoon season with a spacing of 3–4 meters. Initially, regular watering and weeding are necessary, but the plant becomes drought-tolerant as it matures. Organic manure or compost is applied annually to support growth. Generally pest-resistant, the tree requires minimal maintenance. Pods and bark can be sustainably harvested after 4–5 years for medicinal purposes (Kumar & Bhardwaj, 2017). Efforts toward domestication could help meet the rising demand for its medicinal and cultural uses while reducing pressure on wild habitats. Sustainable cultivation practices, such as controlled harvesting and plantation initiatives, are critical to preserving this valuable species (Laupattarakasem et al., 2003).

4.3. Cultural significance:

The winged seeds of *O. indicum* play a significant cultural and economic role for the Kinnauri tribes of Himachal Pradesh (HP) and the Buddhist community. Revered as a sacred plant, *O. indicum* is primarily found in

warmer, plain areas, with mature fruits collected from regions like Mandi, Bilaspur, and other low-altitude areas of HP. These fruits and their winged seeds are sold to Buddhist and Kinnauri communities residing in higher altitudes, such as Dharamshala, Lahul, Rewalsar, Kullu, and Kinnaur. The seeds are believed to protect against evil spirits and misfortune, a belief that has made them integral to various cultural practices. They are used in decorative items and wall hangings, serving as protective charms. One of the most significant uses is in the traditional Kinnauri cap, which is adorned with these sacred seeds, especially during religious and cultural ceremonies such as marriages and retirement rituals. In these ceremonies, the bride and groom's caps are decorated with a greater number of seeds, symbolizing their elevated status. These seeds are also prominently featured in the Tshechu Fair, an annual Buddhist festival held at Rewalsar from March 3 to 5, where thousands of devotees from across the country and abroad gather. The fair has become a major marketplace for trading *O. indicum* seeds, further highlighting their cultural and economic importance (Fig.3).

4.4 Medicinal significance:

O. indicum is renowned for its ethnopharmacological, phytochemical, and pharmacological properties, making it effective in treating a wide range of ailments. The plant is traditionally used as an antipyretic, anti-inflammatory, analgesic, and anti-diarrheal agent, thanks to its rich content of phytochemicals such as flavonoids, alkaloids, steroids, terpenoids, and phenolic compounds. Key phytochemicals in *O. indicum* include baicalein, chrysin, oroxylin A, baicalin, oroxindin, oroxylin B, and sitosterol. These compounds have been shown to exhibit various pharmacological activities, including anti-inflammatory, antioxidant, hepatoprotective, antimicrobial, anticancer, antidiabetic, and antitumor effects (Chopra *et al.*, 2002; Luitel *et al.*, 2010; Chaudhary *et al.*, 2011).

4.4.1. Local Medicinal Uses:

Locally, a decoction of the bark of *O. indicum* is considered a stomachic and is used to treat conditions such as vomiting, diarrhoea, and dysentery. The dried bark powder is also consumed as a tonic by some knowledgeable individuals for its rejuvenating and medicinal properties.

4.4.2. Veterinary Uses: The leaves and bark of *O. indicum* are commonly administered along with feed to cattle to help cure swelling.

4.4.3. Uses in Literature: The root bark of *O. indicum* is described as acrid, bitter, pungent, astringent to the bowels, cooling, aphrodisiac, tonic, and appetite-enhancing. It is considered beneficial for treating conditions such as "vata", biliousness, fevers, bronchitis, intestinal worms, vomiting, dysentery, leucoderma, asthma, inflammation, and anal troubles. It is traditionally used to address diarrhea, dysentery, rheumatism, and as a diaphoretic (Kirtikar & Basu, 2001; Prakash, 2005). A digestive tonic is prepared by mixing powdered root bark with sesame oil (*Sesamum indicum*). The seeds of *O. indicum* act as a purgative and are taken orally to treat throat infections and hypertension (Singh *et al.*, 2002).

The fruit of *Oroxyllum indicum* is acrid, sweet, stomachic, and anthelmintic, and is effective in treating diseases of the throat, heart, piles, bronchitis, as an expectorant, and in improving appetite. It is also useful in leucoderma (Chopra *et al.*, 2002; Drury, 2006; Nadkarni, 1982; Khare, 2007). Leaves are traditionally used to treat snake bites (Nadkarni, 1982; Khare, 2007) and are applied externally for enlarged spleen, headaches, and ulcers. The plant has been reported to have analgesic and antimicrobial properties (Drury, 2006). In various Indian tribes, the bark and seeds of *O. indicum* are used for fever, pneumonia, and respiratory issues (Panghal *et al.*, 2010; Patil *et al.*, 2008), and to treat various stomach disorders (Raut *et al.*, 2009). In Nepal, a root decoction is used to treat diarrhoea and dysentery, and the seeds are taken as a digestive. A paste made from seeds is applied to treat boils and wounds. The root is considered astringent, anti-inflammatory, aphrodisiac, expectorant, anthelmintic, and tonic. The bark is diuretic, stomachic, and useful for diarrhoea and dysentery. Root bark and seeds are carminative, stomachic, tonic, diaphoretic, and astringent. Root bark is also used for treating bile problems, cough, diarrhoea, and dysentery (Kunwar *et al.*, 2009). The plant is also part of formulations used for nootropic activity (Maciuk *et al.*, 2000).

The root and bark are important ingredients in many commonly used Ayurvedic preparations such as *Dasamula*, *Amartarista*, *Dantadyarista*, *Narayana Taila*, *Dhanawantara Ghrita*, *Brahma Rasayana*, *Chyavanprasa Awaleha*, and others (Balkrishna, 2005; Kumar *et al.*, 2009; Anonymous, 1998). The composition of drugs like *Chyavanprasha* and mental tonics includes various parts of *O. indicum* (Laupattarakasem *et al.*, 2003; Gupta *et al.*, 2008).

4.5. Edible Uses:

Almost all above-ground parts of *O. indicum* are edible. The seeds are a key ingredient in "Chyavanprash," a well-known Ayurvedic food tonic. The dried powdered seeds are often consumed with milk as a tonic or used to prepare a refreshing drink. Roasted seeds make an excellent addition to local sweet dishes. Additionally, the tender shoots and young fruits are used as vegetables, showcasing the versatile culinary applications of this plant. (Table.2; Fig.4).

Table; 2. Edible uses of *O. indicum*

S. N.	Parts used	Name of recipe	Method
1	Young Leaves & tender shoots	<i>Pakor</i> as, <i>Omelette</i> , <i>Kachru</i> , <i>Parantha</i> , <i>Kachuri</i> , leafy vegetable saag etc.	Finely chopped young leaves or shoot terminals of <i>O. indicum</i> , when combined with spices, are used in a variety of delicious dishes. They can be stuffed into dough to make <i>paranthas</i> , mixed with besan (gram flour) to prepare <i>kachru</i> (a traditional dish similar to chilla), or made into <i>pakor</i> as. The leaves can also be combined with eggs and spices to create a flavourful omelette. Additionally, they are often boiled with other edible greens and sautéed with spices to prepare a savoury vegetable dish, adding to the plant's versatility in the kitchen. To prepare Urad Dal and <i>O. Indicum</i> Leaf Kachori, start by making a dough with all-purpose flour, salt, yeast and ghee, adding water gradually to form a smooth, firm consistency, and let it rest. For the filling, mix coarsely ground, soaked urad daal with finely chopped leaves and spices to taste. Stuff it into small discs of dough, sealing the edges and shaping them into flattened balls. Heat oil in a deep pan and fry the kachoris on medium heat until golden brown and crispy. Serve hot with chutneys or spiced potato curry.
2	Flowers	<i>Rayata</i> , <i>Pakor</i> as, <i>Omelette</i> , <i>Kachru</i> , <i>Parantha</i> ,	To prepare a <i>rayata</i> , boil the flowers and sauté them with onions and spices. Once the mixture is well-cooked, combine it with curd to create a refreshing and flavourful dish.
3	Flower buds	Pickle	Boiled and sun-dried buds are mixed with spices and mustard seeds to enhance their flavour and create a savoury blend.
4	Young capsules	Sambhar, vegetable, <i>pasta</i> , <i>palau</i> , <i>dalia</i> , <i>oats</i>	Chopped fruits, along with other vegetables, an acidulant, and masoor dal, are boiled and sautéed with spices for sambhar making. For a vegetable dish, the fruits are sautéed with potatoes and seasoned with spices. Finely chopped young fruits can be addition to pasta, dalia and oats along with other seasonal vegetables.
5	Seeds	Dasamula, Amartarista, Dantyadyarista, Narayana Taila, Dhanawantara Ghrita, Brahma Rasayana, Chyavanaprasa Awaleha, etc	Roasted and powdered seeds are consumed as a tonic or used as key ingredients in widely recognized Ayurvedic preparations.

(Source: Author Compilation).

4.6. Economic significance:

Although various parts of *O. indicum* have commercial significance and are widely used in Ayurvedic preparations, its mature fruits are the primary source of income for many. These fruits are initially purchased by local and Kinnauri traders at relatively low prices and later sold in Kinnaur during fairs and festivals for a much higher price, ranging from Rs 150 to Rs 300, depending on the size of the fruit. Additionally, the bark and root powder of *O. indicum* can fetch up to Rs 50 to Rs 60 per kilogram in the local market, further contributing to the plant's economic value (Table.3 & Fig.4).

Table: 3. Market rate of *O. indicum*.

	Fruit size	Price in Rs in local/Nation market
1.	Large	25-50/250-300
2.	Medium	15-20/150-200
3.	Small	10-15/50-100

(Source: Author Compilation).



Fig. 5. Seeds offered for selling in Rewalsar Mandi HP.
(Source: Author Compilation).

Other Uses: It is used as fodder. Non-drying oil is extracted from its seeds that is used in the perfumery industry; stem bark and fruits are used as mordant, with the former also yielding a ‘khaki’-coloured dye and its wood is used to make matchboxes (Jain, *et al*, 2003)

V. Need for conservation:

In developing countries, approximately 80% of the population relies on traditional medicine, with plant-based remedies playing a significant role in primary healthcare. Globally, this figure is about 60%. According to the National Medicinal Plants Board, the annual demand for *O. indicum* is around 100 metric tonnes. Following the COVID-19 pandemic, there has been a notable surge in the use of herbal plants, further increasing the demand for valuable species like *O. indicum*. However, this growing demand has put immense pressure on the plant, especially in Himachal Pradesh, where it is harvested for its winged seeds, which are used in the traditional Kinnauri caps.

The harvesting of mature fruits, essential for seed dispersal, has led to unsustainable practices that threaten the natural population of *O. indicum*. Since the seeds are light and travel over long distances, the plant typically grows singly or in small groups, rarely forming large communities. The overharvesting of fruits and seeds has caused a significant decline in the plant's wild populations, making it increasingly vulnerable. The International Union for Conservation of Nature (IUCN) has already classified *O. indicum* as a vulnerable medicinal plant.

To bridge the gap between growing demand and limited supply, it is crucial to domesticate *O. indicum* and promote its cultivation in natural habitats. The plant can be propagated both through seeds and stem cuttings. Additionally, there is an urgent need to raise awareness about sustainable harvesting practices, such as habitat rotation and leaving some fruits on the parent plant to ensure the regeneration of the species. This will help secure the future of *O. indicum* while meeting industrial demands sustainably.

VI. Conclusion:

O. indicum is a highly valuable multipurpose plant with a wide range of uses, yet its full potential remains underutilized in the study area. Traditional knowledge surrounding its medicinal, cultural, and commercial benefits is rapidly declining, particularly among the younger generation, putting the plant at risk of extinction. Given its significance, there is an urgent need for the domestication and large-scale cultivation of *O. indicum* in forests or other natural habitats. Currently, only a small portion of the population utilizes this plant for medicinal or edible purposes. Therefore, it is crucial to raise mass awareness about its sustainable harvesting, as well as its potential as a food and food supplement, to unlock its medicinal and nutritional value. This would not only enhance public health but also contribute to ecological restoration and rural prosperity.

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