International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

Sustainable Management Potential of a neglected Wild Olive (*Olea cuspidata Wll.ex G. Don*) in Sudurpaschim Province of Nepal

Nabin Raj Joshi
Pragya Solution for Sustainable Development, Kathmandu, Nepal.
nabin2001@gmail.com
https://orcid.org/0000-0001-8741-2531

Type of Research: Original Research
Received: December 01, 2025 Revised & Accepted: March 27, 2026

Abstract

Background: Wild Olive (*Olea cuspidata*) is an ecologically and economically significant species in Nepal's Sudurpaschim Province, yet its production potential remains understudied.
Objectives: This study assessed Olive's distribution, growing stock, and habitat suitability across Bajura and Bajhang districts to inform sustainable management strategies.
Methods: This study employed a participatory resource mapping and Maximum Entropy (MaxEnt) modelling. Field data were collected from 62 concentric circular plots (500 m² each) across 12 Community Forests. Resource assessment followed the Non-Timber Forest Products Inventory Guideline and participatory inventory protocols.
Results: Results showed high regeneration density (mean 17,472±100.2 seedlings ha^{-1}), with mature tree density averaging 133±12.5 ha^{-1}. Total growing stock reached 753.6 tonnes, with an annual allowable harvest of 678.5 tonnes. Optimal productivity occurred on north-facing slopes at 1,300–1,400 m elevation. MaxEnt modelling identified 636 hectares of community forest area with high suitability for Olive cultivation in Sudurpaschim province.
Conclusion: The natural and wild Olive population holds a significant potential for sustainable management, value addition, processing and commercialization in Sudurpaschim Province. We recommend: (1) expanding cultivation in identified suitable areas, (2) developing processing infrastructure for value addition beyond crude oil, and (3) implementing certification schemes to enhance market access. These findings provide a blueprint for sustainable Olive management in the Himalayan region of Nepal.
Novelty: This study provides a comprehensive assessment of Wild Olive (*Olea cuspidata*) in Sudurpaschim province, integrating MaxEnt habitat modelling with community-based

phytosociology and value chain analysis to establish a scientific baseline for its sustainable commercialization and conservation.

Keywords: Non-timber forest products, Sustainable harvesting, Species distribution modelling, Community forestry, Nepal Himalayas

Introduction

Sudurpaschim Province, encompassing the former far-western development region of Nepal, occupies approximately 13.27% (19,539 km²) of the country's total geographical area (CBS, 2021). Despite being endowed with rich natural resources, the province faces significant development challenges, reflected in a high poverty incidence and a low human development index of 0.435 (GoN-NPC & UNDP, 2014). Approximately one-third (33.56%) of the population lives below the poverty line (NPC, 2018), and the province contributes only 6.37% to the national gross domestic product.

In response to these economic challenges, the Government of Sudurpaschim has prioritized key sectors including agriculture, tourism, hydropower, and high-value non-timber forest products (NTFPs), with particular emphasis on medicinal and aromatic plants (MAPs). Provincial budget allocations aim to develop an independent economy through fair resource distribution and value chain enhancement of MAPs production and export (MoFSC, 2019). While substantial quantities of NTFPs such as Rittha (*Sapindus mukorossi*), Tejpat (*Cinnamomum tamala*), and Amala (*Phyllanthus emblica*) are traditionally exported to India and China, most are traded in raw or semi-processed forms, capturing minimal value for local communities (Subedi, 2006).

Medicinal and aromatic plants have been integral to Nepalese livelihoods for millennia. Approximately 20% of Nepal's native flora (2,331 of 11,971 species) possess documented medicinal properties (Rajbhandari & Adhikari, 2009). The NTFP/MAP sector contributes significantly to rural household incomes, with an estimated 10% of rural households engaged in commercial collection (Pyakurel et al., 2018). However, systematic efforts to promote, develop, and upgrade this subsector remain limited.

This study focuses specifically on *Olea cuspidata* (commonly known as Wild Olive), a valuable indigenous species occurring in Nepal's Trans-Himalayan zone between 500–2,600 meters elevation. Notable populations exist in Sudurpaschim Province, particularly in Budhinanda Municipality, Himali Rural Municipality, Swamikartik Rural Municipality of Bajura, and Bungal Municipality of Bajhang. Various plant parts (fruits, seeds, roots, stems, leaves) are commercially utilized for medicinal purposes, oil extraction, wood, and fodder (Ghimire et al., 2016). Despite its acknowledged significance, critical knowledge gaps persist regarding conservation, cultivation, management, processing, value addition, and market dynamics. Comprehensive data on spatial distribution, growing stock, and sustainable harvest levels remain largely unavailable—information essential for developing effective enterprise models and rural development policies aimed at improving livelihoods and reducing poverty among marginalized households.

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

The altitudinal heterogeneity and specific climatic conditions in Sudurpaschim's montane topography create favourable environments for numerous high-value NTFPs/MAPs. Rising market demand and prices for these species highlight significant potential for commercial cultivation and entrepreneurial development. Local communities possess invaluable indigenous knowledge regarding collection, harvesting, processing, and marketing knowledge crucial for sustainable enterprise development and poverty mitigation (Shackleton et al., 2011).

Research objectives

This study aims to assess the present status of the wild olive populations, vegetation analysis and species distribution information of *Olea cuspidata*, with the following specific objectives:

- Generate a robust technical baseline for sustainable management and conservation of Olive resources;
- Quantify existing growing stock and annual allowable harvest to inform sustainable harvesting quantities;
- Identify potential areas for expanding Olive cultivation in both natural forests and private lands.

Review of Literature

Olive (*Olea europaea* L.) is an ancient crop with a domestication history deeply intertwined with Mediterranean civilizations. Archaeological and palaeobotanical evidence suggests olive cultivation dates back to the fourth millennium BC in regions such as Palestine, Crete, and Syria, with its spread across the Mediterranean facilitated by Phoenician, Greek, and Roman expansions (Zohary and Spiegel-Roy, 1975; Van Zeist, 1980). Olive cultivation later extended to the Americas, South Africa, Australia, and parts of Asia, making it a globally significant species. The olive's resilience to poor soils, its long lifespan, and its multipurpose uses particularly for oil have sustained its economic and cultural importance across millennia (Zohary, 1993). The species includes several subspecies, among which *Olea europaea* var. *sativa* is the most widely cultivated, while wild relatives such as *O. cuspidata* are valued for their adaptability and use as rootstocks. Olive belongs to the family Oleaceae, which comprises about 30 genera and 600 species. The genus *Olea* includes both cultivated and wild forms, differentiated by morphological, physiological, and genetic traits. Wild olives, such as *Olea cuspidata*, typically exhibit higher genetic variability and are cross-pollinated, whereas cultivated varieties are often self-pollinated and maintained through vegetative propagation (Simmonds, 1976). Ecologically, olive trees are evergreen, drought-tolerant, and capable of growing on marginal soils, making them suitable for restoration and agroforestry systems. Their ability to thrive in Mediterranean-like climates characterized by hot, dry summers and mild, wet winters has enabled their introduction to regions with similar bioclimatic conditions, including parts of South Asia.

In Asia, wild olive species are naturally distributed across the Himalayan and sub-Himalayan regions. *Olea cuspidata* (syn. *O. ferruginea*) is native to the pre-Himalayan range, extending from Pakistan through Nepal to southwestern China. These wild populations are adapted to

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

elevations between 500–2600 meters above sea level and often occur in dry, temperate forests alongside species such as *Artemisia* and steppe grasses. Regional studies highlight the ecological role of wild olives in stabilizing slopes, providing fuelwood and fodder, and supporting biodiversity in fragile mountain ecosystems.

In Nepal, wild olive (*Olea cuspidata*) is naturally found in the high mountain districts of Bajura, Dolpa, Humla, Rukum, Bajhang, and Mugu. The species is locally known as *Launthao* or *Lotto* and is classified as "Rare" in the IUCN-based Red Data Book for Nepal (Shrestha & Joshi, 1996). Despite its ecological and potential economic value, wild olive remains understudied and inadequately documented in national forest inventories. Early reports by the Tree Improvement and Silviculture Component (TISC, 2002) note its occurrence in Trans-Himalayan high alpine vegetation but lack detailed distribution or status assessments. Wild olives in Nepal are primarily associated with the Karnali River basin and its tributaries, where Mediterranean-like winter rainfall creates suitable microclimates. The FAO (1999) identified Bajura district particularly areas like Kaligod, Kolt, and Boldhik as a prime distribution site at around 2192 meters elevation. Vegetation surveys describe scattered olive stands within dry temperate forests, often mixed with grasses and shrubs. However, these ecosystems are increasingly fragmented due to deforestation, overgrazing, and agricultural expansion, leading to population declines in many areas. The conservation status of wild olive in Nepal is precarious. The species faces multiple threats, including illegal cutting for fuelwood and timber, overgrazing, habitat conversion, and lack of awareness among local communities and government agencies. The Nepal Biodiversity Strategy (2002) identified inadequate baseline data and poor coordination among stakeholders as major impediments to conservation. Additionally, wild olive forests are not represented in national topographic maps or forest resource databases, further marginalizing them in policy and planning.

Wild olive holds significant socio-economic potential for poverty alleviation in remote mountain regions. The fruit can be processed into oil, pickles, and other products, offering income opportunities for rural communities. Studies by Dhakal et al. (2008) highlight the role of non-timber forest products, including olive, in supporting livelihoods in Bajura. However, limited technical knowledge, lack of processing facilities, and weak market linkages constrain its commercial development. Community-based enterprises, supported by projects such as FAO's "Promotion of Olive Production and Consumption in Nepal," have demonstrated feasibility but require scaling up.

Methods

Study area

The study was conducted in Bajura district of Sudurpaschim province of Nepal (Fig1). The area covers a temperate ecological zone ranging from 2,500 m to 4,700 m altitude. The three selected municipalities from Bajura which formed the primary study sites for this study. The data illustrates a landscape dominated by forest cover, with total areas ranging significantly. Budhinanda Municipality (Bajura) has the highest forest percentage at 62.2%, followed by

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

Swamikartika Rural Municipality, both at 56.1%. The expansive Himali Rural Municipality, while having the largest absolute forest area (~40,198 ha), shows a slightly lower relative forest cover of 48.6%, likely due to its high-altitude, non-forested alpine terrain. Cumulatively, the study area spans over 161,283 hectares, of which approximately 85,746 hectares (53.2%) is forested. This substantial forested area across diverse municipalities provided a robust spatial framework for sampling the inventory plots across different management regimes and ecological zones within the region.

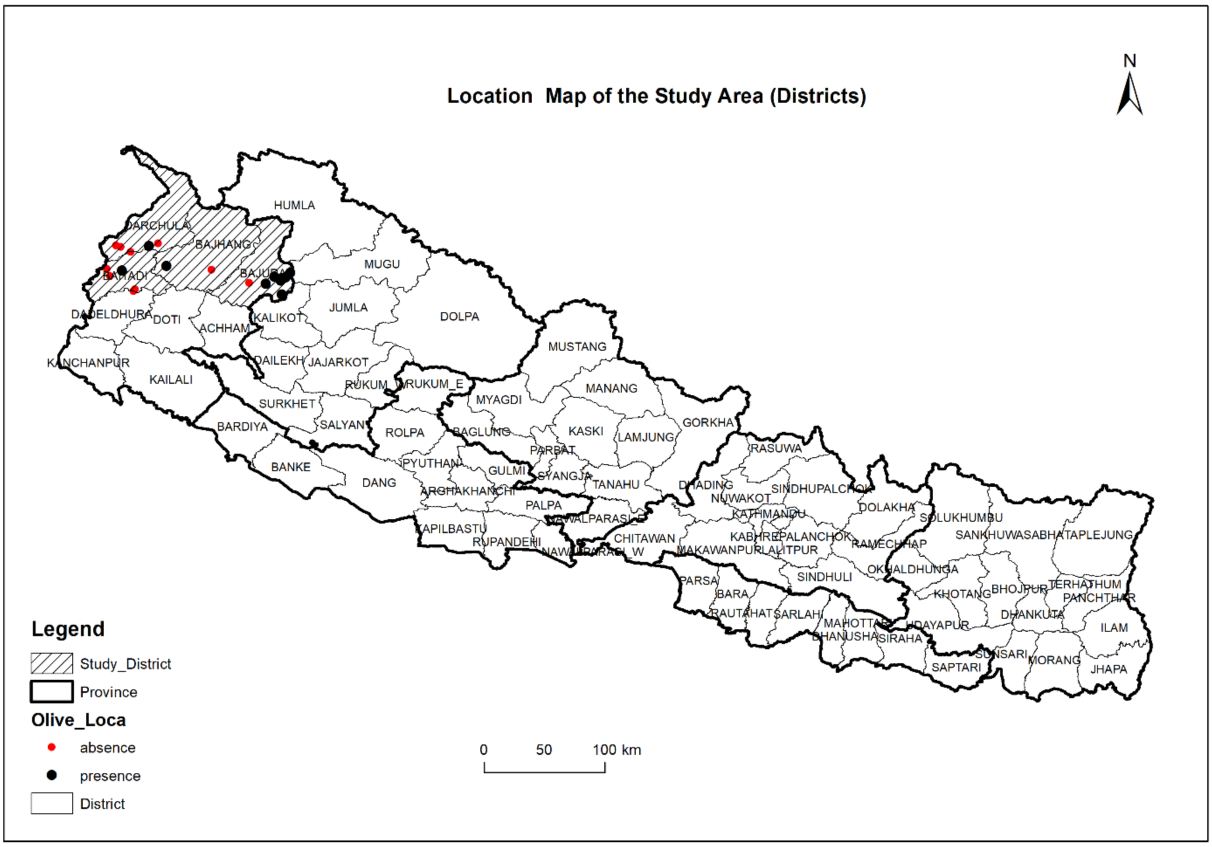

Figure 1:Map showing the study sites

The foundational methodological paradigm employed in this study was inherently participatory and consultative. This approach systematically explored and investigated the biophysical conditions of *Olea europaea* resources within privately, communally, and state-governed forest domains across the Bajura district of far-western Nepal.

This study adhered rigorously to established methodological standards and guidelines, specifically the Non-Timber Forest Products Inventory Guideline (GoN, 2012) and the Participatory Inventory of Non-Timber Forest Products toolkit (ANSAB, 2010). The resource assessment primarily focused on the enumeration of target species, measurement of regeneration indices, and meticulous estimation of Olive growing stock. Participatory

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

instrumentation, complemented by a review of secondary materials, facilitated information triangulation. Established mathematical equations and empirical conversion factors were employed for precise calculation of ecological parameters, encompassing frequency, density, dry weight, and overall growing stock of *Olea europaea*.

After identifying the potential forests incl. private olive farms and delineating the boundaries of potential area during the participatory resource mapping. The study team digitized and produced potential area map through digitization process in Arc GIS 10.2.2. For the CFUGs level resources assessment, a sampling intensity of 0.1% to 0.05% of potential habitat was maintained depending on size of species distribution area. The sampling was taken based on CF inventory guideline 2061 of the Government of Nepal.

The targeted Olive species in this assessment represents three life forms. Thus, we used a co-centric circular plot of 500 m^2 with a radius of 12.62 meter as a standard sample plot size. Based on the sampling intensity and size of sample plots, a total of 62 co-centric circular sample plots were estimated for detailed resources assessment for the targeted species in 12 CFs and one private Olive farms in Bajura districts. Some forests provided habitat for multiple NTFPs species, and the other important species occurred in these plots.

A multistage sampling technique was systematically applied for the strategic selection of study districts, local administrative echelons, Community Forest User Groups (CFUGs), and private agricultural landholdings. This hierarchical approach facilitated robust estimation of prioritized Non-Timber Forest Product resource abundance and availability within natural forest ecosystems, acknowledging the impracticality of surveying entire geographical areas. The sampling process was disaggregated into sequential stages, progressively refining units into circumscribed, specific, and homogeneous entities.

Sampling Intensity

Subsequent to the definitive identification of potential forest areas, inclusive of private *Olea europaea* cultivation sites, and the precise delineation of potential area boundaries during the participatory resource mapping phase, the research team proceeded to digitize and generate a comprehensive potential area map. This was accomplished through the proficient utilization of the digitization capabilities inherent in Arc Map 10.2.2. For the CFUG-level resource assessment, a meticulously maintained sampling intensity ranging from 0.1% to 0.05% of the potential habitat was rigorously upheld. The precise intensity applied was judiciously determined by the demonstrable size of the species distribution area, with all sampling procedures strictly adhering to the CF inventory guideline 2061 stipulated by the Government of Nepal.

Field Data collection

A systematic field protocol was implemented to gather comprehensive ecological data across all sample plots. The geographic location of each plot center was precisely recorded using high-accuracy GPS devices. For all trees within the sampling radius, Diameter at Breast Height (DBH) was measured using a diameter tapes, while total tree height was determined using a Vertex-IV and Transponder. Regeneration was quantified by conducting exhaustive counts of all seedlings (height <1 m) and saplings (height ≥ 1 m, DBH <10 cm) within designated nested

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

subplots. For phenological assessment, a standardized fruit sampling method was employed, collecting fresh fruit from representative lower, middle, and upper canopy branches to account for intra-crown variability. Furthermore, key environmental variables including aspect (using a compass), slope gradient (measured with a clinometer), and elevation (verified via GPS altimeter) were documented at each plot to contextualize the regeneration data within its topographic setting.

Data Analysis

The collected data underwent a dual analytical approach, encompassing both qualitative and quantitative methodologies. Information derived from focus group discussions and key informant surveys was subjected to qualitative analysis, employing a descriptive methodological framework. Conversely, data obtained from field and plot-level assessments were quantitatively analyzed through the proficient utilization of MS-Excel and R-Core development software. The Max-Ent model was additionally employed for specific distribution modeling analyses. This analytical phase was specifically directed towards the precise calculation of pivotal parameters, including effective area, NTFP frequency and density, total fresh and dry growing stock, and annual allowable harvest (AAH) quantity.

Frequency of occurrence: Frequency represents the proportion of sampling units in which a particular species is present, thereby reflecting its dispersion as a percentage of occurrence (Raunkiaer, 1934; Zobel et al., 1987).

$$\text{Frequency (F)} = \frac{Total\ number\ of\ plots\ in\ which\ species\ \text{"A"}occured}{Total\ number\ of\ plots\ sampled} \times 100$$

Density

Density is rigorously defined as the total number of individuals of a given species per unit area, providing a quantitative measure of the species' numerical strength within a specific ecological community (Zobel et al., 1987).

$$\text{Density (plants/ha)} = \frac{\text{Total number of Individyals of species "A"}}{\text{Total number of quadrats sampled} \times \text{Area of quadrats } (m^2)} \times 10000$$

Effective area (ha)

The effective habitat (expressed in hectares) for *Olea europaea* was estimated by integrating the potential habitat, as meticulously delineated from district and CFUG-level participatory resource mapping, with the species frequency of occurrence obtained from plot-level inventory data.

Effective area of Olive (ha)=Potential habitat of species "A" (ha)×frequency of occurrence (%)

Growing Stock

Growing stock was estimated in terms of kilograms per hectare and subsequently converted to total metric tonnes across the entire forest area. During the field survey, the fresh weight of sampled *Olea europaea* fruits was precisely measured from the field plots through a process of destructive harvesting. The corresponding dry weight of these fruits was then estimated utilizing a predefined conversion factor (cf). The dry weight of a species, when multiplied by the Annual Allowable Harvest (AAH) factor, yielded the AAH amount. AAH factors were

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

applied as recommended by the ANSAB's participatory NTFPs inventory toolkit (ANSAB, 2010) and the NTFP inventory guideline of the Department of Forests, Government of Nepal (2012).

Species Distribution Modelling

Maximum Entropy (MaxEnt) modelling was implemented using the sdm package in R (Phillips et al., 2006). Nineteen bioclimatic variables from WorldClim (Fick & Hijmans, 2017) were used with species occurrence points to predict habitat suitability. The output probability map (0-1) was reclassified into three suitability classes using natural breaks (Jenks) method.

Statistical Analysis

Principal Component Analysis (PCA) was conducted to examine relationships between environmental variables (aspect, elevation, slope) and Olive productivity. Box-and-whisker plots were generated to visualize productivity variation across CFUGs. Statistical analyses were performed in R software (R Core Team, 2022).

Results

Frequency, Density and Effective area of Olive Species

The frequency, density and effective area of *Olea europaea* within the Community Forest User Groups (CFUGs) of Bajura district, Nepal, is systematically presented in Table 4. The discernible presence of mature plants serves as an indicator of currently harvestable products, whereas the presence of regeneration signifies juvenile and naturally germinated individuals not yet amenable to immediate harvesting but possessing considerable future harvesting potential. Based upon the data articulated in Table 1, the highest frequency of *Olea europaea* was recorded at 78% within Kalika CF, while the lowest frequency was observed at 43% in Bhawanimandu CF of Bajura district. Likewise, the density of regenerating individuals serves to indicate future harvesting potential, while the density of mature plants directly reflects the current availability of harvestable products. As per the data contained within Table 5, the highest density of regeneration, amounting to 140 individuals per hectare, was observed in Bhamkedhaireni CF of Bajura. Conversely, the lowest density of regeneration, registering 36 individuals per hectare, was recorded in Thadomela CF. Similarly, the highest density of mature *Olea europaea*, comprising 226 individuals per hectare, was observed in Bhawanimandau CF, with the lowest density, at 80 individuals per hectare, being documented in Dhimsera CF. Finally based on the mean frequency the effective area of Olive within the selected CFUGs was estimated. The current investigation ascertained that a total of 417.8 hectares of forest area constituted an effective habitat for *Olea europaea* species within the CFUGs of Bajura. The largest effective area, spanning 130 hectares, was quantified in Kalarishi CF, whereas the smallest effective area was observed in Bhawanimandau CF.

International Journal of Atharva
IJA
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

Table 1: Frequency of Olive in the CFs of Bajura

CF Name	Frquency (%)	Density of regeneration	Density of mature plants	Effective area (ha)
Bhawanimandau	43	140	220	3.3
Bhamkedhaireni	67	100	226	10.0
Dhimsera	75	60	80	60.0
Kalarishi	62	100	120	130.0
Kalika	78	40	80	70.0
Maluwapahad	50	60	120	10.0
Ragaumata	50	100	83	20.0
Samundrapalgadhi	50	80	100	4.5
Saunegaun kuragad	56	40	100	10.0
Simaili	70	80	120	70.0
Thadomela	71	36	100	20.0
Tusare	77	60	81	10.0
Total				**417.8**

Growing Stock (GS) and Annual Allowable Harvest (AAH) Quantity of Olive

The mean growing stock of the Olive was found to be highest (3217.5 kg ha^{-1}) in the Bhamkedhaireni CF of while the lowest (509.1 kg ha^{-1}) was observed in Dhimsera CF of Bajura district. The total growing stock in all 12 CF was found to be 753 .6 tonne and the annual allowable harvest or sustainable harvest amount was found to be 678.5 tonne (Table 2).

Table 2: Mean and total growing stock with AAH of Olive in CFs of Bajura

CF Name	Effective area (ha)	Mean GS (Kg ha^{-1})	Total GS (Kg)	Total GS (Tonne)	Total AAH (Tonne)
Bhawanimandau	10.0	3,111.0	31,109.6	31.1	28.0
Bhamkedhaireni	3.3	3,217.5	10,725.1	10.7	9.7
Dhimsera	60.0	509.1	30,547.2	30.5	27.5
Kalarishi	130.0	3,094.7	402,308.4	402.3	362.1
Kalika	70.0	874.7	61,227.6	61.2	55.1
Maluwapahad	10.0	689.7	6,896.8	6.9	6.2
Ragaumata	20.0	1,255.0	25,100.8	25.1	22.6
Samundrapalgadhi	4.5	1,339.4	6,027.3	6.0	5.4
Saunegaun kuragad	10.0	1,617.6	16,176.4	16.2	14.6
Simaili	70.0	1,527.4	106,915.2	106.9	96.2
Thadomela	20.0	1,826.3	36,526.4	36.5	32.9
Tusare	10.0	2,020.2	20,202.0	20.2	18.2
Total	**417.8**		**753,762.8**	**753.6**	**678.5**

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

The box and whisker plots (Fig 2) effectively illustrate the visual patterns of *Olea europaea* productivity and production potential within the selected 12 CFUGs of Bajura district. These plots systematically present large datasets in terms of mean and median values. Furthermore, extreme values are graphically depicted, which serve to indicate the potential productivity of a particular species up to an optimal level, contingent upon the implementation of sustainable forest management practices. Figure 5 additionally indicates that Bhamkedhaireni, Bhawanimandau, and Kalarishi CFs exhibit the most substantial per-hectare spreadness in productivity, whereas Maluwapahad and Tusare CFs demonstrate the minimum spreadness within Bajura.

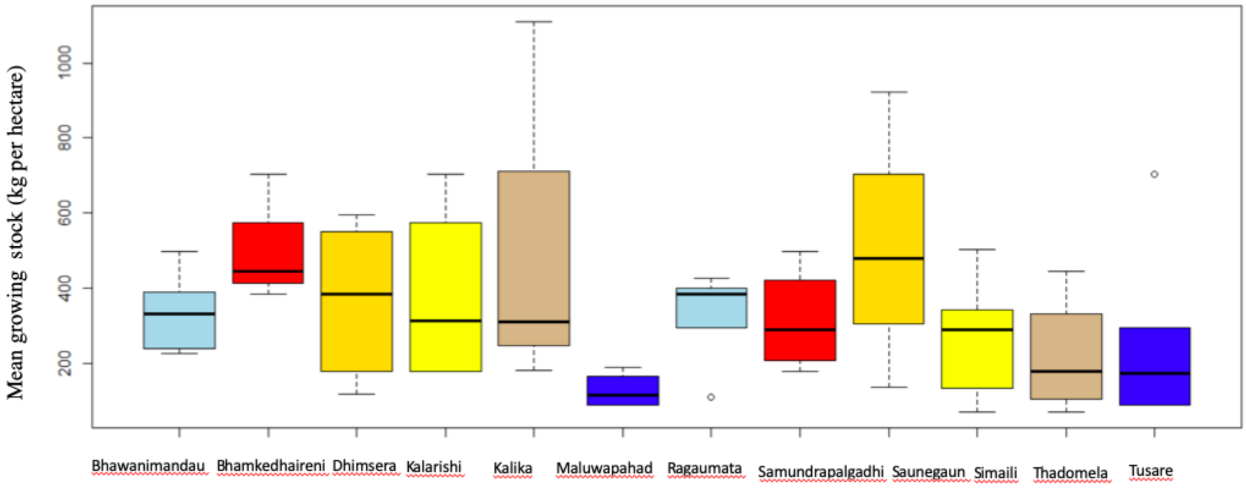

Figure 2: Box and whisker plot showing productivity and production potential of Olive

A highly significant and positive correlation was observed between the tree basal area and the mean growing stock with the principal component analysis with the aspect shows that the N, NW, NE and SE aspects are the best suitable for the production of Olive showed the highest yield in these aspects with strong correlation (Fig 3).

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

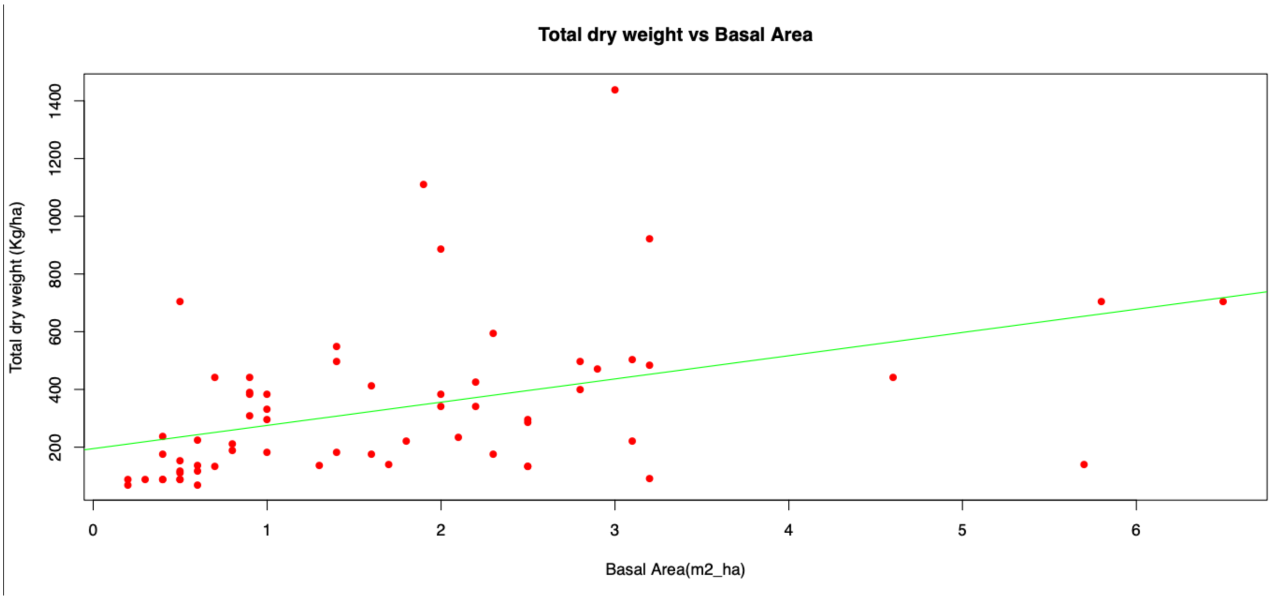

Figure 3: Relationship between tree basal area and mean growing stock

Discussion

The comprehensive assessment of *Olea europaea* resources in the Bajura district of Sudurpaschim Province corroborates the significant potential for its production, processing, value addition, and marketing, contingent upon the implementation of sustainable forest and biodiversity management practices. The quantifiable abundance of this high-value resource suggests its capacity to serve as a pivotal source of cash income, thereby contributing to the livelihoods of forest-dependent populations within the province.

The identified total growing stock of 753.6 tonnes and an Annual Allowable Harvest (AAH) of 678.5 tonnes underscore the substantial and sustainable supply of *Olea europaea* available for utilization. This quantitative baseline is crucial for developing management plans that prevent overexploitation while maximizing economic returns. The observed variation in mean growing stock across different Community Forests (ranging from 509.1 kg ha^{-1} to 3217.5 kg ha^{-1}) highlights the heterogeneous distribution and productivity of *Olea europaea* within the study area, necessitating localized management strategies to optimize yield.

Furthermore, the habitat suitability analysis, incorporating Max-Ent modeling and Principal Component Analysis (PCA), provides critical insights into the ecological preferences of *Olea europaea*. The identification of North, Northwest, Northeast, and Southeast aspects as most conducive for production, coupled with optimal elevation ranges between 1300-1400m, offers invaluable guidance for future cultivation efforts and land use planning. These findings suggest that strategic expansion of Olive cultivation should prioritize areas exhibiting these specific environmental characteristics to maximize productivity and ensure ecological suitability. The strong positive correlation observed between tree basal area and mean growing stock further reinforces the importance of forest stand dynamics in influencing Olive productivity, implying that management interventions aimed at optimizing tree health and growth could yield substantial benefits.

While the potential for *Olea europaea* is evident, the study also identifies several pervasive threats to its sustainable management. Forest fires, uncontrolled grazing, lopping for fodder, the proliferation of invasive alien species, and soil erosion collectively undermine the long-term productivity and ecological integrity of Olive habitats. These threats necessitate immediate and concerted conservation efforts, including the development and implementation of robust fire management protocols, controlled grazing regimes, and strategies for invasive species eradication.

The current state of Olive value chain in Bajura indicates rudimentary processing activities, primarily limited to oil extraction, with minimal product diversification. This presents a significant opportunity for enhancing value addition through the development of diversified products, such as jams, pickles, and handicrafts. Strengthening market linkages and networks is also critical, as the present marketing infrastructure appears limited. Promoting business planning, entrepreneurship development training, and fostering business-to-business (B2B) connections through buyer-seller meetings and trade fair participation could substantially improve the commercial viability of Olive products.

In light of the findings, the establishment of supportive policies and robust infrastructure is indispensable for fully realizing the economic potential of *Olea europaea*. Agricultural policies encompassing subsidies, grants, training, and research and development are required to incentivize cultivation. Land use policies should designate suitable zones and ensure tenure security to encourage long-term investment. Financial policies, including accessible credit facilities and insurance schemes, are vital for farmers and processors. Moreover, trade and export policies, emphasizing incentives, quality standards, and certification, are necessary to facilitate market penetration.

The successful implementation of these policies must be complemented by the development of essential infrastructure, including efficient irrigation systems, soil testing laboratories, modern olive oil mills, appropriate storage facilities, improved road networks, and effective supply chain management. Furthermore, a well-developed market information system and strategic marketing campaigns are crucial for establishing Nepali Olive oil as a recognized brand in both domestic and international markets.

The proposed sustainable enterprise management model, centered around an Enterprise Management Committee (EMC) overseen by a lead CFUG and supported by an Enterprise Management Coordination Committee (EMCC), offers a structured framework for community-led sustainable management. This model underscores the importance of local ownership and equitable benefit sharing. For the enterprise to operate at full capacity, the expansion of Olive cultivation to encompass a larger area (estimated at 100-250 hectares) is indicated, necessitating active management of existing wild populations and promotion of cultivation in suitable, abandoned lands.

Conclusion

The comprehensive resource assessment of *Olea europaea* within the Bajura district of Sudurpaschim Province unequivocally demonstrates substantial potential for its sustainable production, processing, value addition, and market integration. This offers a pivotal mechanism for income generation, directly enhancing forest-dependent livelihoods. The quantifiable abundance, evidenced by total growing stock and annual allowable harvest, indicates significant opportunities for sustainable utilization and economic advancement. Moreover, Nepal's rich mountainous NTFP biodiversity accentuates broader sustainable trade prospects. Promoting responsible harvesting and strategic value addition can fortify local economies while safeguarding fragile ecosystems.

Based on these findings, selected Community Forest User Groups (CFUGs) possess formidable potential for managing and economically exploiting wild *Olea europaea* through sustainable harvesting and localized value-adding enterprises. This necessitates a fundamental paradigm shift to enterprise-driven community forest management, requiring detailed resource assessments, stringent harvesting protocols, domestication efforts, and strategic processing development. Crucially, augmenting CFUG institutional capacity is essential for proactive responsiveness to resource threats and safeguarding community interests.

Ultimately, this study underscores the imperative for systematic, long-term research into sustainability, complemented by robust forest certification schemes. These measures are vital for fostering responsible management and ethical practices concerning *Olea europaea*, significantly contributing to its sustainable and efficient management and regional livelihood amelioration.

Acknowledgments

The author thanks the all the local communities, Community Forest User Groups, and traditional knowledge holders of Bajura district for their invaluable cooperation and sharing of indigenous knowledge. We acknowledge the support of field assistant.

Conflict of Interest

The author declares no conflicts of interest.

International Journal of Atharva
Vol. 4, No. 1, February 2026. Pages: 14-28
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: 10.3126/ija.v4i1.92370

References

Agrawal, A., & Gibson, C. C. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development*, 27(4), 629-649.

Bartolucci, P., & Dhakal, B. R. (1999). Prospects for Olive Growing in Nepal. FAO TCP/NEP/6713.

Biodiversity Profile Project (BPP). (1995). Biodiversity Profile of High Mountain/High Himalayan Physiographic Zones. Department of National Parks and Wildlife Conservation, Nepal.

ANSAB. (2010). *Participatory inventory of non-timber forest products*. Asia Network for Sustainable Agriculture and Bioresources, Kathmandu, Nepal.

Cantini, C., Cimato, A., & Sani, G. (2008). Morphological evaluation of olive germplasm present in Tuscany region. *Euphytica*, 116(3), 317-322.

Central Bureau of Statistics (CBS). (2021). *National population and housing census 2021*. Government of Nepal, Kathmandu.

Cocksedge, W. (Ed.). (2006). *Incorporating non-timber forest products into sustainable forest management: An overview for forest managers*. Royal Roads University, Victoria, Canada.

Dhakal, B. R., & Regmi, A. (2008). Jaitoon: Promotion of Olive Production and Consumption in Nepal. FAO Project Publication.

DoF. (2012). *NTFPs inventory guideline*. Department of Forests, Ministry of Forests and Soil Conservation, Government of Nepal, Kathmandu.

FAO. (1999). Olive Production Development Project. Field Document, Nepal.

Fick, S. E., & Hijmans, R. J. (2017). WorldClim 2: New 1-km spatial resolution climate surfaces for global land areas. *International Journal of Climatology*, 37(12), 4302-4315.

Gerber, M. (1994). Olive oil and cancer. In *Epidemiology of Diet and Cancer* (pp. 263–275). Ellis Horwood.

Ghimire, S., Thapa, B., & Poudel, B. (2016). Export of medicinal and aromatic plants from Nepal: An analysis of COMTRADE data (2005-2014). *Nepal Economic Forum*, 12(1), 45-62.

GoN-NPC & UNDP. (2014). *Nepal human development report 2014*. Government of Nepal - National Planning Commission & United Nations Development Programme, Kathmandu.

Lange, D., & Schippmann, U. (1997). *Trade survey of medicinal plants in Germany*. Bundesamt für Naturschutz, Bonn, Germany.

McGeoch, L., Gordon, I., & Schmitt, J. (2008). Impacts of land use, anthropogenic disturbance, and harvesting on an African medicinal liana. *Biological Conservation*, 141(9), 2218-2229.

MoFSC. (2019). *Forestry sector strategy 2019-2023*. Ministry of Forests and Soil Conservation, Government of Nepal, Kathmandu.

Nepal Biodiversity Strategy. (2002). Ministry of Forests and Soil Conservation, Government of Nepal.

NPC. (2018). *Multidimensional poverty index*. National Planning Commission, Government of Nepal, Kathmandu.

Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3-4), 231-259.

Pyakurel, D., Bhattarai Sharma, I., & Smith-Hall, C. (2018). Patterns of change: The dynamics of medicinal plant trade in far-western Nepal. *Journal of Ethnopharmacology*, 224, 323-334.

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria.

Rajbhandari, K., & Adhikari, M. K. (2009). *Endemic flowering plants of Nepal, Part I*. Department of Plant Resources, Kathmandu, Nepal.

Shrestha, T. B., & Joshi, R. M. (1996). Rare, Endemic and Endangered Plants of Nepal. WWF Nepal.

Simmonds, N. W. (1976). Evolution of Crop Plants. Longman.

Tree Improvement and Silviculture Component (TISC). (2002). Forest and Vegetation Types of Nepal. TISC Document Series No. 105.

Shackleton, C., Shackleton, S., Shanley, P., & Ndoye, O. (2011). Non-timber forest products: Concept and definitions. In S. Shackleton, C. Shackleton, & P. Shanley (Eds.), *Non-timber forest products in the global context* (pp. 3-21). Springer.

Shrestha, K. K., Tiwari, N. N., & Ghimire, S. K. (2000). Medicinal and aromatic plants database of Nepal (MAPDON). In *Proceedings of Nepal-Japan Joint Symposium on Conservation and Utilization of Himalayan Medicinal Plant Resources* (pp. 53-74).

Subedi, B. P. (2004). Conservation and use of medicinal and aromatic plants in Nepal: Status and prospects. Asia Network for Sustainable Agriculture and Bioresources (ANSAB), Kathmandu.

Subedi, B. P. (2006). *Linking plant-based enterprises and local communities to biodiversity conservation in Nepal Himalaya*. Adroit Publishers, New Delhi.

Subedi, B. P., Ghimire, P. L., Koontz, A., Khanal, S. C., Katwal, P., Sthapit, K. R., & Mishra, S. K. (2014). Private sector involvement and investment in Nepal's forestry sector: Status, prospects and ways forward. *Multi Stakeholder Forestry Programme Working Paper*, 14(2), 1-45.

Trichopoulou, A., et al. (1995). Consumption of Olive Oil and Specific Food Groups in Relation to Breast Cancer Risk in Greece. *Journal of the National Cancer Institute*, 87(2), 110–116.

Zobel, D. B., Jha, P. K., Behan, M. J., & Yadav, U. K. R. (1987). *A practical manual for ecology*. Ratna Book Distributors, Kathmandu, Nepal.