PU Journal of Science and Engineering
Purbanchal University Science and Engineering Campus
Biratnagar
ISSN: XXXX-XXXX

Phytosociology and Production Potential of Wild Olive ($Oleacuspidate Wall.ex G.Don$) in Western Central Himalayas' of Nepal

Krishna Prasad Sigdel[1], Hem Raj Bista[2], Nabin Raj Joshi[3*], Bijay Lal Pradhan[4*]

Received: 03 Nov 2025 / Accepted: 15 Jan 2026

Abstract

Wild Olive (*Olea cuspidata*) is an ecologically and economically significant species in Nepal's Sudurpaschim Province, yet its production potential remains understudied. This research paper assessed Olive's distribution, growing stock, and habitat suitability across Bajura and Bajhang districts using participatory resource mapping and MaxEnt modeling. Results showed high regeneration density (17,472 $\pm$ 100.2 seedlings ha^{-1}), with mature tree density averaging 133 $\pm$ 12.5 ha^{-1}. Total growing stock reached 753.6 tonnes (annual allowable harvest: 678.5 tonnes), with optimal productivity on north-facing slopes at 1,300–1,400 m elevation. Value chain analysis revealed limited processing (crude oil only), highlighting opportunities for product diversification. We recommend (1) expanding cultivation in 636 ha of community forests, (2) policy incentives for processing infrastructure, and (3) certification to enhance market access. These findings provide a blueprint for sustainable Olive management in the Himalayas.

Keywords: *Oleacuspidate* • Non-timber forest products • Sustainable harvesting • Species distribution modeling • Nepal Himalayas

1. Introduction

Sudurpaschim Province, the erstwhile Far-Western Development Region of Nepal, occupies approximately 13.27% of the total geographical area of the country (Government of Sudurpashchim Province, 2023). Despite being endowed with abundant natural resources, the province faces serious development bottlenecks, as reflected in a high incidence of poverty and a low Human Development Index (HDI) of 0.435 (National Planning Commission, Government of Nepal and United Nations Development Programme, 2014). More than one-third of the population (33.56%) lives below the poverty line (NPC, 2018), and the province contributes only

[1] Innovative Vision Pvt. Ltd., Kathmandu, Nepal
[2] Forest Directorate, Sudurpaschim Province, Dhandhadhi, Kailali, Nepal
[3] Pragya Solutions for Sustainable Development, Kathmandu
[4] Amrit Campus, Tribhuvan University, Nepal

[1]Corresponding authors:
nabin2001@gmail.com
bijaya.pradhan@ac.tu.edu.np

6.37% to the national gross domestic product.

Against the backdrop of economic growth prospects, the Government of Sudurpaschim Province has accorded high priority to key sectors such as agriculture, industry, tourism, hydropower, forestry, and high-value non-timber forest products (NTFPs), with particular emphasis on medicinal and aromatic plants (MAPs). This policy direction is further reinforced through provincial budgetary allocations aimed at fostering an independent and socialistic economy through equitable resource distribution and the promotion of MAP production and export via value chain enhancement (Asia Network for Sustainable Agriculture and Bioresources (ANSAB) and SNV Nepal, 2003; Subedi, 2004). Although substantial quantities of NTFPs/MAPs—such as Rittha (*Sapindus mukorossi*), Tejpat (*Cinnamomum tamala*), and Amala (*Phyllanthus emblica*)—are traditionally exported from the region, primarily to India and China, most are traded in raw or semi-processed forms. Consequently, despite considerable export potential, the province has been unable to fully capitalize on these opportunities due to institutional immaturity, limited technical capacity, and constrained financial and physical resources.

Medicinal and aromatic plants and other NTFPs have constituted an integral component of Nepalese livelihoods for millennia. Approximately one in five of Nepal's native flowering plant species (2,331 out of 11,971) is known to possess medicinal properties (World Health Organization, 2002). Annually, NTFPs/MAPs worth several million US dollars are harvested and exported, contributing substantially to rural household incomes; nearly 10% of rural households are engaged in their commercial collection (Subedi, 2001). Despite their socio-economic importance, efforts to systematically promote, develop, and upgrade this sub-sector have remained modest.

The present study specifically focuses on *Olea cuspidata* (locally known as Olive), a valuable indigenous species occurring sporadically within Nepal's Trans-Himalayan zone across altitudes ranging from 500 m to 2,600 m. In Sudurpaschim Province, notable occurrences are reported in Budhinanda Municipality, Himali Rural Municipality, and Swamikartik Rural Municipality of Bajura District, as well as Bungal Municipality of Bajhang District. Various parts of the Olive tree—including fruits, seeds, roots, stems, and leaves—are commercially utilized for medicinal purposes, oil extraction, timber, and fodder (Subedi, 2006). However, despite its recognized importance, substantial knowledge gaps persist regarding its conservation, cultivation, management, processing, value addition, and market dynamics. Comprehensive information on spatial distribution, effective growing stock, and annual allowable harvest (AAH) within Sudurpaschim Province remains largely unavailable.

The pronounced altitudinal heterogeneity and relatively low precipitation in the mountainous and hilly landscapes of Sudurpaschim Province provide a conducive ecological environment for numerous high-value NTFPs/MAPs. Rising market demand and escalating prices further underscore the potential for commercial cultivation and enterprise development. To identify spatially explicit opportunities for entrepreneurship, local communities were actively engaged through participatory resource mapping. Their indigenous knowledge and experiential insights related to collection, harvesting, processing, and marketing are invaluable for sustainable enterprise development and poverty alleviation (ANSAB, 2010).

In this context, the present study was undertaken to address critical information gaps through a detailed feasibility and value chain analysis of *Olea cuspidata*. Specifically, the study aims to:

- generate a robust technical baseline for sustainable management and conservation of Olive resources;
- quantify existing growing stock and annual allowable harvest to support informed harvesting decisions;
- identify potential areas for the expansion of Olive cultivation in both natural forests and private lands;
- map the complete value chain from primary production to market interfaces, includ-

ing channels, linkages, and pricing mechanisms;

- propose a pragmatic business plan framework and implementation modalities for sustainable Olive enterprises; and
- identify requisite policy and infrastructural interventions for effective processing and commercialization of Olive products.

Ultimately, this research seeks to provide evidence-based guidance to align private-sector investment objectives with broader societal goals of sustainable resource use, livelihood enhancement, wealth creation, and equitable benefit sharing among communities of Sudurpaschim Province (Subedi et al., 2014).

2. Materials and Methods

The foundational methodological paradigm employed in this investigation was inherently participatory and consultative. This approach systematically examined the biophysical conditions of *Olea europaea* resources within privately owned, community-managed, and state-governed forest domains across the Bajura and Bajhang districts of far-western Nepal. Complementary strategic frameworks—including a multi-stakeholder collaborative model, an inclusive and participatory orientation, a conflict-sensitive approach, and a targeted cluster-based value chain development strategy—were integrated into the research design. These methodological elements were applied to foster synergistic engagement among stakeholders, ensure inclusive representation of perspectives, mitigate potential conflicts during field operations, and enhance the effectiveness of enterprise development interventions.

This study rigorously adhered to established methodological standards and guidelines, notably the *Non-Timber Forest Products Inventory Guideline* (Department of Forests (DoF), 2012) and the *Participatory Inventory of Non-Timber Forest Products* toolkit (ANSAB, 2010). Resource assessment primarily focused on the enumeration of target species, evaluation of regeneration status, and systematic estimation of Olive growing stock. Participatory tools, supplemented by a comprehensive review of secondary sources, were employed to facilitate data triangulation. Standard mathematical equations and empirically derived conversion factors were applied to ensure accurate estimation of ecological parameters, including frequency, density, dry biomass, and total growing stock of *Olea europaea*.

The study was conducted across two districts and four local levels within Bajura and Bajhang districts of Nepal (Figure 1). The study area lies within a temperate ecological zone, spanning an altitudinal range of approximately 2,500 m to 4,700 m above sea level. Municipality- and rural municipality-wise forest cover areas within the study sites are summarized in Table **??**.

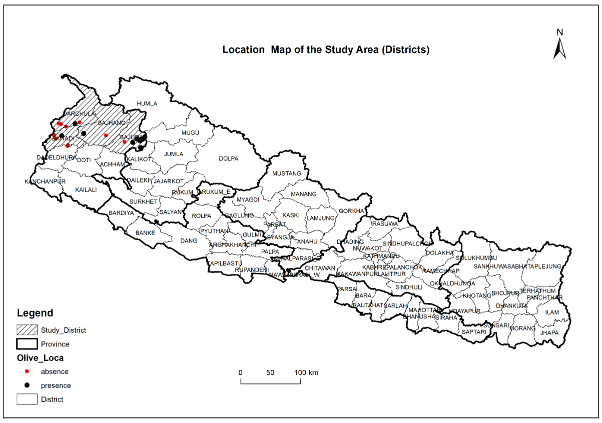

Figure 1: Study area

Study Area and Selected Local Levels

Table 1 presents details of the selected local levels within Bajura and Bajhang districts of Sudurpaschim Province, Nepal.

Following the identification of potential forest areas, including private Olive farms, and the delineation of potential habitat boundaries through participatory resource mapping, the study team digitized and produced a potential area map using QGIS software. For Community Forest User Group (CFUG)-level resource assessment, a sampling intensity ranging from 0.1% to 0.05% of the potential habitat was maintained, depending on the size of the species distribution area. All sampling procedures strictly followed the Community Forest (CF) inventory guideline 2061 of the Gov-

Table 1: Municipalities and coverage area

SN	District	Municipality/Rural Municipality	Total Area (ha)	Forest Area (ha)	Forest (%)
1	Bajura	Budhinanda Municipality	23,137	14,390	62.2
		Swamikartik Rural Municipality	11,004	6,173	56.1
		Himali Rural Municipality	82,640	40,198	48.6
		Sub-total Bajura	**116,781**	**60,761**	–
2	Bajhang	Bungal Municipality	44,502	24,985	56.1
		Grand Total	**161,283**	**85,746**	–

ernment of Nepal.

The targeted Olive species exhibited three distinct life forms; therefore, a concentric circular plot design was adopted. A standard sample plot size of 500 m^2, with a radius of 12.62 m, was used for data collection. Based on the prescribed sampling intensity and plot size, a total of 62 concentric circular sample plots were established for detailed resource assessment of the target species across 12 CFUGs and one private Olive farm in Bajura District. Several plots also supported additional NTFP species occurring within the same habitat.

A multistage sampling technique was systematically applied to select study districts, local administrative units, CFUGs, and private agricultural lands. This hierarchical sampling framework enabled robust estimation of prioritized NTFP resource availability while acknowledging the impracticality of complete area enumeration. Sampling units were progressively refined into smaller, homogeneous units to enhance precision.

CFUG-level participatory resource mapping exercises were conducted in selected community forests, including Dhimsera, Bhawanimandau, Saunegaun Kuragad, Bhamkidhaireni, Thadomela, Radhumata, and Siddhaba CFs. These sessions ensured the active participation of CF executive members, local producers, harvesters, indigenous leaders, educators, traditional healers, and forest guards. Scoring and ranking techniques were applied to identify resource-rich CFUGs, followed by a comprehensive review of Community Forest Operational Plans (CFOPs) for final validation.

Field preparation and data collection strictly adhered to the *Non-Timber Forest Products Inventory Guideline* (Department of Forests (DoF), 2012) and the *Participatory Inventory of Non-Timber Forest Products* toolkit (ANSAB, 2010). Using GPS devices and base maps, precise locations of sample plots were navigated, and nested plots of varying dimensions were established. Data collected included scientific name, Diameter at Breast Height (DBH), tree height, number of regeneration individuals, number of mature trees, and fresh weight of fruits harvested from lower, middle, and upper canopy strata within the 500 m^2 plots.

Field measurements were conducted using Vertex-IV and transponder, GPS units, survey master, diameter tape, linear tape, and electronic weighing scales.

Data Analysis

Both qualitative and quantitative analytical approaches were employed. Information obtained from focus group discussions and key informant interviews was analyzed qualitatively using descriptive techniques. Quantitative data from plot-level assessments were analyzed using MS Excel and R statistical software. Species distribution modeling was performed using the MaxEnt model.

The analysis focused on estimating effective habitat area, frequency and density of Olive, total fresh and dry growing stock, and annual allowable harvest (AAH).

Effective Area (ha): Effective area represents the habitat where *Olea europaea* is currently present and was calculated as:

Effective Area (ha) = Potential Habitat (ha) × Frequency of Occurrence (%)

Frequency of Occurrence: Frequency represents the proportion of plots in which a species occurs (Zobel et al., 1987):

$$F = \frac{\text{Number of plots where species occurs}}{\text{Total number of plots sampled}} \times 100$$

Density: Density is defined as the number of individuals per unit area (Zobel et al., 1987):

$$D \text{ (plants ha}^{-1}) = \frac{N}{n \cdot a} \times 10{,}000$$

Where: D = density of species, N = total individuals, n = quadrats sampled, a = quadrat area in m^2

Growing Stock and AAH: Growing stock was estimated in kg ha^{-1} and converted to total metric tonnes. Fresh fruit weight measured in the field was converted to dry weight using an established conversion factor (cf). The dry weight multiplied by the Annual Allowable Harvest (AAH) factor yielded the total AAH, following recommendations of (ANSAB, 2010; Department of Forests (DoF), 2012).

3. Result

Location Map of Olive Plants in Sudurpaschim Province

The spatial distribution of *Olea europaea* occurrence was precisely identified through the integration of participatory resource mapping methodologies, extensive stakeholder consultations, transect walks, and rigorous field verifications. These derived spatial locations were subsequently digitized to ascertain their accurate geographical coordinates. Figure 2 delineates the spatial distribution of *Olea europaea* within Sudurpaschim Province, illustrating the presence of ten distinct natural populations dispersed across the Bajura, Bajhang, Baitadi, and Darchula districts, with the most pronounced abundance observed within Bajura.

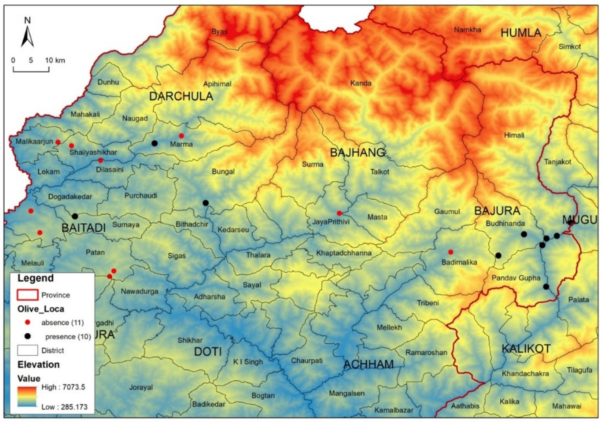

Figure 2: Spatial location map of Olive in Sudurpaschim Province

Potential and Existing Cultivation Area of Olive Plants in Bajura

A comprehensive review of Community Forest (CF) operational plans, coupled with the outcomes of participatory resource mapping, revealed an estimated 813.65 ha of CF area exhibiting the discernible presence of *Olea europaea* species. Within this aggregate area, 636 ha were identified as possessing significant potential for Olive cultivation in Bajura district, as systematically presented in Table 2. Concurrently, a total of 6 ha of private land within Bajura has been formally designated for *Olea europaea* cultivation. Specifically, Bajura Agroenterprises Private Limited manages 3.5 ha, while a distinct independent entrepreneur cultivates an additional 2.5 ha; both initiatives have been operational for a duration exceeding five years. To date, activities encompassing the collection, preliminary grading, and initial processing of Olive have been systematically undertaken within the confines of the district.

Table 2: Potential and existing Olive cultivation area in Bajura district

Category	Area (ha)
Community Forests with Olive presence	813.65
Potential CF area for Olive cultivation	636
Private land cultivation	6
- Bajura Agroenterprises Pvt. Ltd.	3.5
- Independent entrepreneur	2.5

Habitat Suitability Map of Olive Species

The climatically suitable areas for *Olea europaea*, as depicted in Figure 3, were computationally derived through the utilization of occurrence points collected during comprehensive field visits and a suite of nineteen bioclimatic variables. The computational process was executed in strict adherence to the principles of ecological niche modeling, alternatively termed a species distribution modeling approach. This procedure involved the initial importation of occurrence points into the R statistical environment, succeeded by the direct download of requisite bioclimatic layers from the WorldClim database via the `geodata` package. Subsequently, the Maximum Entropy Analysis (MaxEnt model) algorithm was rigorously implemented to fit the predictive model employing the `sdm` package. The optimally parameterized model was then applied to forecast the probability of *Olea europaea* occurrence.

The resultant output constitutes a probability map of *Olea europaea* occurrence, wherein values range from 0 to 1, with 0 indicating the lowest and 1 signifying the highest suitability. This output map was subsequently reclassified into three discrete suitability classes based upon the natural breaks (Jenks) method, with the class exhibiting the highest numerical values being designated as optimally suitable areas for *Olea europaea* growth and overall development.

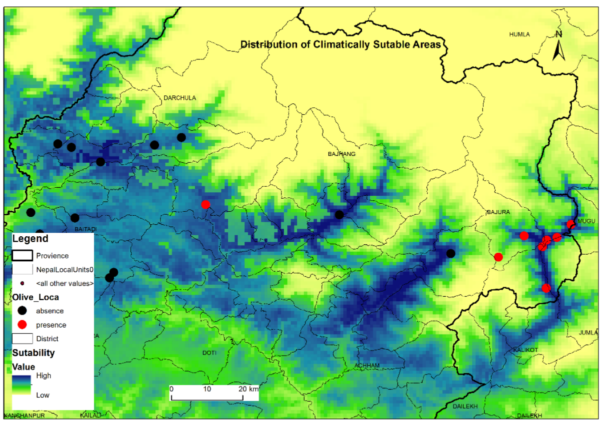

Figure 3: Habitat suitability map of Olive in Sudurpaschim Province

Distribution of Olive Species

The Distribution of *Olea europaea* within the Community Forest User Groups (CFUGs) of Bajura district, Nepal, is systematically presented in Table 3. 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 3, 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.

Table 3: Frequency of *Olea europaea* in CFUGs of Bajura district

CF Name	Frequency of Olive (%)
Bhawanimandau	43
Bhamkedhaireni	67
Dhimsera	75
Kalarishi	62
Kalika	78
Maluwapahad	50
Ragaumata	50
Samundrapalgadhi	50
Saunegaun Kuragad	56
Simaili	70
Thadomela	71
Tusare	77

Density of Olive Species

The density of both regenerating and mature plants of *Olea europaea* in Bajura district is systematically presented in Table 4. 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 4, 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.

Table 4: Density per hectare of *Olea europaea* in CFs of Bajura district

CF Name	Density of Regeneration (plants ha^{-1})	Density of Mature Plants (plants ha^{-1})
Bhamkedhaireni	140	220
Bhawanimandau	100	226
Dhimsera	60	80
Kalarishi	100	120
Kalika	40	80
Maluwapahad	60	120
Ragaumata	100	83
Samundrapalgadhi	80	100
Saunegaun Kuragad	40	100
Simaili	80	120
Thadomela	36	100
Tusare	60	81

Effective Area Covered by Olive Species

Subsequent to the completion of the field inventory and the determination of the frequency of occurrence of *Olea europaea* species within the sampled forest strata, the effective area dedicated to 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 (Table 5). The largest effective area, spanning 130 hectares, was quantified in Kalarishi CF, whereas the smallest effective area was observed in Bhawanimandau CF.

Table 5: Effective area covered by *Olea europaea* species in CFs of Bajura district

CF Name	Effective Area (ha)
Bhamkedhaireni	3.3
Bhawanimandau	10.0
Dhimsera	60.0
Kalarishi	130.0
Kalika	70.0
Maluwapahad	10.0
Ragaumata	20.0
Samundrapalgadhi	4.5
Saunegaun Kuragad	10.0
Simaili	70.0
Thadomela	20.0
Tusare	10.0
Total	**417.8**

Growing Stock and Annual Allowable Harvest of Olive Species

This study primarily centered upon the resource assessment of the prioritized and high-value *Olea europaea* species. The mean Growing Stock (GS), total GS, and Annual Allowable Harvest (AAH) of *Olea europaea* for the selected district are presented in Table 6. The mean growing stock of *Olea europaea* attained its highest value (3217.5 kg ha^{-1}) in Bhamkedhaireni CF, while the lowest value (509.1 kg ha^{-1}) was observed in Dhimsera CF of Bajura district. The cumulative total growing stock across all twelve (12) CFs was calculated to be 753.6 tonnes, with the corresponding annual allowable harvest or sustainable harvest amount determined to be 678.5 tonnes.

Olive Productivity Distribution

The box and whisker plots (Figure 4) 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

Table 6: Mean and total growing stock with Annual Allowable Harvest (AAH) of *Olea europaea* in CFs of Bajura district

CF Name	Effective Area (ha)	Mean GS (kg ha^{-1})	Total GS (kg)	Total GS (t)	Total AAH (t)
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

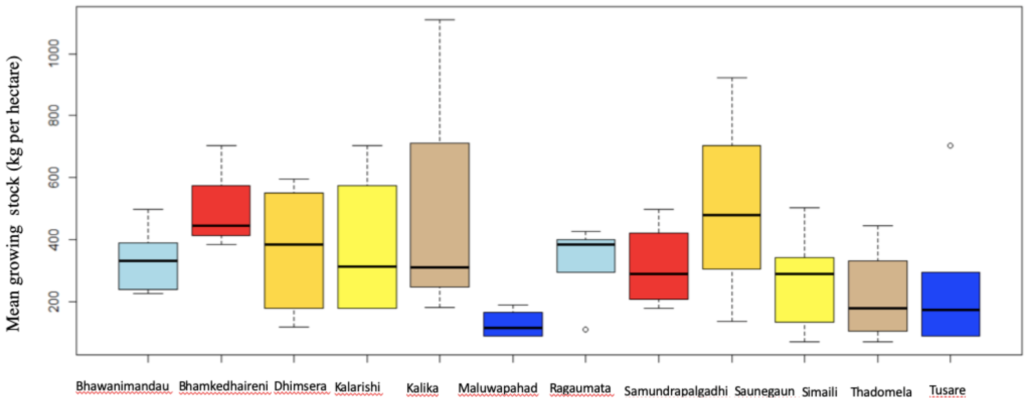

Figure 4: Per-hectare productivity of *Olea europaea* in 12 CFUGs of Bajura district

forest management practices. Figure 4 additionally indicates that Bhamkedhaireni, Bhawanimandau, and Kalarishi CFs exhibit the most substantial per-hectare spread in productivity, whereas Maluwapahad and Tusare CFs demonstrate the minimum spread within Bajura.

Aspect, Elevation, and Slope-wise Production and Productivity of Olive

Principle Component Analysis (PCA) conducted with respect to aspect (Figure 5) unequivocally reveals that the North, Northwest, Northeast, and Southeast aspects are most conducive for *Olea europaea* production, consistently demonstrating the highest yields concomitant with strong statistical correlations. Similarly, PCA performed with respect to elevation (Figure 5) indicates that elevations ranging between 1300–1400 m are optimal for *Olea europaea* production, yielding the highest productivity. This optimal range is succeeded by elevations exceeding 1400 m, whereas elevations between 1100–1300 m exhibit the lowest mean growing stock of *Olea europaea*.

A highly significant and positive correlation was observed between the tree basal area and the mean growing stock. Principal Component Analysis (PCA) with respect to aspect shows that the North (N), Northwest (NW), Northeast (NE), and Southeast (SE) aspects are the most suitable for the production of *Olea europaea*, exhibiting the highest yield with strong correlation (Figure 6).

4. Discussion

The comprehensive assessment of *Olea europaea* resources in the Bajura district of Sudurpaschim

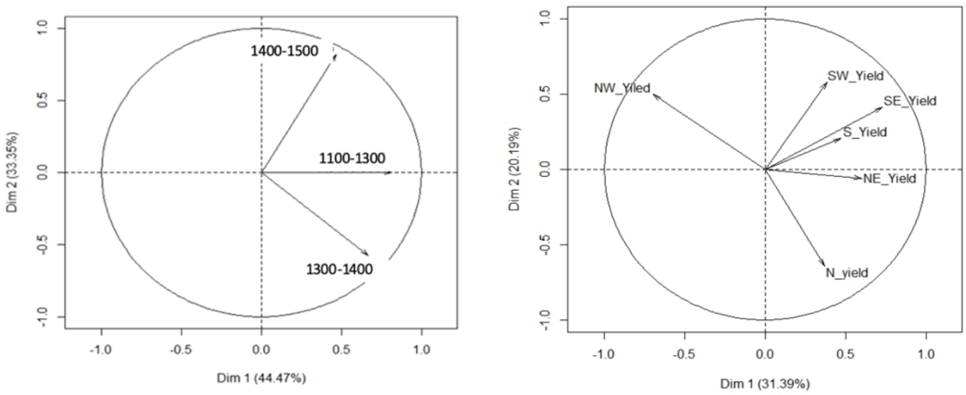

Figure 5: Aspect & Elevation wise principle component analysis for Olive

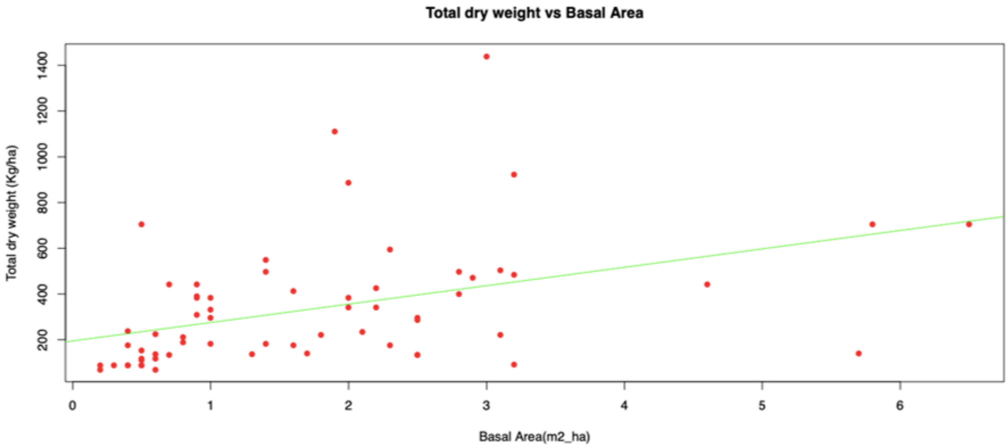

Figure 6: Regression Analysis

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 1300–1400 m, 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 the 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 ha) is indicated, necessitating active management of existing wild populations and promotion of cultivation in suitable, abandoned lands.

In conclusion, the study affirms the substantial potential of *Olea europaea* to contribute significantly to the economic development and livelihood enhancement of the Sudurpaschim Province. Realizing this potential, however, is contingent upon integrated efforts that address ecological threats, enhance value chain efficiencies, and are underpinned by supportive policy frameworks and robust infrastructural development.

5. 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.

References

ANSAB (2010). *Participatory Inventory of Non-Timber Forest Products.* Asia Network for Sustainable Agriculture and Bioresources, Kathmandu, Nepal.

Asia Network for Sustainable Agriculture and Bioresources (ANSAB) and SNV Nepal (2003). *Commercially Important Non-Timber Forest Products of Nepal.* Asia Network for Sustainable Agriculture and Bioresources (ANSAB) and SNV Nepal, Kathmandu, Nepal. Published in 2003; covers commercially important non-timber forest products of Nepal.

Department of Forests (DoF) (2012). NTFPs Inventory Guideline.

Government of Sudurpashchim Province (2023). Annual report 2022/23. Annual progress report, Office of the Chief Minister and Council of Ministers, Sudurpashchim Province, Nepal. Sudurpashchim Province covers 19,539 sq km (approximately 13.27% of the total land area of Nepal) as stated in the Background section of the report.

National Planning Commission, Government of Nepal and United Nations Development Programme (2014). Nepal human development report 2014: Beyond geography, unlocking human potential. Technical report, National Planning Commission, Government of Nepal and UNDP, Kathmandu, Nepal.

Subedi, B. P. (2001). *Marketing of Medicinal and Aromatic Plant Products of Nepal in Domestic and International Markets.* Asia Network for Sustainable Agriculture and Bioresources (ANSAB), Kathmandu, Nepal. Lecture notes.

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, Nepal.

Subedi, B. P. (2006). *Linking Plant-Based Enterprises and Local Communities to Biodiversity Conservation in Nepal Himalaya.* Adroit Publishers, New Delhi, India.

Subedi, B. P., Ghimire, P. L., Koontz, A., Khanal, S. C., Katwal, P., Sthapit, K. R., and Mishra, S. K. (2014). Private Sector Involvement and Investment in Nepal's Forestry Sector: Status, Prospects and Ways Forward.

World Health Organization (2002). Traditional Medicine Strategy 2002–2005.

Zobel, D. B., Jha, P. K., Behan, M. J., and Yadav, U. K. R. (1987). *A Practical Manual for Ecology.* Ratna Book Distributors, Kathmandu, Nepal.