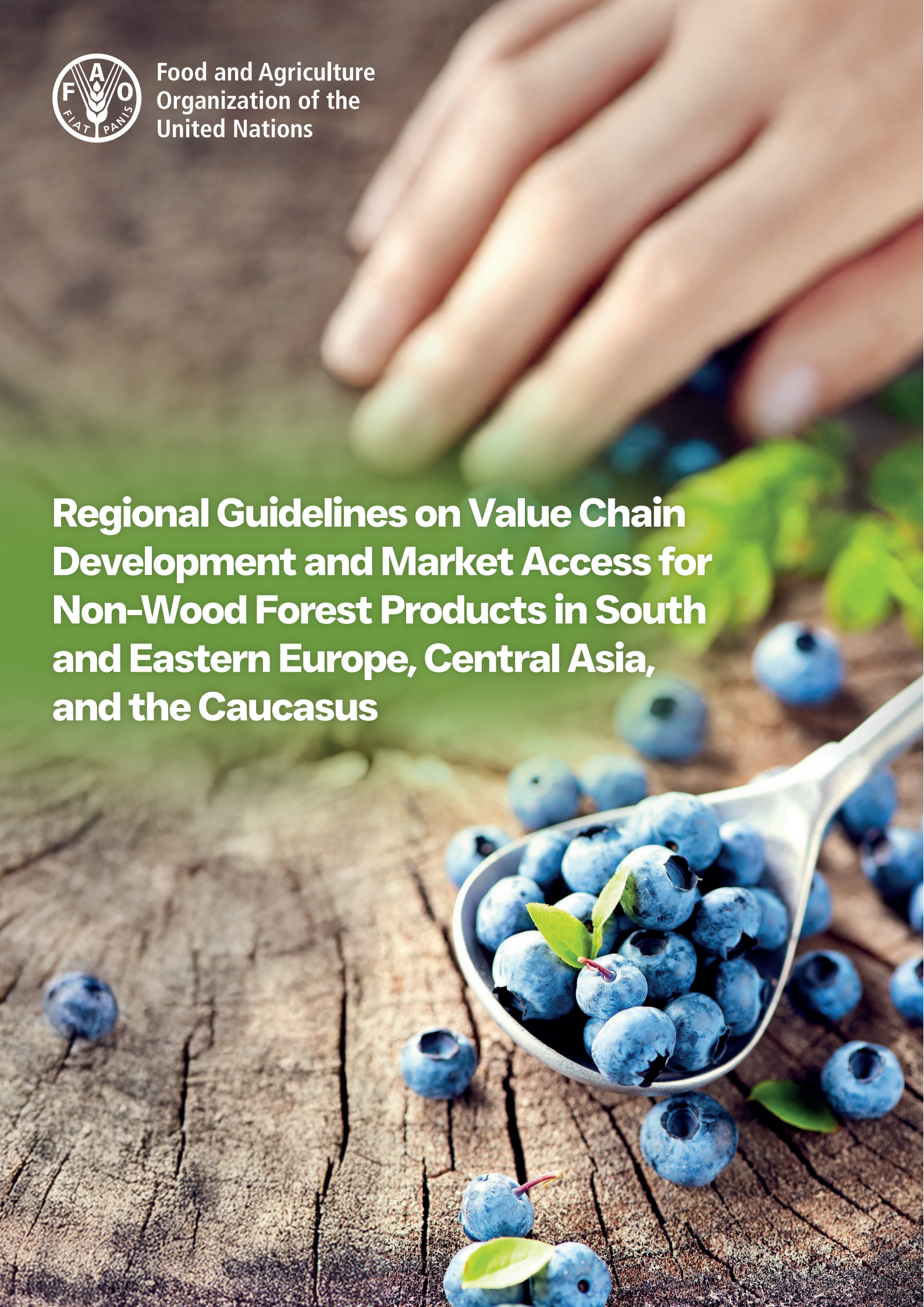

Food and Agriculture Organization of the United Nations

Regional Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products in South and Eastern Europe, Central Asia, and the Caucasus

Regional Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products in South and Eastern Europe, Central Asia, and the Caucasus

Compiled by

The Chamber of Forest Engineers of Türkiye

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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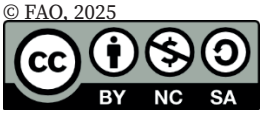

Contents

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The Chamber of Forest Engineers of Türkiye (OMO) compiled this **"Regional Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products in South and Eastern Europe, Central Asia, and the Caucasus"** in close cooperation with;

- The Food and Agriculture Organization of the United Nations (FAO) Headquarters,
- The FAO Regional Office for Europe and Central Asia (REU),
- The FAO Subregional Office for Central Asia (FAO-SEC) and,
- The United Nations Economic Commission for Europe (UNECE)/FAO Joint Forestry and Timber Section,
- The General Directorate of Forest of Türkiye

The Guidelines aim to compile and systematize relevant and up-to-date information on value chain development and market access for non-wood forest products (NWFPs) in South and Eastern Europe, Central Asia, and the Caucasus. (SECCA)
OMO extends its gratitude to the FAO Headquarters, FAO-REU, FAO-SEC, and the UNECE/FAO Forestry and Timber Section for their leadership, support, and guidance throughout the preparation process. Their collaboration and expert input significantly contributed to the relevance and quality of the Guidelines.

Moreover, the preparation and consultation process of the Guidelines was enriched by contributions from national experts and practitioners across the participating countries. Their diverse perspectives, practical knowledge, and shared experiences made a valuable contribution to strengthening the regional relevance and applicability of the Guidelines.

The Guidelines have been meticulously designed as an inclusive framework that brings together all relevant stakeholders, ensuring a collaborative approach. It integrates insights from diverse experts, fostering a well-rounded perspective and a comprehensive understanding of the subject matter.

ABBREVIATIONS AND ACRONYMS

B2B	business-to-business
CBFM	community-based forest management
COFO	FAO Committee on Forestry
CSO	civil society organization
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GAC	Gum Arabic Company
GDF	Turkish General Directorate of Forestry
GI	geographical indication
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IDF	International Day of Forests
IPARD	Instrument for Pre–Accession Assistance Rural Development
LoA	Letter of Agreement
LWfG	Lesser White-fronted Goose
NGO	non-governmental organization
NSS	national support scheme
NTFP	non-timber forest product
NWFP	non-wood forest product
OCOP	One Country One Priority Product
OGM	General Directorate of Forestry
OMO	Chamber of Forest Engineers of Türkiye
PDO	protected designation of origin
PGI	protected geographical indication
PPP	public-private partnership
REU	FAO Regional Office for Europe and Central Asia
SDG	Sustainable Development Goal
SEC	FAO Subregional Office for Central Asia
SECCA	South and Eastern Europe, Central Asia, and the Caucasus
SFM	sustainable forest management
SME	small-medium enterprise
SWOT	strengths, weaknesses, opportunities, and threats
The Guidelines	The Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products in South and Eastern Europe, Central Asia, and the Caucasus
UN	United Nations
UNECE	United Nations Economic Commission for Europe

CURRENCY, UNITS, AND SYMBOLS

€	Euro
kg	kilogram
%	percentage
USD	United States dollar

Foreword on behalf of FAO

EXECUTIVE SUMMARY

RATIONALE AND BACKGROUND

The SECCA region (South and Eastern Europe, Central Asia, and the Caucasus) faces growing environmental and economic challenges, including poverty, climate change, and limited food security. Forests—especially non-wood forest products (NWFPs) like mushrooms, nuts, and honey—play a key role in addressing these challenges by supporting livelihoods, nutrition, and biodiversity.

NWFPs—such as mushrooms, nuts, berries, and honey—are vital for rural livelihoods, food security, and biodiversity in the SECCA region. Despite their importance, NWFP value chains in the SECCA region remain underdeveloped due to limited market access, informal operations, weak institutional support, and lack of standards, limiting their full potential—especially for women and small-scale producers. To address this, the **Guidelines** provide practical tools to develop sustainable, inclusive, and competitive NWFP value chains and improve sustainability, quality, traceability, and market integration. The Guidelines offer solutions to improve production, resource management, quality, financing, and equitable benefit-sharing. The Guidelines aim to integrate NWFPs into national strategies, enhance rural economies, and contribute to the Sustainable Development Goals by drawing on global best practices and local realities.

The Guidelines adopt a **holistic and practical approach**, integrating policy, institutional, economic, social, and environmental dimensions. Each chapter builds upon the previous ones to provide a structured path from conceptual understanding to concrete recommendations. This format is designed to support both strategic planning and operational implementation.

KEY OBJECTIVES OF THE GUIDELINES

The primary objective of *the Guidelines* is to support the development of a regional approach for strengthening NWFP value chains and improving market access in the SECCA region. It aims to provide countries with a structured and practical framework for identifying, implementing, and upgrading NWFP value chains in a sustainable, inclusive, and market-oriented in meeting their commitments under the **2030 Agenda for Sustainable Development** and **FAO's Strategic Framework 2022–2031**.

In this way, *the Guidelines* serve as a reference document and a practical guidance document for organizing capacity development activities to support national implementation and regional cooperation.

TARGET AUDIENCE

The Guidelines are intended for (i) Policy-makers, forest managers, and technical experts; (ii) Research institutions, civil society, and private sector actors; (iii) Local communities, especially women, youth, and small-scale producers.

KEY STRATEGIES AND RECOMMENDATIONS ON VALUE CHAIN DEVELOPMENT AND MARKET ACCESS

Value Chain Development Strategies:

To strengthen the NWFP sector across SECCA, the Guidelines sets forth a set of integrated strategies for effective **value chain development**. These strategies aim to enhance productivity, ensure sustainability, and improve market performance throughout the NWFP value chain, from production to end-market access. The key strategies include:

- **Comprehensive Value Chain Mapping**: Systematic identification of key actors, production zones, volumes harvested and traded?, infrastructure, and bottlenecks within NWFP value chains to support evidence-based interventions.
- **Targeted Gap Analysis**: Detailed assessment of existing weaknesses and missing links across the stages of production, processing, distribution, and marketing, helping stakeholders to prioritize areas for improvement.
- **Empowering Producer Organizations**: Promoting and strengthening cooperatives, associations, and community-based enterprises to enhance collective bargaining power, market negotiation capacity, and access to services and inputs.
- **Investment in Processing, Standardization, and Innovation**: Support for upgrading local processing capacities, fostering product diversification, and aligning production with evolving market demands and quality expectations.

- **Development and Application of Certification and Quality Assurance Mechanisms**: Introduction and promotion of credible certification schemes (i.e. organic, fair trade, geographical indications), quality control protocols, and traceability systems to ensure sustainable sourcing and boost market credibility.

- **Enhancing Digital Integration and E-Commerce Opportunities**: Leveraging digital platforms, mobile technologies, and online marketplaces to improve supply chain efficiency, facilitate market entry, expand consumer outreach, and increase transparency in trade.

Enhancing Market Access:

Improving market access is a critical pillar in unlocking the economic potential of any product, including NWFPs, and ensuring that producers—particularly smallholders and forest-dependent communities—can participate more equitably in local, regional, and international markets. The Guidelines offer a set of strategic actions to address structural barriers and promote more inclusive and competitive market systems:

- **Market Intelligence and Strategic Promotion**: Conduct comprehensive market research and trend analysis to understand consumer preferences, identify emerging demand patterns, and develop effective branding and positioning strategies for selected NWFPs.
- **Trade Facilitation and Regulatory Alignment**: Simplifying administrative procedures, streamlining trade regulations, and improving transport and logistics infrastructure to reduce transaction costs and improve the efficiency of NWFP supply chains.
- **Improving Access to Finance**: Promoting tailored financial mechanisms—such as microcredit schemes, matching grants, revolving funds, and impact investment instruments—to support producers, cooperatives, and small and medium-sized enterprises (SMEs) engaged in NWFP value chains.
- **Strengthening Regional and International Cooperation**: Fostering cross-border trade by harmonizing technical standards, certification protocols, and regulatory frameworks and facilitating dialogue among neighboring countries to build integrated NWFP markets.

Policy Recommendations:

Creating an enabling policy environment is essential to support the development of resilient, inclusive, and market-oriented NWFP value chains across South and Eastern Europe, Central Asia, and the Caucasus. The Guidelines outline key policy recommendations that aim to reinforce institutional coherence, mobilize investment, and accelerate the integration of NWFPs into broader development agendas:

- **Policy Alignment and Integration**: Embedding NWFP development within national forestry, rural development, bioeconomy, and climate adaptation strategies to ensure policy coherence and long-term sustainability.
- **Fostering Public–Private Partnerships (PPPs)**: Encouraging active engagement of the private sector, including investors, processors, retailers, and service providers, to scale up sustainable NWFP initiatives and promote value chain development through joint investment and innovation.
- **Strengthening Research and Data Systems**: Improving the availability and quality of data on NWFP production, trade volumes, market trends, and socio-economic impacts to guide evidence-based policymaking, resource planning, and monitoring efforts.
- **Designing Incentive Mechanisms**: Introducing targeted financial and fiscal incentives—such as tax reliefs, subsidies, green investment schemes, and payment for ecosystem services—to support environmentally sustainable NWFP enterprises and reward good practices in sustainable harvesting and resource management.

1. INTRODUCTION

1.1. What is the bioeconomy?

The bioeconomy is an economic system that uses biological resources—such as plants, animals, microbes, and organic waste—to sustainably produce food, materials, energy, and services. It aims to reduce dependence on fossil fuels, limit environmental impact, and support circular and green economic models. Key sectors in the bioeconomy include:

- Agriculture and forestry
- Fisheries and aquaculture
- Biotechnology
- Food and feed production
- Bio-based chemicals and materials
- Bioenergy (i.e. biofuels, biogas)

A core principle is using renewable biological resources efficiently and innovatively, often incorporating biotechnology and circular economy approaches.

The bioeconomy for NWFPs focuses on sustainable harvesting and adding value to forest products other than timber—like mushrooms, berries, nuts, medicinal plants, resins, and honey—to support green economies, rural livelihoods, and biodiversity conservation.

1.2. General context of NWFPs in the region

The general context of NWFPs in South and Eastern Europe, Central Asia, and the Caucasus is shaped by a rich diversity of ecosystems, long-standing traditional knowledge, and increasing economic interest in sustainable forest-based livelihoods. NWFPs in these regions play a critical role in rural economies, food security, cultural heritage, and emerging bioeconomy strategies.

1. Ecological and Cultural Richness

- The regions host **biodiverse forests** (i.e. alpine, Mediterranean, steppe, and temperate).
- NWFPs are deeply embedded in **traditional practices**, **ethnobotany**, and **local diets**.
- Common NWFPs include:
  - **Wild mushrooms** (i.e. porcini, chanterelles)
  - **Berries and fruits** (i.e. rosehips, juniper, sea buckthorn)
  - **Medicinal and aromatic plants** (i.e. thyme, sage, licorice root)
  - **Resins, gums, and essential oils**
  - **Bee products** (i.e. honey, propolis, wax)

2. Socioeconomic Importance

- NWFPs provide **critical income** for rural, mountainous, and forest-dependent communities.
- Many smallholders, women, and Indigenous groups rely on wild collection or small-scale processing.
- NWFP trade is often **informal or under-reported**, yet vital for local resilience.

3. Sector Challenges

- **Lack of formal market data** and weak value chain organization.
- **Overharvesting**, habitat degradation, and climate change threaten some NWFPs.
- Limited infrastructure, inconsistent quality standards, and low access to export markets.
- Insufficient policies or regulations governing sustainable collection and land tenure.

4. Opportunities and Trends

- **Rising demand** for organic, natural, and health-promoting products in EU and global markets.
- A growing interest in NWFPs for:
  - **Bio-based cosmetics and pharmaceuticals**
  - **Functional foods and teas**
  - **Eco-tourism and branding** (i.e. geographic indication labels)
- International organizations support policy development, training, and market access.
- NWFPs are increasingly recognized in **national forest strategies and bioeconomy frameworks**.

1.3. Rationale and background of the guidelines

Humanity today faces a complex web of interconnected environmental and economic challenges—ranging from poverty and hunger to climate change and inequality. Ensuring access to nutritious food, promoting inclusive growth, and empowering vulnerable groups are the key global priorities emphasized in **the 2030 Agenda for Sustainable Development.**

Forests are vital in addressing these challenges by supporting food systems, rural livelihoods, and ecosystem services. More than half the global population depends on forest resources—especially non-wood forest products such as fruits, nuts, mushrooms, and honey—for nutrition, medicine, and income generation. Sustainable forest management is, therefore, essential to food security and economic and

ecological sustainability. Recognizing this role, FAO, in line with its **Strategic Framework 2022–2031**, promotes integrated approaches across agriculture, forestry, and ecosystem services.

NWFPs hold significant potential to contribute to sustainable development by supporting rural livelihoods, enhancing food and nutrition security, and promoting biodiversity conservation. Products such as mushrooms, nuts, medicinal plants, resins, berries, and honey provide essential income sources for forest-dependent communities, particularly in remote and marginalized areas. Beyond their economic value, NWFPs play a crucial role in traditional knowledge systems, cultural heritage, and ecological stability. **When sustainably managed and integrated into well-functioning value chains,** NWFPs can drive local entrepreneurship, create green jobs, and support climate resilience—making them key components of a sustainable, inclusive bioeconomy.

Here, an **NWFP value chain** refers to the whole sequence of activities and actors involved in harvesting, processing, distributing, and selling forest products that do not come from timber—such as mushrooms, berries, nuts, medicinal plants, resins, or honey.

Despite their importance, NWFP value chains in the SECCA region remain underdeveloped due to limited market access, informal operations, weak institutional support, and lack of standards, limiting their full potential—especially for women and small-scale producers. Within this context, a regional initiative has been launched to develop the Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products in South and Eastern Europe, Central Asia, and the Caucasus (*The Guidelines*), which aim to foster forest-inclusive solutions that enhance nutrition, rural livelihoods, and climate resilience. This vision is central to agroforestry systems and well-functioning value chains for non-wood forest products.

1.4. Why Guidelines

Non-wood forest products play a vital role in the livelihoods, traditions, and economies of many rural communities in the SECCA region. These products—mushrooms, nuts, medicinal plants, berries, resins, and honey—contribute to food security and income generation, supporting biodiversity conservation, forest resilience, and climate change mitigation. Despite their importance, the value chains of non-wood forest products remain largely underdeveloped in the region. Producers and communities face multiple challenges, including limited market access, weak infrastructure, unsustainable harvesting, lack of quality standards and certification systems, and insufficient institutional support. Moreover, many activities remain informal, limiting the economic potential of forest-dependent communities and small-scale producers—especially women.

There is a clear need for structured, regionally adapted guidance to harness the potential of these products in a sustainable, inclusive, and market-oriented way. The Guidelines respond to that need.

The Guidelines aim to help countries and stakeholders strengthen non-wood forest product value chains by offering practical approaches to improve sustainability, productivity, and competitiveness. The Guidelines provide tools and recommendations to:

- Address existing gaps in production, processing, and marketing,
- Support sustainable harvesting and resource management,
- Enhance quality standards, certification, and traceability,
- Improve infrastructure, financing mechanisms, and market linkages,
- Promote equitable benefit-sharing among all value chain actors.

The Guidelines also reflect the region's unique ecological and cultural context, drawing on international best practices and local experiences. It seeks to build institutional capacity, foster innovation, and encourage cross-border cooperation to scale up non-wood forest products in a sustainable forest-based bioeconomy.

Ultimately, the Guidelines offer a roadmap to integrate non-wood forest products more effectively into national strategies, support rural development, and contribute to broader goals—such as poverty reduction, food and nutrition security, gender equality, and the Sustainable Development Goals. In this context, the Guidelines complement national and regional strategies and serve as a practical tool to support the sustainable development of non-wood forest product value chains in the SECCA region.

The Guidelines, which are being developed under a Letter of Agreement (LoA) signed between FAO and OMO on 29 August 2024, contribute to FAO's Regional Priority Programme on "Transforming Food Systems And Facilitating Market Access And Integration" and support global commitments under Sustainable Development Goals (SDGs). Beyond being a technical reference, The Guidelines are a strategic tool to inform policies, foster innovation, and promote investment in sustainable forest-based value chains. Its effective implementation relies on the engagement of public institutions, producer organizations, private sector actors, and local communities.

1.5. The methodology of developing the guidelines

The Regional Workshop on NWFPs in Eastern Europe, Central Asia, and the Caucasus, held on 8–11 October 2024 in Fethiye, Türkiye, marked a key milestone in developing ***The Guidelines***. It brought together participants from various countries, FAO offices, civil society, and the private sector to assess needs, share experiences, and identify priority actions. The outcomes of the workshop[1], combined with literature reviews and stakeholder consultations, were consolidated in the **Stocktaking Report**[2], forming the technical foundation of The Guidelines.

In addition to the sources mentioned above, ***The Guidelines*** also build upon previous efforts and continue earlier work carried out in this field. In particular, it is closely linked to the following key initiatives and studies:

- The reports prepared under the LoA signed between FAO and OMO on **20 December 2019**, titled *"Provision of Technical Guidelines on Sustainable Management of NWFPs and the Status Reports on Specific Selected Products,"* particularly the *NWFP Assessment Report* and *NWFP Policy Report*.
- The **National Workshop on NWFPs**, jointly organized by FAO and the General Directorate of Forestry of Türkiye (OGM) on **20 September 2023 in Ankara**, provided valuable inputs on NWFP management and market access.
- The **INCREDIBLE Project** (*Innovation Networks of Cork, Resins, and Edibles in the Mediterranean basin*), supported under the European Commission's **Horizon 2020** Programme, fosters stakeholder collaboration and innovative business models in the Mediterranean NWFP sector.

1.6. Objectives and purpose of the guidelines

The primary objective of *the Guidelines* is to support the development of a regional approach for strengthening NWFP value chains and improving market access in the SECCA region. It aims to provide countries with a structured and practical framework for identifying, implementing, and upgrading NWFP value chains in a sustainable, inclusive, and market-oriented manner in meeting their commitments under the **2030 Agenda for Sustainable Development** and **FAO's Strategic Framework 2022–2031**.

A key pillar of *the Guidelines* is to enhance institutional and human capacities in the region. It is specifically designed to serve as a foundation for capacity development efforts, including targeted regional training workshops and online training sessions. This capacity will help national institutions, local authorities, and practitioners better understand and apply the concepts, tools, and methodologies presented in *the Guidelines*.

Through these trainings, stakeholders will:

- Improve their technical and institutional knowledge of value chain development,
- Strengthen their ability to plan, implement, and monitor NWFP value chains,
- Learn about sustainable harvesting practices, quality standards, certification schemes, and traceability systems,
- Explore approaches for improving access to finance and markets,
- Understand the importance of inclusive approaches, including gender equality and the participation of forest-dependent communities.

In this way, *the Guidelines* serve as a reference document and a practical guidance document for organizing capacity development activities to support national implementation and regional cooperation.

Furthermore, ***the Guidelines*** seek to:

- Foster regional knowledge exchange and cooperation among SECCA countries,
- Promote sustainable forest-based economic development,
- Support alignment with global objectives such as the Sustainable Development Goals.

Importantly, the Guidelines are not a static product. It is intended to be a dynamic and adaptable tool that evolves in response to emerging challenges, lessons learned, and good practices. As such, it can be expanded over time by incorporating additional training modules, tools, and case studies based on country needs and future developments in the NWFP sector.

1.7. Nature and scope of the Guidelines

Nature: ***The Guidelines*** serve as a practical tool to support stakeholders—including practitioners, policymakers, and land managers—in the sustainable management, conservation, and utilization of NWFPs. ***The Guidelines*** offer a structured approach for integrating NWFPs into national and local policies, forest planning, and value chains.

Scope: The Guidelines are applicable to a wide range of geographical, ecological, and socio-economic contexts across Europe, Central Asia, and the Caucasus. The Guidelines are relevant for all NWFPs and address sustainability from environmental, economic, and social

1 Workshop Report: https://www.omoprojects.com/_files/ugd/03d574_5496a76f01fd4862a5937e2e053783cc.pdf

2 Stocktaking Report: https://www.omoprojects.com/_files/ugd/03d574_4950d7c8599e4dedb7e996c7af15866e.pdf

perspectives. The document provides a flexible framework tailored to local realities. It includes planning, governance, monitoring, value chain development, market access, and knowledge exchange recommendations.

1.8. Target groups

To ensure effective implementation, *the Guidelines* are designed for stakeholders who play key roles in policy-making, forest management, and value chain development.

The primary target groups of *the Guidelines* include:

- **Policy- and decision-makers** from relevant ministries and public institutions,
- **Forest managers and practitioners**, including staff from forest services and natural resource agencies,
- **Technical experts and extension officers** working on NWFP value chains,
- **Academic and research institutions** involved in forestry, agriculture, and rural development,
- **Civil society organizations and local development groups**,
- **Private sector actors**, including producers, processors, traders, and marketers across NWFP value chains,
- **Local communities and forest-dependent households**, with particular attention to **women**, **youth**, and **small-scale producers**.

In addition to serving as a reference document, *the Guidelines* are also intended as a core resource for capacity-building activities. As emphasized in the LoA, the regional workshop outcomes and knowledge transfer are central to supporting sustainable NWFP value chains in the SECCA region.

The Guidelines aim to enhance technical and institutional capacities in SECCA countries by providing practical tools, regionally adapted approaches, and good practices. The document seeks to empower target groups to:

- Identify and implement sustainable NWFP value chains,
- Increase economic and social benefits from NWFPs,
- Improve quality, certification, and traceability standards,
- Strengthen inter-institutional and cross-sectoral collaboration, and
- Promote regional cooperation and knowledge exchange.

Ultimately, *the Guidelines* aim to contribute to a more inclusive, sustainable, and resilient forest-based economy that benefits people and ecosystems across the SECCA region.

1.9. How can the target audience use the guidelines?

The **target audience** can use the **NWFP Guidelines** in several **practical and strategic ways** to support sustainable development, strengthen value chains, and improve market access across the SECCA region.

Policymakers and public institutions can develop or revise policies to support NWFP value chains, integrate NWFP strategies into national forestry, rural development, and bioeconomy plans, and establish certification systems, quality standards, and traceability frameworks.

Forest managers and technical experts can identify gaps in production, processing, and marketing through value chain mapping, implement sustainable harvesting techniques, improve resource management practices, and monitor compliance with sustainability and quality standards.

Local communities and producer organizations can organize into cooperatives or associations to increase collective bargaining power, access training on sustainable practices, certification, and digital tools, and improve incomes and livelihoods by participating in better-functioning value chains.

Private sector actors (i.e. small- and medium-sized enterprises, traders, processors) can invest in processing and product diversification to meet evolving market demands, use digital platforms and e-commerce to access wider markets, and adopt and promote certification for market credibility and premium pricing.

Academic, research and civil society institutions can generate and share data to support evidence-based policymaking, facilitate training and capacity-building programs aligned with the Guidelines, and advocate for inclusive development, especially for women, youth, and disabled people.

2. IMPORTANCE OF NWFPS IN THE REGION AND BEYOND

KEY MESSAGES

1. NWFPs Are Integral to the Sustainable Bioeconomy

- NWFPs contribute directly to the bioeconomy by offering renewable, low-impact biological resources for food, cosmetics, pharmaceuticals, and specialty chemicals.
- Their sustainable use supports environmental conservation, rural livelihoods, and the diversification of forest-based economies.
- There is growing global and regional recognition of their economic, social, and ecological value within the broader bioeconomy narrative.

2. Significant Regional Economic Importance

- NWFPs are crucial income sources for rural populations, especially in marginal and forest-adjacent areas with limited alternatives.
- Examples include:
    - **Türkiye**: Pine honey generates over €30 million/year.
    - **Georgia**: Wild bay leaves and blueberries bring in around €5 million/year.
    - **Serbia & North Macedonia**: Mushroom and herb exports valued at €20–25 million/year.
    - **Kyrgyzstan & Tajikistan**: Wild medicinal plants generate €10–15 million/year.

3. Environmental Benefits Support Forest Integrity

- NWFP harvesting, when sustainably managed, preserves biodiversity, reduces forest fragmentation, and enhances carbon sequestration.
- Compared to timber extraction, NWFP-oriented management maintains biomass structure and habitat quality with lower environmental impact.

4. Social and Cultural Relevance

- NWFPs are embedded in local traditions, community knowledge, and cultural landscapes.
- They play a role in gender empowerment, especially for women, and strengthen community identity.
- Cultural services tied to NWFP collection (e.g., foraging, festivals, food practices) are significant but often undervalued.

5. Value Chain Development Offers Untapped Potential

- Most NWFP value chains are informal, underdeveloped, and suffer from:
    - Low levels of processing and value addition,
    - Poor market access,
    - Lack of data and traceability,
    - Limited stakeholder coordination.
- Building robust NWFP value chains can improve income, sustainability, and resilience, especially when backed by innovation, infrastructure, and policy.

6. Challenges Include Market Fragmentation, Policy Gaps, and Overharvesting

- Persistent policy and governance gaps, including lack of national strategies and weak coordination, limit NWFP development.
- Overharvesting and poor management practices threaten resource sustainability.
- Fragmented markets, lack of product standardization, and inadequate storage or processing facilities reduce competitiveness.

7. Policy Integration and Data Are Critical

- There is an urgent need to:
    - Integrate NWFPs into national bioeconomy and forest strategies,
    - Improve data collection and reporting systems,
    - Support research, capacity building, and stakeholder engagement.

8. Region-Specific Strategies Are Essential

- Bioeconomy strategies must be tailored to local contexts—mountainous vs. lowland, rural vs. urban, and resource-abundant vs. resource-scarce.
- Traditional knowledge systems and community-based governance models should be part of policy design.

KEY MESSAGES

2.1. Bioeconomy

2.1.1. Definition and scope of bioeconomy

When addressing the meaning of bioeconomy, it is essential to mention that the term did not appear until 2005 (Frisvold *et al.,* 2021; Töller *et al.,* 2021; Stephenson and Damerell, 2022). The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals, and microorganisms – to produce food, materials, and energy (Pal *et al.,* 2024; Antar *et al.,* 2021; Lee *et al.,* 2022; Muscat *et al.,* 2021). Bioeconomy generally refers to using biological resources, processes, knowledge, technologies, policies, and regulations. It exploits the potential of biological resources to create a safer, healthier, and cleaner environment while facilitating the production of food, renewable energy, material products, and commodities (Tilica, 2021; Frisvold *et al.,* 2021; Wohlgemuth, 2021; Thrän and Moesenfechtel, 2022; Barañano *et al.,* 2021; Kardung *et al.,* 2021). More recently, the concept of bioeconomy has been extended to include some additional aspects, such as the employment that the sector generates, the contribution to climate change, and the commitment to environmental sustainability (D'Amato and Korhonen, 2021; Stephenson and Damerell, 2022; Nowak *et al.,* 2021; Frisvold *et al.,* 2021; Calicioglu and Bogdanski, 2021; Stark *et al.,* 2022).

There exist two main perspectives: the more traditional one, based on agro-commodities (and bio-based products), and the knowledge-based bioeconomy, which leverages scientific knowledge concerning ecosystems and biodiversity (Muttilainen and Vilko, 2022; Huber *et al.,* 2023; Hoeben *et al.,* 2023; Baskent *et al.,* 2024; Utomo *et al.,* 2021).

In 2011, a flagship communication about bioeconomy (EC, 2012) highlighted the importance of knowledge and innovation (Park and Grundmann, 2023; Scordato *et al.,* 2022; Befort, 2023; Fava *et al.,* 2021; Kircher *et al.,* 2022). Furthermore, it pointed out the role to be played by green biotech as a key to unfolding productivity gains from ecosystems, agricultural, and industrial processes (Aileni, 2022; Stark *et al.,* 2022; Hassoun *et al.,* 2022; Yap *et al.,* 2021). For instance, one of the initiatives focuses on Mediterranean organic, high-quality plants for the promotion of the cultivation of organic non-food producing plants (Rüegg and Ertem, 2021; Del Soldato and Massari, 2024; Fava *et al.,* 2021; Albahri *et al.,* 2023).

The development of the bioeconomy is closely linked to advances in biotechnology and the sustainable use of diverse biological resources. While biotechnology plays a significant role, the growth of the bioeconomy also depends on other critical factors such as research and development, economic incentives, supportive regulations, and market demand (Maximo *et al.,* 2022; Miassi and Dossa, 2024).

At its core, the bioeconomy aims to foster sustainable economic growth, social development, and environmental sustainability through the responsible utilization and transformation of renewable biological resources. This approach can stimulate markets for bio-based products and services, often leading to new employment opportunities and contributing to a "triple win" for the economy, society, and the environment (Stephenson & Damerell, 2022; Calicioglu & Bogdanski, 2021; D'Amato & Korhonen, 2021; D'Amico *et al.*, 2022; Wei *et al.*, 2022; Maksymiv *et al.*, 2021; Dolge *et al.*, 2023; Czyżewski *et al.*, 2021).

These developments should be guided by and embedded in fundamental social and economic values such as equity, inclusiveness, environmental justice, intergenerational responsibility, and the fair distribution of benefits. Ensuring that bioeconomy strategies reflect these values is essential for gaining public trust, supporting local communities, and promoting long-term resilience (Goni *et al.*, 2021; Silvestri *et al.*, 2024).

To fully realize the potential of a future bioeconomy, coordinated actions are required at multiple levels—local, regional, national, and international. These actions must account for the diverse geographic, ecological, and socio-economic contexts in which bioeconomy activities occur. Tailoring strategies to specific conditions—such as rural versus urban settings, mountainous versus lowland areas, or resource-abundant versus resource-scarce regions—ensures that bioeconomy initiatives are both effective and equitable across different locations and scales (Muscat *et al.,* 2021; Halonen *et al.,* 2022; Ayrapetyan *et al.,* 2022; Di Cori *et al.,* 2024; Park and Grundmann, 2023). It should be recognized that innovation in the bioeconomy depends on access to the full range of biological diversity, as it provides the raw materials, genetic resources, and ecological knowledge needed to develop new products and solutions. Preserving this diversity is essential for safeguarding ecosystems and unlocking future opportunities in medicine, agriculture, biotechnology, and

sustainable materials. These opportunities have already demonstrated their value in various sectors and regions, reinforcing the importance of biodiversity conservation as a foundation for long-term innovation (Hoffmann, 2022; Salgotra and Chauhan, 2023). A knowledge-based economy—grounded in responsible research and innovation principles—is a key pillar of the bioeconomy. This philosophy emphasizes transparency, ethical standards, stakeholder engagement, and long-term societal benefit throughout the research and innovation process. At the same time, the development of the bioeconomy depends on adopting sustainable production and consumption practices that minimize environmental impact, ensure resource efficiency, and promote social well-being. Together, these elements help ensure that bioeconomic growth is both scientifically sound and socially responsible (Wilke *et al.,* 2021; Calicioglu and Bogdanski, 2021; Maksymiv *et al.,* 2021; D'Amico *et al.,* 2022; Muscat *et al.,* 2021; D'Amato and Korhonen, 2021).

Developing bioeconomy strategies in South and Eastern Europe, Central Asia, and the Caucasus is progressing, with several countries formulating or implementing national strategies. The FAO's Bioeconomy Strategies Dashboard[1] provides insights into these developments, although access issues may occasionally arise.

In South and Eastern Europe, countries like Slovenia have integrated bioeconomy concepts into various national strategies, including agriculture, green economy, and smart specialization plans. The BIOEAST Initiative supports Central and Eastern European countries in developing knowledge-based bioeconomies and promoting sustainable agriculture, forestry, and aquaculture.
In Central Asia and the Caucasus, efforts are underway to promote sustainable and circular bioeconomy practices in agriculture. FAO reports highlight the potential of bioeconomy to address environmental and economic challenges in the region, emphasizing nature-based solutions and the revitalization of rural areas.

Key Insights are listed below:

- **Strategic Alignment:** Many countries align their bioeconomy strategies with broader environmental and sustainability goals, including biodiversity conservation and climate resilience.
- **Sectoral Focus:** Agriculture remains a primary focus, with increasing attention to forestry, bioenergy, and biotechnology sectors.
- **Policy Integration:** Bioeconomy concepts are being integrated into national development plans, green economy frameworks, and smart specialization strategies.

The FAO's Bioeconomy Strategies Dashboard offers comprehensive data on national and regional strategies, thematic focuses, and implementation statuses for a more detailed analysis. Additionally, the BIOEAST Knowledge Platform provides resources and concept papers supporting the development of bioeconomy strategies in Central and Eastern Europe.

Regarding the forestry sector, the document titled "Enhancing the contribution of forestry to the bioeconomy – Opportunities and challenges[2]," prepared for the 27th Session of the FAO Committee on Forestry (COFO) in July 2024, presents a comprehensive overview of the role of forestry in advancing a sustainable bioeconomy.

Key points include:

Bioeconomy as a Strategic Priority: In 2021, the FAO Conference recognized "Bioeconomy for sustainable food and agriculture" as a Programme Priority Area within the FAO Strategic Framework 2022-31, emphasizing the need for policy advisory services, capacity building, partnerships, and knowledge sharing to support bioeconomy development.

Definition and Scope: The bioeconomy is defined as the production, utilization, conservation, and regeneration of biological resources, including related knowledge and innovation, to provide sustainable solutions across economic sectors. It represents a scientific, technological, and social transformation to replace fossil fuel-based resources with biobased goods and services.

Global Trends and Challenges: Material use has surged over the past decades, with biomass extraction nearly doubling, driven by population growth, urbanization, and economic development. This raises the demand for forest products and necessitates sustainable resource management to meet the Sustainable Development Goals (SDGs).

Role of Forestry: Forests and forest-based value chains are integral to the bioeconomy, offering renewable materials, supporting biodiversity, sequestering carbon, and fostering rural development. Sustainable forestry practices and innovation in forest product markets are critical for enhancing the bioeconomy's contribution.

1 https://tableau.apps.fao.org/views/Bioeconomystrategiesdashboard/Globaloverview?%3Aembed=y&%3AisGuestRedirectFromVizportal=y
2 https://openknowledge.fao.org/items/f47e3de6-7d1d-4ef3-bc3c-e5e1c37cdae9

Policy and Governance Gaps: There is a need to better align bioeconomy policies with national development and agrifood system strategies. Data gaps on biomass availability and sustainability metrics hinder effective policy-making. Inclusive participation of local communities, Indigenous Peoples, women, and youth is essential for equitable benefits and successful implementation.

FAO's Role and Recommendations: FAO is encouraged to scale up technical support and capacity building for members to develop bioeconomy policies incorporating forestry, promote sustainable practices and market development, and foster innovation. The document suggests mobilizing resources for a global bioeconomy partnership and convening an international conference on the forest sector's role in the bioeconomy.

Sustainability Objectives: Common goals across bioeconomy strategies include safeguarding food security, substituting fossil fuels with sustainable bioproducts, protecting biodiversity and ecosystems, mitigating climate change, creating jobs, and revitalizing economies, all underpinned by good governance.

In summary, the document highlights the transformative potential of the forest-based bioeconomy for sustainable development and calls for coordinated efforts among FAO members, inclusive stakeholder engagement, and enhanced technical and policy support to realize this potential effectively.

In this context, NWFPs—gathering, harvesting, and industrial processing—contribute meaningfully to bioeconomic strategies, especially in rural and forest-based economies. The growing use of NWFPs contributes to developing diverse bio-based sectors, including food, cosmetics, health, pharmaceuticals, polymers, and specialty chemicals (Miassi and Dossa, 2024; Mondo *et al.,* 2024). When managed sustainably, using NWFPs supports local livelihoods, fosters rural development, and reduces reliance on fossil-based and synthetic inputs, contributing to a more sustainable and circular economy. However, unsustainable harvesting practices can lead to resource depletion and ecosystem degradation. It is, therefore, essential to implement science-based management, monitoring, and governance systems that ensure the long-term availability and ecological integrity of NWFP resources.

In general, NWFPs can generate seasonal or complementary family income in the context of diversified farming with synergies among different agrarian activities. Indeed, they are available through a transitory or cyclic extraction process from managed forests, reinforcing their potential role as green crops (Musa *et al.,* 2023; Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Derebe and Alemu, 2023; Huber *et al.,* 2023; Delgado *et al.,* 2023; Baskent *et al.,* 2024). Furthermore, most of

them are obtained without depletion of the forest resources. On the contrary, there are cases of overexploitation, which remains a risk for specific products. Hence, there is a need for sustainable harvesting techniques. If based on low-impact and environmentally friendly harvesting systems, the NWFP supply chain can be effective in terms of the creation of added value in the process of job distribution, particularly in the innermost and most disadvantaged territories, increasing the recognition of rural and traditional knowledge (Schimetka and Ingram, 2024; Asamoah *et al.,* 2023a, b; Muir, 2021; Musa *et al.,* 2023; Nguyen *et al.,* 2021; Temphel, 2021; Bhattarai and Acharya, 2021; Bhattarai, 2022).

2.1.2 Key principles and strategies

While it is true that several NWFPs have been valued since human beings began to rely on forests for their subsistence, the relationship between these products and the forest-based bioeconomy has seldom been the focus of such policy attention as in the last decade (Di Cori *et al.,* 2022; Huber *et al.,* 2023; Di Cori *et al.,* 2024; Piplani and Smith-Hall, 2021; Verkerk *et al.,* 2021; Weiss *et al.,* 2023; Chamberlain and Smith-Hall, 2024; Miassi and Dossa, 2024). The contribution of NWFPs can be further improved through a combination of policies and actions supporting the development of policies and strategies that integrate different activities related to the use, production, trade, and consumption of NWFPs, identifying governance, institutional, and technical improvements that promote better bridging between policy and practice, including calls for forest-based bioeconomy strategies and relevant policy documents (Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024; Di Cori *et al.,* 2022; Huber *et al.,* 2023; Delgado *et al.,* 2023). It should be noted that the NWFP contribution to the bioeconomy can only be considered if they are sourced sustainably.

Policies aiming at planning and action for the sustainable management of forests need to recognize the key role that NWFPs play in supporting the bioeconomy, also within broader perspectives that integrate different goods and services provided by forests and highlight the multiple benefit functions offered by NWFPs (Huber *et al.,* 2023; Di Cori *et al.,* 2022; Di Cori *et al.,* 2024; Weiss *et al.,* 2023; Chamberlain and Smith-Hall, 2024; Muttilainen and Vilko, 2022). These benefits need to be considered not only when calculating their economic value but also to acknowledge their role in supporting local livelihoods, human well-being, and sustainable land use (Razafindratsima *et al.,* 2021; Yang *et al.,* 2022; Ntawuruhunga *et al.,* 2023; Di Cori *et al.,* 2021). These policy goals are best achieved through systematic monitoring and reporting, including qualitative feedback from stakeholders, to make informed choices on governance, regulatory frameworks, and investment options (Abhayawansa *et al.,* 2021; Fanzo *et al.,* 2021; Hoffmann, 2022). Improving data collection and analysis, better research and innovation, and fostering stakeholder engagement with forest-based bioeconomy strategies and research and development initiatives are essential to make better use of NWFPs' potential, sustain their supply, and valorize the part they play in the diverse and fast-evolving forest-based bioeconomies throughout the region, in both rural and urban areas (Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024; Shackleton *et al.,* 2024; Huber *et al.,* 2023; Musa *et al.,* 2023; Muir, 2021; Di Cori *et al.,* 2022).

2.2. Definition and types of NWFPs

Forest products traditionally have been divided into three main categories: wood (timber and pulpwood for industrial use and firewood, charcoal, and poles for domestic use), NWFPs, and ecosystem services. NWFPs are often collected or extracted from forests and brought to market with little or no processing. This is mainly because of the diversity. However, most NWFPs are part of long and high-added value chains. Many NWFPs (nuts, fruits, mushrooms) are edible and an important food source. Others are used for medicine (medicinal plants, herbs), perfumes (essential oils from flowers), spices (herbs or seeds from plants), or decorative crafts (such as seeds, flowers, moss, vines, and wild grasses) (Shackleton et al., 2024; Muir, 2021; Lovrić et al., 2021; Muttilainen and Vilko, 2022; Musa et al., 2023). Extracts from several NWFPs are also used in the manufacture of pharmaceutical, food, and cosmetic products, while many insects, fungi, and mosses grow on dead trees, fallen timber, and leaf litter, which provide essential ecological functions in forests. In this chapter, we will mainly focus on NWFPs benefiting or potentially benefiting the bioeconomy in the region countries (Muir, 2021; Shackleton et al., 2024; Stobart et al., 2023).

There is a wide array of NWFPs. Some of these products are gathered on a gradient from the wild to managed (i.e. mushrooms, truffles, snails, small game) and remain an essential source of income and supplementary food for many people, including Indigenous and local communities in forests and other rural areas (Lovrić et al., 2021, Muttilainen and Vilko, 2022; Huber et al., 2023; Laird et al., 2024). Certain agronomic practices—such as cultivating high-value tree crops like Mediterranean olive and chestnut—demonstrate the integration of agriculture and forestry. However, specific management operations are still essential for the sustainable collection of NWFPs. These operations differ significantly from

those used in conventional forestry plantations or typical agricultural systems and must be carefully planned and implemented to ensure resource sustainability and product quality (Delgado et al., 2023; Shackleton et al., 2024; Muir, 2021). Additionally, some NWFPs have an elevated value, and sustainable management can often be associated with forest conservation. In many cases, the combination of NWFPs with other forest products (wood and water) does not require minimization of the other uses but, on the contrary, it is often synergistic (Delgado et al., 2023; Xess and Tiwari, 2023; Piras and Santoro, 2023).

2.3. Contribution of NWFP production to regional economies

The contribution of NWFP production to regional economies is an essential component of forest resources in South and Eastern Europe, Central Asia, and the Caucasus (Lovrić *et al.,* 2021; Musa *et al.,* 2023; Muir, 2021). Given geographic, topographic, and bioclimatic differences, the range of NWFPs is more diverse and variable. These differ among countries and within them (Akyol *et al.,* 2023; Shafeian *et al.,* 2021). NWFPs have long been important to people in the region as sources of food, materials, and commercial goods since recent times (Derebe and Alemu, 2023).

There is a tendency for increased interest in the potential of NWFPs to contribute to the regional economy and society and in broader academic research on NWFPs in general (Delgado *et al.,* 2023; Rovira *et al.,* 2022; Lovrić *et al.,* 2021). However, there is a gap in the current literature in the regional context to evaluate the share of NWFPs in the overall forest products range (Derebe and Alemu, 2023; Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Shackleton and de Vos, 2022). It is also often understood that the amount of wild-harvested produce is unknown. Information may be scarce and based on the experience of those producing, accessing, or scaling up NWFP chains, and "updated" information is often not available to the public (Perrino and Wagensommer, 2022; Burkhart *et al.,* 2021; Madsen and Smith-Hall, 2023).

Historically, NWFP production and use were widespread in these regions, providing a wide range of products used for local consumption and international trade (Shackleton and de Vos, 2022; Delgado *et al.,* 2023). Global economic and political events had their influence on the production and consumption of NWFP, so the consumption of these products decreased at the beginning of the last century (Shackleton *et al.,* 2024; Muir, 2021; Delgado *et al.,* 2023). An abrupt economic transition from a socialist planned economy system to a free-market economy resulted in a drop in forest-related activities, which was followed by a significant decline in the overall consumption levels of NWFP (Imbrenda *et al.,* 2023; Sohag *et al.,* 2023).

The contribution of NWFP to overall household income in the region was - and to a certain extent is - significant. South and Eastern Europe, Central Asia, and the Caucasus regions have been historically and culturally characterized by their long tradition of utilizing NWFP, starting from subsistence households in the mountain and rural areas (Shackleton *et al.,* 2024).

NWFPs in South and Eastern Europe, Central Asia, and the Caucasus are highly economically significant. The income gained from NWFPs by local people, particularly in rural areas, has great significance, especially in poor and marginal ecologies, where there are few sources of alternative employment or social security (Máthé and Turgut, 2023; Talpă *et al.,* 2022; Mattalia *et al.,* 2022). NWFP gathering and harvesting, as well as their first-stage processing, are performed mainly by households. Overall, tens of thousands of urban and rural inhabitants of the region accrue significant income from NWFPs in the largest urban agglomerations, where incomes would allow considerable spending on luxury food and cosmetic items (Muir, 2021; Shackleton *et al.,* 2024).

Accurate and reliable information about the contribution of NWFPs to regional and national economies is useful for policy decisions related to the role of forests and forestry in rural livelihoods, forest development, and the conservation and management of forest resources (Shackleton *et al.,* 2024; Baskent, 2024; Di Cori *et al.,* 2022; Trigkas *et al.,* 2023; Muir, 2021).

The European subregions of South and Eastern Europe, Central Asia, and the Caucasus have

carried out very few studies addressing the contribution NWFPs make at the national level. They have been conducted recently in Greece, the Kyrgyz Republic, Serbia, Tajikistan, and Türkiye and have generated valuable information on the production, trade, and socio-economic importance of non-wood forest products (NWFPs) in these regions (Belmonte-Ureña *et al.,* 2021; Harrison *et al.,* 2021). Key findings include identifying species with high commercial value, gaps in market infrastructure, and the importance of NWFPs for rural livelihoods and income diversification. Six primary methodologies were used: questionnaires sent to NWFP experts, interviews with individuals or organizations, literature review, fieldwork, statistical or other data, and other techniques. The use of each country's official statistics, where available, should make a significant difference to the reliability of the estimates. However, the impact of these official statistics on the estimations depends on their quality.

2.4. Global context of NWFP value chain development in the sustainable bioeconomy

The value chain of any system is the components and services working in a chain that will lead to a desired achievement. The value chain development of NWFPs consists of a handful of components or services whose development will enhance the efficiency of the system (Muttilainen and Vilko, 2022; Huber *et al.,* 2023; Schimetka and Ingram, 2024; Baskent *et al.,* 2024; Di Cori *et al.,* 2022). Thus, the collection, storage, processing, packaging, marketing, transportation, research and development, innovation, research at the consumer level, policy and strategy formulation, and intervention for local development, as well as capacity development of the stakeholders, will have a direct effect on the value chain (Schleper *et al.,* 2021; Spieske and Birkel, 2021; Rusch *et al.,* 2023; Kazancoglu *et al.,* 2022; Sahoo and Vijayvargy, 2021). Producers, processors, marketers, and traders are collectively known as the stakeholders. When the coordination and cooperation among these stakeholders toward a common goal are developed, the value chain of a particular system is expected to be enhanced. These activities will lead to the production of end products that satisfy consumer demand. The development at each step of the NWFP value chain is definitely expected to overcome the drudgery of traditional practices, reduce energy expenditure, and alleviate psychological stress on those involved in natural resource exploitation while avoiding leaks at every stage of value addition, which is indeed value addition and revenue generation at the local level (Schleper *et al.,* 2021; Spieske and Birkel, 2021; Rusch *et al.,* 2023; Kazancoglu *et al.,* 2022; Magableh, 2021).

The development of a NWFP value chain, which started as a non-commercial activity with no value addition at the local level, is expected to be developed at all levels, especially to create social capital at the local level (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Rovira *et al.,* 2022). The development of value chains promises the tradition of bringing in new production and processing techniques, innovations for new markets for NWFPs, and aims to mitigate deleterious impacts on the environment and efficiency management (Wang *et al.,* 2022; Ponte,

2022; Baghizadeh *et al.,* 2021; Nahr *et al.,* 2021). The marketing practices at each value chain stage can be improved to overcome the psychological and related impacts on the people involved in value addition at different levels. Thus, emphasis on market research and normative pricing of the NWFPs and their associated environmental services is important at the local level (Newell *et al.,* 2021; Sudirjo, 2023). Marketing at the local level is believed to have a consensus on fair trade business and cleanliness. Only then will value chain development have relevance in sustainable resource management (Johnson-Hall and Hall, 2022; Di Cori *et al.,* 2024; Meaton *et al.,* 2021; Djekic *et al.,* 2021; Desiderio *et al.,* 2022).

The value chain management can be harmonized in a way that it will bring a handful of socio-economic benefits for local communities, involving producers, marketers, and civil societies, without excluding policy enforcement agencies (Arcese *et al.,* 2023; Apel *et al.,* 2024; Syofya, 2023; Barua *et al.,* 2021). Moreover, this exerts a bidirectional relationship with environmental outputs and inputs and the availability of resources for the future. Thus, sustainability will essentially depend on the economic viability of the programs and the size of the venture (Yang *et al.,* 2021; Rasoulinezhad and Taghizadeh-Hesary, 2022). The marketing prospects will determine future investment and the improvement needs of value chain management. The value chain stakeholders must adapt according to consumer demand (Sousa and Soares, 2023; Moura and Saroli, 2021).

2.4.1. Challenges and opportunities in NWFP value chain development

To identify the global context and, consequently, the justified position of NWFP value chain development in the sustainable bioeconomy concept, we first have to understand the challenges and opportunities in the sector (Rovira *et al.,* 2022; Tong, 2024; Muttilainen and Vilko, 2022; Tong *et al.,* 2024; Pohl *et al.,* 2024). At present, there are only a few NWFP value chains with sustainable development indicators resulting in social, economic, and environmental benefits (Tong, 2024; Tong *et al.,* 2024; Pohl *et al.,* 2024; den Herder *et al.,* 2022). Several constraints are the same for individual chains and involve a lack of market access and storage facilities, a low level of knowledge and resources, market uncertainty, and hence inappropriate policies, high price volatility, dependence on climatic conditions, and historical place of origin with exploitation (Autio *et al.,* 2021; Yadav *et al.,* 2022; Nandi *et al.,* 2021).

There are many other factors at the same time. In our view, the significant barriers associated with the poor market response for NWFP value chains can be the role or impact of small-scale production, high labor intensity, and intense fragmentation of the marketing chains (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Bhattarai, 2022; Nguyen *et al.,* 2021; Shackleton *et al.,* 2024). To promote NWFP value chains as a 'non-wood' source and avoid competition with wood products, one has to generate potential by finding new consumer demands in the general and regional markets (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Rovira *et al.,* 2022; Baskent *et al.,* 2024; Zubair *et al.,* 2021; Rovira *et al.,* 2022; Muir, 2021; Kero, 2024).

As expected, diversification in the NWFP value chains in the bioeconomy concept aims to address these challenges by focusing on the promotion of capacity building and stakeholder involvement in policy development activities (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Muir, 2021; Baskent *et al.,* 2024). It was also concluded that achieving sound capacity-building and policy-making activities might significantly increase the possibility of decade-long existing challenges and market constraints in chain development (Saguin and Howlett, 2022; Fernández-i-Marín *et al.,* 2024). The primary enabling factors for the opportunity examination in chain development were correlative stock production capacity and market growth dynamics, alignment of producers and traders in respective activities to look for market demand, and technical and policy support programs having A to Z approaches (Bai *et al.,* 2022; Smidt and Jokonya, 2022; Kulkov *et al.,* 2024).

However, innovation in processing trends has enabled the development of products in the market, though they are still unappealing to policy decisions and storage facilities are insufficient (Liu *et al.,* 2022; Försterling *et al.,* 2023; Kumar and Agrawal, 2023). The development of NWFP value chains in the future is an opportunity and optimistic target for local development as a sustainable economic model and will promote regional and nationwide progress toward the prevailing sustainable bioeconomy concept (den Herder *et al.,* 2022; Magry *et al.,* 2024; Rovira *et al.,* 2022; Di Cori *et al.,* 2024; Verkerk *et al.,* 2021; Güngör, 2024; Hetemäki *et al.,* 2024). This is true only if the NWFPs are managed sustainably.

The concept of bioeconomy assumes not only new opportunities for the use of natural, including forest resources but also the creation of new products based on a wide range of uses (Muscat

et al., 2021; Frisvold *et al.,* 2021; Piplani and Smith-Hall, 2021; Giurca and Befort, 2023; Di Cori *et al.,* 2022; Kardung *et al.,* 2021; Korhonen *et al.,* 2021). As a driver of regional and national economic development, the bioeconomy supports job creation, technological innovation, skill development, and sustainable growth while contributing to environmental conservation and ensuring energy and food security (Wang *et al.,* 2022; Wei *et al.,* 2022; Kardung *et al.,* 2021; Calicioglu and Bogdanski, 2021; Stephenson and Damerell, 2022).

At the same time, contemporary bioeconomy strategies increasingly acknowledge the value of traditional and ecosystem-based practices. Wiersum (2017) highlights the resurgence of "re-wilding" approaches, which draw on older land-use systems that emphasize ecological complexity, minimal intervention, and the multifunctionality of landscapes. Integrating historical knowledge and cultural practices into modern bioeconomic frameworks reflects a broader trend toward rebalancing innovation with restoration, aligning technological progress with long-standing human-nature relationships.

Therefore, global, national, and regional demands of various socio-economic actors for sustainable and stable access to bioeconomy resources are constantly increasing (Halonen *et al.,* 2022; Kardung *et al.,* 2021; D'Amato and Korhonen, 2021; Stephenson and Damerell, 2022). A variety of resources are used in region forests, and there are many suppliers. The wide range of resources and market barriers requires a comprehensive study of the many elements that make up the bioeconomy (Mason *et al.,* 2022; Patacca *et al.,* 2023; Vacek *et al.,* 2023; Pardos *et al.,* 2021; Weiss *et al.,* 2021; Grebner *et al.,* 2021).

2.4.2. Value chain development

Many producers and collectors operate in environments with limited access to national or international markets (Grabs and Carodenuto, 2021). Most value chains are not well-developed and have many players, often with limited links to more formal market structures (MacCarthy *et al.,* 2022; Ambos *et al.,* 2021; Wiedmer and Griffis, 2021; Barrett *et al.,* 2022; Seuring *et al.,* 2022). In many cases, traders largely set the price and conditions of the negotiation, leaving collectors few alternatives. Violent conflicts or fraud are not uncommon in the value chain, placing the collectors in positions of danger or financial risk (Hieronymus, 2023; Staritz *et al.,* 2022). In other cases, collectors with raw products without the ability to capture value exist on the fringes of a mature value chain. The development of the value chain can have significant economic, social, and environmental impacts on the value chain players (Tesfaw *et al.,* 2021; Baloch and Rashid, 2022).

Many traditional products have regional significance without creating significant income for the collectors (Van Thao *et al.,* 2025; Reardon *et al.,* 2021). Developing the value chain can significantly improve the economic conditions of the collectors (Awan *et al.,* 2022; Van Thao *et al.,* 2025; Bechtsis *et al.,* 2022; Kazancoglu *et al.,* 2021). The value chain development standardizes the product, sorting the dried root by size. The use of conservation rule distributions allows for future raw material supplies (Rao *et al.,* 2022; Kaur and Watson, 2024; Versino *et al.,* 2023). Individual dealers often provide members with sustainability guidelines for collection (such as the minimum size of the harvested plant, the number of juvenile plants harvested, the distance between plants, and regulating the harvest period to allow for natural re-emergence of the plants) (Lovrić *et al.,* 2021; Bhattarai and Acharya, 2021; Delgado *et al.,* 2023; Posavec *et al.,* 2021). For example, in Türkiye, collectors of Galanthus species (snowdrops) are required to adhere to regulations regarding bulb size and harvest timing to support regeneration. In Serbia and Bosnia and Herzegovina, guidelines for harvesting wild mushrooms and medicinal plants like Gentiana lutea include quotas and required permits to prevent overharvesting and ensure traceability. In Georgia and Armenia, sustainable harvesting of wild berries and herbs (i.e. Thymus and Origanum species) is promoted through community-based protocols that emphasize rotational harvesting and preservation of juvenile plants. Similarly, in Kyrgyzstan and Tajikistan, Ferula and Rheum species collectors are advised to follow distance-based collection standards and seasonal restrictions to allow natural regrowth and protect vulnerable populations. Developing processing plants significantly improves the health and safety of disabled collectors. In general, the development of the value chain can provide the market incentive to improve the rate and quality of the raw collection, including an element of sustainability in the collection (Van Thao *et al.,* 2025; Herrmann *et al.,* 2021).

2.5. Role of NWFPs in supporting the bioeconomy

The bioeconomy represents an economic system that combines the use and protection of available biological resources. The sustainable bioeconomy combines the principle of sustainable

development by considering ecological, economic, and social issues (Muscat *et al.,* 2021; D'Amato and Korhonen, 2021; Wei *et al.,* 2022; Stephenson and Damerell, 2022). However, the bioeconomy was more connected with the forestry, agriculture, and fisheries sectors in the past (Lakner *et al.,* 2021; Jankovský *et al.,* 2021; Piplani and Smith-Hall, 2021).

In recent years, the production of NWFPs has visibly increased. Sustainable harvest practices of NWFPs and sustainably collected or produced non-wood products that offer protection of soil and water systems in forests will also substantially impact landscape management, especially in urban areas. Additionally, NWFPs can exert pressure on flora, fauna, and other protected areas while providing a sustainable source of shelter (Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Delgado *et al.,* 2023).

NWFPs offer a myriad of social incentives for environmental sustainability. They enable the creation of local income and employment and often benefit communities in remote rural areas where there is minimal potential for other economic development (Musa *et al.,* 2023; Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021). The sustainable utilization of non-wood products and forests is instrumental for society and the environment. These products contribute to food security and nutrition in many parts of the world. The integration of NWFPs into farm systems can also play a positive role in enhancing agrobiodiversity.

Understanding NWFPs also serves to enhance the understanding of wildcrafting, domestication, multifunctional product landscapes, and the principle of integration, which are becoming increasingly valued for rural development (Muir, 2021; Khairul Alam, 2022; Rovira *et al.,* 2022; Paluš *et al.,* 2021). Furthermore, non-wood products can make a substantial contribution to sustainable resource management. There are many instances where NWFPs also serve a dual purpose, fulfilling vital roles in health, sanitation, nutraceuticals, and nutrition. Various policy statements and actions recognize the nexus between the sustainable bioeconomy and NWFPs (Baskent *et al.,* 2024; Huber *et al.,* 2023; Delgado *et al.,* 2023).

Agriculture, forestry, and rural development strategies in some countries are recognizing the socio-economic and environmental importance of products other than traditional wood goods. To put the concept of bioeconomy into sustainable action, both policies and practices are needed (Muttilainen and Vilko, 2022; Muir, 2021; Baskent *et al.,* 2024; Weiss *et al.,* 2023; Musa *et al.,* 2023; Huber *et al.,* 2023; Lovrić *et al.,* 2021; Delgado *et al.,* 2023).

In reality, even though some policies supportive of non-wood products are in place, there is a lack of integrated national bioeconomy strategies that engage a wide range of potential stakeholders intending to realize the vision of the bioeconomy more generally. In recognition of the need for research to inform policy and practice, it has been claimed that there is an increasing need for research to inform both the policy and practical areas of non-wood products as a whole (Huber *et al.,* 2023; Weiss *et al.,* 2023; Di Cori *et al.,* 2022).

Case study examples from various developing countries illustrate the many and varied ways in which NWFPs have been included in bioeconomy strategies to achieve a range of ecological, social, and economic development objectives. This has produced increasingly more evidence of the interconnection between NWFPs and bioeconomy objectives, including food, energy, and water security.

As well as enriching insights into the interconnectedness of community-based management and the potential for cascading benefits, these studies revealed increases and decreases in uncertainty, ecological and social vulnerability, and resilience as outcomes of this management (Huber *et al.,* 2023; Di Cori *et al.,* 2022; Weiss *et al.,* 2023; Baskent *et al.,* 2024; Chamberlain and Smith-Hall, 2024; Posavec *et al.,* 2021; Stoyanov, 2023).

In the specific global context, the importance of NWFPs for a sustainable socio-economic environment has prominently emerged in various discourses (Shackleton *et al.,* 2024; Huber *et al.,* 2023; Smith-Hall and Chamberlain, 2023; Hernández-Morcillo *et al.,* 2022; Juerges *et al.,* 2021). NWFPs are one of the dominant sources of living and livelihood alternatives primarily for vulnerable sections of rural and/or forest-dwelling communities, which usually directly manage forests and plantations. The social and cultural significance of NWFPs as dietary supplements for the sustenance of indigenous people is substantial. They also serve as a vital source of income for women in many cultures (Temphel, 2021; Derebe *et al.,* 2023; Peerzada *et al.,* 2022).

The majority of NWFPs come from naturally growing plants and trees. They are fundamental for preserving the variety of genes and flora, notably by promoting sustainable commercialization,

supplementing consumer choices in green markets, and stimulating further environmental, economic, social, and cultural sustainability in different places and societies. The unique supply chain that involves the collection, purchase, processing, value addition, and marketing of NWFPs creates opportunities for entrepreneurial economic progress in forest fringe areas (Shackleton *et al.,* 2024; Musa *et al.,* 2023). Accordingly, it also contributes to the revival of the conversion of the rural population faced with various environmental and resource conflicts into rehabilitated individuals in a bioeconomy (Haddad *et al.,* 2021).

While conventional conceptions of bioeconomy are considered to be associated with renewable primary natural biomass resources coming from agriculture, horticulture, fisheries, and forestry, the post-2010 era of emphasis has been mostly on the forest-based bioeconomy (Di Cori *et al.,* 2024; Piplani and Smith-Hall, 2021; Jankovský *et al.,* 2021; Halonen *et al.,* 2022; Luhas *et al.,* 2021). However, this emphasis on forest-based bioeconomy often perceives wood as the primary feedstock in the production of biofuels, biomass, bio-based processed products, and wood-based businesses (Verkerk *et al.,* 2021; Aggestam and Giurca, 2022). The recent heightened bioeconomic interests in the value-added contributions of the agri-food chain focus quite extensively on the biogenetic NWFPs, such as nuts, berries, mushrooms, leaves, aromatic plants, barks, and resins (Weiss *et al.,* 2023; Maximo *et al.,* 2022; Hassegawa *et al.,* 2022a; b).

This shift towards the expanded recognition of non-wood resources in the bioeconomy has echoed the existing recognition that the forested environment produces value-added economic activities beyond conventional log-based wood and wood fiber production (Campos *et al.,* 2021; Angelstam *et al.,* 2022). In the forested landscape, foraging, collecting, harvesting, or cultivating wild food, herbal, and other non-wood plant resources as an agro-ecosystem or accessory land use of the forested environment also contribute to human well-being. These non-wood forest resources have long been embraced in different historical settings and cultures, as reflected in the utilization patterns of herbal, medical, and other cultural contributions, and have been integrated within the institutional framework of communities (Gurung *et al.,* 2021; Delgado *et al.,* 2023).

2.5.1. Economic importance

Environmental, economic, and social benefits from converting raw materials to the processing of NWFPs have been adequately highlighted. Many NWFPs are poised to contribute immensely to trade, not only because of the tariffs and stigmatization associated with forest timber but also because they promote and support diversified rural economies (Derebe and Alemu, 2023; Delgado *et al.,* 2023). For instance, in Türkiye, pine honey production generates over €30 million annually in export value and supports more than 15,000 forest beekeepers. In Georgia, the export of wild-collected bay leaves and blueberries is valued at approximately €5 million per year, providing seasonal income for hundreds of rural households engaged in collection and drying. Consequently, decision-makers generally acknowledge and accept the role of NWFPs in the sustainable management of forests. However, the development and commercialization of these low-volume but highly demanded products have not yet been realized to the desired levels (Baskent *et al.,* 2024; Delgado *et al.,* 2023; Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Rovira *et al.,* 2022). In Serbia and North Macedonia, for example, the collection and trade of mushrooms, juniper berries, and medicinal herbs such as Hypericum perforatum (St. John's Wort) represent a combined market of approximately €20–25 million annually, fueling export-oriented processing companies and small cooperatives.

The role of NWFPs in managing forest resources, rural income generation, and enhancing food security will be increasingly realized, primarily if they are sustainably managed and marketed. The increased interest in the commercialization of NWFPs lies largely in policy attention to their ability to alleviate poverty by providing income to rural populations (Musa *et al.,* 2023; Derebe *et al.,* 2023; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024). In many developing countries, the commercialization of forest resources has been targeted to redistribute wealth from public institutions to rural development and poverty reduction. In Kyrgyzstan and Tajikistan, the collection and trade of wild medicinal plants such as *Rheum ribes* and *Ferula* spp. generate estimated revenues of €10–15 million annually, much of which directly supports remote mountain communities. These products are often exported regionally and to markets in China and Europe, enhancing their strategic value in local development and cross-border trade.

2.5.2. Environmental benefits

The modern framework for sustainable development, which seeks to balance social, economic, and environmental objectives, was formalized in the Rio Declaration on Environment and Development (1992). This declaration outlines 27 guiding principles emphasizing sustainability across governance levels and sectors (Jordan and Brown, 2021; Sands, 2023; Pavoni and Piselli, 2022; Sparviero and Ragnedda, 2021).

Traditionally, forest management has prioritized timber production, often relegating NWFPs to a secondary role. However, a growing body of research demonstrates that NWFP-oriented forest management can yield measurable environmental benefits. Studies show that NWFP harvesting typically maintains forest biomass, species composition, and structure, reducing habitat disturbance and preserving biodiversity (Lovrić *et al.,* 2021; Huber *et al.,* 2023). For example, Di Cori *et al.* (2022) quantify reduced soil erosion and enhanced carbon sequestration in NWFP-managed plots, while Muttilainen and Vilko (2022) find lower levels of forest fragmentation and improved resilience to climate impacts. These findings suggest that NWFP-focused management can offer an ecologically sustainable alternative to timber-centric models by providing economic returns without compromising environmental integrity.

2.5.3. Social and cultural aspects

The social aspects of NWFPs are cross-cutting issues directly related to the benefits resulting from the NWFP value chain. Local communities have a long-standing tradition of forest management in which NWFP value chains have a historic place. The broader public is strongly interested in NWFP's non-commercial benefits in a specific location (Muir, 2021). The correlation between such tangible and intangible non-commercial benefits is the basis of the social contracts that maintain the support of external democracy for activities that may have local and global public interests and yet do not provide, or have a shortage in delivering, an equitable level of economic benefits to all involved stakeholders.

Therefore, we conserve. The need to promote a fairer distribution of benefits is one of the cornerstones of several international conventions currently in force affecting NWFP. Suppose we acknowledge that the sustainable management of NWFP resources contributes to resolving issues of global concern. In that case, we also need to acknowledge the rights and responsibilities of equity of those who make that possible (Rashid *et al.,* 2022; Handa and Mohapatra, 2021; Dadebo *et al.,* 2024; Delgado *et al.,* 2023).

Local communities are the first actors in the sustainable management of NWFPs. The recognition of the intellectual heritage of local communities is increasingly becoming an essential element of the shared value of NWFPs (Baskent *et al.,* 2024; Rovira *et al.,* 2022; Schimetka and Ingram, 2024; Rovira *et al.,* 2022). The SDGs also play a role in NWFPs (Rashid *et al.,* 2022). Although the commercial benefits of NWFPs may appear small compared to the forest products sector, they are essential to the income of many rural people and often provide access to global markets.

Therefore, the commercialization of NWFPs is central to the economic and social development of many rural areas and their sustainable development (Zubair *et al.,* 2021; Rovira *et al.,* 2022; Musa *et al.,* 2023; Bhattarai, 2022; Shackleton *et al.,* 2024; Rashid *et al.,* 2022).

The cultural effects of the NWFP value chain include the knowledge, art, and traditions that stand behind NWFPs, which, although sometimes intangible, are regional names (Rovira *et al.,* 2022; den Herder *et al.,* 2022). Management and productive activities related to NWFPs are often interconnected with cultural expressions that, while essentially local, are at the same time part of the common cultural heritage (Romeo *et al.,* 2021; Giliberto and Jackson, 2022). The setting in which NWFPs are used centers on biodiversity. Gathering NWFPs from the wild enhances the spiritual bond with the environment. It benefits the social unit of those who obtain those products. Thus, the recognition of these socio-economic practices, both through customs and laws, demonstrates and promotes sustainable use (Rashid *et al.,* 2022; Xess and Tiwari, 2023; Temphel, 2021; Baskent *et al.,* 2024; Bhattarai and Acharya, 2021; Shackleton *et al.,* 2024; Rovira *et al.,* 2022; Handa and Mohapatra, 2021; Saifullah and Jewel, 2021).

The cultural aspects of NWFPs are extremely complex, and the role of NWFP activities in maintaining the landscape is always vital. The decline in NWFP activities and their trade leads to a considerable decrease in land management and then to the disappearance of secondary heath, in which the variety of landscapes creates exceptional elements in terms of beauty and humility that are very much appreciated (Gaines *et al.,* 2022; Salas, 2021; Piras and Santoro, 2023). The perception of these landscapes and iconic elements is reflected in local heritage and anecdotal expressions that can create value.

The social use of NWFPs is extremely complex and goes beyond consideration. It is an expression of an identity deeply attached to the forest landscape, which represents an essential cultural heritage and cultural services (Rovira *et al.,* 2022; Baskent *et al.,* 2024; Piras and Santoro, 2023; Muir, 2021; Di Cori *et al.,* 2021; Hochmalová *et al.,* 2021). NWFPs with immediate economic benefits to those involved in their management, often women, are not sufficient to justify such activities to those who benefit, including the broader public who enjoys the resulting cultural services (Wang *et al.,* 2023a, b; Delgado *et al.,* 2023).

3. ANALYZING EXISTING NWFP VALUE CHAINS IN THE REGION

KEY MESSAGES

1. Data Gaps and Fragmentation Remain a Core Challenge

- Reliable, up-to-date, and comparable data on NWFP value chains is largely missing or fragmented across countries.
- Inconsistencies in definitions and cross-sector classification (forestry, agriculture, wildlife) limit integration into national statistics and international comparisons.
- This hampers evidence-based policymaking and investment planning.

2. Regulatory and Institutional Barriers Persist

- Producers and operators face complex and inconsistent regulations that hinder NWFP collection, processing, and marketing.
- Poor institutional coordination and overlapping mandates across sectors undermine value chain development.

3. Overharvesting Is the Most Pressing Sustainability Concern

- The absence of regulation, monitoring, and science-based management often leads to unsustainable harvesting, biodiversity loss, and forest degradation.
- Community-based harvesting protocols (e.g. rotation, size/season rules) offer replicable good practices but remain underutilized.

4. Growing Market Demand Offers Opportunities

- Consumer preference for natural, organic, and ethically sourced products is growing rapidly, opening high-value niche markets for NWFPs.
- Certification schemes, eco-labels, and sustainable sourcing standards are becoming critical for competitiveness.

6. Innovation and Product Diversification Are Needed

- Sustainable value chains cannot rely solely on wild harvesting; cultivation, processing, and product development are essential.
- Opportunities exist to integrate NWFPs into agroforestry, ecotourism, and multifunctional landscape models.

6. NWFP Cooperatives Can Be Engines of Inclusive Growth

- Well-organized cooperatives can enhance sustainability, improve bargaining power, meet quality standards, and connect rural producers to premium markets.
- They play a key role in value retention at the community level and in supporting women and marginalized groups.

7. Climate and Market Risks Are Growing

- NWFP supply chains are highly vulnerable to climate change, price volatility, and external competition.
- Transitioning to resilient and adaptable value chains is critical, requiring investment in research, infrastructure, and risk-sharing mechanisms.

8. Policy and Governance Reforms Are Essential

- Strong, inclusive, and coordinated policies are needed to unlock the potential of NWFPs.
- Strategies should integrate biodiversity conservation, sustainable livelihoods, and rural development goals, guided by empirical evidence and multi-stakeholder dialogue.
- Localized eco-labeling, participatory regulations, and investment incentives can help mainstream NWFPs into national bioeconomy strategies.

KEY MESSAGES

3.1. Review of studies and data on NWFP value chains

Finding comprehensive and up-to-date data on NWFP value chains remains a challenge. However, a growing body of partial and case-specific information sheds light on market dynamics, production volumes, and livelihood impacts. For example, Lovrić *et al.* (2021) provide insights into the economic significance of NWFPs in Europe, while Palahí *et al.* (2021) and FAO (2020) highlight selected country-level trends in collection, processing, and trade. Several studies, including Di Cori *et al.* (2022), also offer anecdotal evidence of value-added potential through local processing and branding efforts. While fragmented, these data points are valuable for understanding the contours of NWFP-based economies and identifying areas where targeted investments or policy interventions could improve transparency and sustainability.

Without reliable information on the current status of NWFPs, designing effective policies to support NWFP value chain development at local, national, and regional levels remains difficult (Muir, 2021; Handa and Mohapatra, 2021; Rovira *et al.,* 2022; Maisharou and Larwanou, 2022). Although some countries collect data on NWFPs, inconsistencies in definitions and classifications across countries hinder the comparability of data at the international level (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Shackleton *et al.,* 2024; Weiss *et al.,* 2023). As a result, most commercially relevant NWFPs remain underrepresented or absent from global statistical systems and are often excluded from national economic reporting frameworks (Lovrić *et al.,* 2021; Di Cori *et al.,* 2021, 2022; Di Cori *et al.,* 2024).

Further complicating the picture is the cross-sectoral nature of NWFPs, which can be classified under agriculture, forestry, or wildlife sectors, depending on national institutional arrangements. NWFPs span a broad range of uses, including edible products—such as mushrooms, berries, and nuts—as well as hundreds of thousands of non-edible products like medicinal plants, resins, and fibers (Muir, 2021; Handa and Mohapatra, 2021; Rovira *et al.,* 2022). This diversity, combined with varying sectoral responsibilities and weak integration into national accounts, contributes to the persistent data gaps.

Throughout Europe, a tendency to externalize all NWFPs from traditional forest management and new forestry values has marked the development of the last decade (Muir, 2021; Rovira *et al.,* 2022; Maisharou and Larwanou, 2022; Handa and Mohapatra, 2021). Most East European and post-Soviet countries followed the post-1990 shift in the core values of forestry and forest management priorities (Muir, 2021; Handa and Mohapatra, 2021; Rovira *et al.,* 2022). These result from the global market demand, the level of complexity in the entire NWFP value chain, the renewal of neglected resources or the production of new resources of NWFPs, and the increasing development of knowledge and experience. In parallel, classifications were established based on the economic structure of the NWFPs landscape products and the nature of the measures used for their conservation (Muir, 2021; Handa and Mohapatra, 2021; Rovira *et al.,* 2022).

3.2. Identification of gaps and needs across production, processing, and marketing

Many regulatory hurdles NWFP producers and operators face are limiting collection, production chain organization, and market access. These barriers are encountered both in the production and marketing phases. They hinder trade and thus cause extra profits to be shared between the stakeholders (Muttilainen and Vilko, 2022; Bhattarai, 2022; Schimetka and Ingram, 2024).

Local and regional communities strongly depend on NWFP income (Musa *et al.,* 2023; Peerzada *et al.,* 2022; Derebe *et al.,* 2023). The uncontrolled collection of wild NWFPs is often unsustainable (Muir, 2021; Delgado *et al.,* 2023; Akomaning *et al.,* 2023; Pasaribu *et al.,* 2021). The technological innovation that can enable the sustainable use of wild and cultivated NWFPs can bring remarkable economic and environmental benefits, ultimately promoting the protection and valorization of forest ecosystems (Muttilainen and Vilko, 2022; Weiss *et al.,* 2023; Delgado *et al.,* 2023; Miassi and Dossa, 2024). The availability of several wild NWFPs is deeply affected by habitat degradation due to inappropriate management, which can also be related to the impacts of climate change (Muir, 2021; Felton *et al.,* 2024; Fromentin *et al.,* 2023).

On the other hand, there is an increasing demand for non-wood forest product-based products driven by higher consumer awareness and the expanding organic market. For example, global sales of organic products have grown by over 10% annually in recent years. Market surveys indicate that 65% of consumers now prioritize natural and sustainably sourced ingredients in their purchases (Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Baskent *et al.,* 2024; Özderin *et al.,* 2024; Musa *et al.,* 2023). This trend is creating new opportunities as attention from a broader range of consumers continues to rise. Competition with the development of non-wood product markets, especially organic cultivation, could be a limiting

factor in quantifying the percentage of plant species becoming economically exploited. Anyway, having several valuable NWFPs, especially medicinal and aromatic plants, and fungi, associated with the development of supportive quality and certification schemes, there is a chance to foster the production of NWFPs and time to match the product market season and improve the economic income generated with NWFPs (Delgado *et al.,* 2023; Muir, 2021; Zhang *et al.,* 2021; Pasaribu *et al.,* 2021).

However, product diversification and innovation are particularly required as it is impossible to satisfy sustainable resource utilization only by harvesting wild stands. There are ample opportunities to improve and enhance existing supply chains. The opportunity to transfer good practices largely depends on innovative training programs, which contribute to adopting better practices (Sharma *et al.,* 2021; Kar and Harichandan, 2022). Marketing at multiple sites to promote eco-tourism and the sale of products procured from NWFPs and agro-processors in the region is thereby created (Virgin *et al.,* 2022).

At the conservation level, while conservation biologists primarily focus on protected species, which can include certain NWFPs, the specific management and sustainable use of NWFPs have often received less direct attention. In cases where protected NWFP species are neglected, this may indicate broader gaps in nature conservation efforts within that country. Rather than the extremes of not using these resources at all and thereby losing the traditional management systems or allowing exploitation without regulation, a balance between conservation and exploitation of these resources must be found (Mjoli and Shackleton, 2024; de Mello *et al.,* 2023; Ogwu and Osawaru, 2022; Shedage *et al.,* 2023; Delgado *et al.,* 2023; Asamoah *et al.,* 2024).

Even though NWFP has not emerged as a global integration initiative in the same way as the forestry and forest industry have towards the development of strategies specific to industrial policies and global issues, we believe that in the short term many business strategies in the international markets will continue to progress, involving the wide possibilities of diversification and integration in the value chains of the NWFP (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Shackleton *et al.,* 2024; Utomo *et al.,* 2021). Emerging trends show buyers and consumers increasingly prefer ethically sourced, environmentally sustainable, and socially responsible products. In a well-functioning bioeconomy, this demand is met through systems that ensure transparency, certification, and strong links to local communities and ecosystems. These characteristics build consumer trust and add value to bio-based products. In addition, the potential to absorb into NWFP value chains, especially the enterprises that are also organic or involved in agroforestry and related economic activities (Wilke *et al.,* 2021; Otto *et al.,* 2021; Lang *et al.,* 2023; Morone *et al.,* 2021; Muscat *et al.,* 2021; Woźniak *et al.,* 2021).

It is probable that in both developed and low-income countries, the NWFP development is fraught with various risks and uncertainty. The potential problems that NWFP value chains are likely to face include the impacts of external price volatility, price competition from producers in other regions, the influence of the scarcity of NWFP resources, and access to very cheaply priced competing goods and services in remote rural market shops (Chen and Xu, 2024; Baig *et al.,* 2022; Ocicka *et al.,* 2022; Teno, 2022). The potential impacts will include the future provision or actual supply of NWFP facing the consequences caused by climate change. The new technological possibilities will further erode the traditional ways of natural resource management, further changing the trends in supply chains associated with NWFPs and the world of non-wood forest services (Temphel, 2021; Gaines *et al.,* 2022; Hashmi *et al.,* 2021; Khan *et al.,* 2023).

It is argued that there are possibilities of changes in the roles of the producers, the actual service and production base of environmental goods and services, and marketing strategies among the involved stakeholders. It is even possible that a series of effects on the cross-sectoral alliances formed during the discussion on the implementation could change (Farida and Setiawan, 2022; Grabs and Carodenuto, 2021; Bertassini *et al.,* 2021; Sehnem *et al.,* 2022). One of the possible scenarios where NWFP could play a key role in economic diversification strategies focuses on developing strategic alliances with a special focus on the tourism industry and relevant segments. It can be argued that while the vast possibilities for tourism that combine forest access and experience provide new surrogate markets for potentially affected and poor NWFP gatherers and collectors, it is still possible for consumers to foresee new business and socio-ecological models that are halfway between NWFP and tourism-based value chains (Rovira *et al.,* 2022; de Bruyn *et al.,* 2022; Dadebo *et al.,* 2024; Muir, 2021).

It is, therefore, important for policy to selectively act according to user practices and value chains. In the scenarios where selective regulation associated with other packaging and material flow regulation provides attention to the NWFP production and service base, it strengthens these value chains as a whole for the countries themselves. These regions tend to be more peripheralized in scenarios where NWFP regulations are weakened. However, there is progress in adjacent strategies, such as the use of support measures where producers would sell commodities based on a significant trend (Susilawati and Kanowski, 2021; Susilawati and Kanowski, 2022; Rovira *et al.,* 2023; Chen *et al.,* 2021). Similarly, on the matters of policymaking, it can be argued that trends for scenarios of exclusive frameworks associated with primary commodities and emphasis on resource protection and the increasing values of packaging schemes also have the potential to aid in the construction of regulatory frameworks (Du *et al.,* 2023; Hool *et al.,* 2024).

In different ways, the policy can also play a role in facilitating a clear vision of the policies, partnerships, and strategies, especially including the selective type of eco-labeling, which will help to back up countries' bio-protection measures (Chen, 2021; Marrucci *et al.,* 2021). Despite the level of support from the existing institutions, these innovative experiences are important, and all the concerned stakeholders should be able to provide protection and support for their setup (Audretsch *et al.,* 2022; Bacq and Aguilera, 2022).

Despite their potential, the NWFPs also represent obstacles to development because they are often associated with marginalized people who are facing unequal trading conditions in remote rural settings and with higher extraction and transformation costs by orders of magnitude that are sometimes made worse by unsustainable practices (Muir, 2021; Asamoah *et al.,* 2023; Delgado *et al.,* 2023; Wang *et al.,* 2023a, b; Taghouti *et al.,* 2022). Unregulated exploitation presents conservation concerns, and, unfortunately, significant areas of NWFP production occur in ecologically important regions of the world. However, value chain approaches are also making considerable progress in demonstrating the lessons from the sustainable silviculture and agroforestry developed for NWFPs. These production innovations send positive signals to the many rural households whose cultures and incomes are heavily associated with the established benefits of NWFPs (Bhattarai and Acharya, 2021; Delgado *et al.,* 2023; Magry *et al.,* 2024; Zhang *et al.,* 2021; Güngör, 2024; Balasso *et al.,* 2022).

3.2.1. Market access and trade

The local communities from throughout the world have come to realize that market awareness, international regulation, or organized access rights for a limited and mostly meager list of more commercially important NWFP species are essential foundations to secure their income opportunities in global trade (Bhattarai, 2022; Musa *et al.,* 2023; Ahmed *et al.,* 2023; Muttilainen and Vilko, 2022; Taghouti *et al.,* 2021; Khairul Alam, 2022).

The network of trade relationships forms the market access and trade dimension of governance in decentralized and localized institutional arrangements. It is exciting to see how the kaleidoscope of trade can translate into the freedom of economic and entrepreneurial development of individual self-employed people fulfilling the wishes of honest, hardworking people profitably making a living to support their families by marketing the goodness (Ababouch *et al.,* 2023; Shaffer, 2021; Gritsenko and Wood, 2022). Popular governance arrangements in marketing sustainable NWFP, where the local administrative level can control all aspects of regulation and administration, are the main guarantee to keep the marketing network open for trade (Rovira *et al.,* 2022; Schimetka and Ingram, 2024; Rashid *et al.,* 2022; Weiss *et al.,* 2023).

3.2.2. Sustainability concerns

One of the most pressing sustainability issues related to NWFPs is the risk of **overharvesting**, which threatens both ecosystem health and the long-term viability of NWFP value chains.

Despite strong theoretical arguments regarding the potential contribution of NWFPs to the bioeconomy (Rovira *et al.,* 2023; Baskent *et al.,* 2024), unsustainable harvesting practices—particularly in the absence of regulation and monitoring—can lead to biodiversity loss, resource depletion, and forest degradation ((Peng *et al.,* 2022; Ahmad *et al.,* 2024; Ahmad *et al.,* 2023).

Explorations of the ethical and sustainability dimensions of NWFP economic activity yield mixed conclusions. On the one hand, NWFP collection and trade have occurred on a large, often informal and unmeasured scale for centuries, frequently contributing to forest sustainability through low-impact practices maintained by local and Indigenous communities (Santo *et al.,* 2021; Rovira *et al.,* 2022; de Bruyn *et al.,* 2022; Handa and Mohapatra, 2021; Schimetka and Ingram, 2024; Bhattarai, 2022). These activities may support local provisioning and act as informal safety nets by financing responses to future emergencies or severe shocks. On the other hand, market expansion and commercialization—especially when poorly governed—can lead to overexploitation, loss of traditional ecological knowledge, and marginalization of local users. In addition, gender dynamics and migration-related vulnerabilities in NWFP value chains often remain invisible (Borderon *et al.,* 2021; Bourgeault *et al.,* 2021).

There is growing recognition in conservation and forest management discourse of the ecological contributions made by local communities and traditional forest users, whose sustainable harvesting practices and landscape stewardship are vital for maintaining ecosystem resilience. However, this recognition increasingly clashes with rigid environmental protection frameworks—such as the designation of national parks and protected areas—that often exclude customary users and disrupt long-standing, sustainable practices (Ickowitz *et al.,* 2022; Lepetu *et al.,* 2024; Chanza and Musakwa, 2021; Haq *et al.,* 2023; Octavia *et al.,* 2022).

These sustainability concerns make an effective and efficient engagement between the vast crowd of resource users and the policy environment vital. Without such an engagement, forest resource harvesting can continue successfully, with remaining resources swept into a background of environmental degradation (Khatibi *et al.,* 2021; Awan *et al.,* 2021; Çop *et al.,* 2021). These sustainability concerns also make NWFP user cooperatives of key importance in the realm of resource governance. These cooperatives have value not only in assisting with biodiversity-related goals but also with clients beyond the conservation sphere by linking NWFP collectors to important national and international markets for their products, ensuring that producers receive a significant share of the promotion and retail price and other benefits; steering a considerable portion of the economic value of NWFP back to local communities; providing initial raw material customization to market demand; ensuring that all relevant control and consumer protection standards are met throughout the value chain; and offering alternative financial services and distribution options to producers (Saritaş and Türker, 2023; Başkent, 2022; Schimetka and Ingram, 2024; Bargah *et al.,* 2024; Qiao *et al.,* 2024; Syofya, 2023; Khan *et al.,* 2022). With the technical support of diverse partners, cooperatives can provide producer training, product quality improvement services, and assistance in market development. These cooperatives can, in fact, be an indispensable launching pad for rural development initiatives anchored in the sustainable use of natural resources (Afanaseva *et al.,* 2021; Akbari *et al.,* 2023; Gava *et al.,* 2021; Ovcharenko *et al.,* 2022).

3.2.3. Policy and governance

Institutional capacity and functions in policy and governance are probably the first and foremost areas where weaknesses must be addressed. Decision-making and policy development require broad expertise but often integrate only narrowly defined competencies (Dubey *et al.,* 2023; Boulhaga *et al.,* 2023; Ali *et al.,* 2021). Progressive policy development depends on dialogue among the multitude of actors—community of communities, non-governmental organizations, private enterprises, and all levels of government (Banaś *et al.,* 2024). Value chain development identifies design, verification, and regulation over the life cycle as key issues in the innovation coalitions and their governance. In many cases, not differences in values cause conflicts, but rather differences in perceptions of facts, scenes, or impacts. In the appraisal of rules or their implementation, we may benefit from more empirical and factual research (Hansen and Schmitt, 2021; Chiu and Lin, 2022; Harland, 2021; Khan *et al.,* 2024; Dubey *et al.,* 2023; Suchek *et al.,* 2021). Establishing a clear global policy supported and adapted at lower levels would not affect the specific local adaptation of targets and actions. However, within the given framework, it offers guidance in national strategy building, cooperation among countries, and reporting and represents a strong tool for advocacy (Emanuel *et al.,* 2022; Cooper and Vargas, 2024). Focused and specific coalitions are decisive actors in innovation development, catalyzing, optimizing, and adapting technology and organization to use local and global secondary resources (Kamalaldin *et al.,* 2021; Haque *et al.,* 2024).

4. VALUE CHAIN STAGES FOR NWFPS

KEY MESSAGES

1. NWFP Value Chain Stages Are Interdependent

- The NWFP value chain includes five interlinked stages:
    1. Resource Management & Harvesting
    2. Primary Processing
    3. Value Addition & Transformation
    4. Distribution & Marketing
    5. Consumer Markets & End-Use

2. Each Region Has Unique NWFP Specialties

- South & Eastern Europe: Porcini mushrooms, berries, medicinal herbs.
- Central Asia: Pine nuts, pistachios, resins.
- Caucasus: Pine honey, walnuts, truffles.

3. Key Constraints in NWFP Development

- Overharvesting and lack of sustainable practices.
- Poor infrastructure for processing and storage.
- Weak market access and limited digital presence.
- Lack of product traceability, quality control, and branding.
- Climate change and governance gaps exacerbate these challenges.

4. Strategic Development Interventions

- Sustainable Harvesting: Train collectors, promote agroforestry, and support domestication.
- Processing Upgrades: Invest in cooperative infrastructure and quality standards.
- Value Addition: Promote innovation, branding, and geographical indications (e.g., PDOs).
- Market Access: Strengthen cooperatives, e-commerce, and international certifications.
- Policy Support: Align national strategies with EU regulations and strengthen land tenure.
- Research & Innovation: Focus on new cultivation techniques and product development.
- Climate Resilience: Encourage reforestation and climate-smart forestry.

5. Strong Governance and Holistic Approach Needed

- Successful NWFP development hinges on integrating sustainability, innovation, market systems, and policy reforms with a regional and product-specific lens.

KEY MESSAGES

Since considerable importance for the development of NWFP value chains is related to the description and characteristics of individual activities, we are going to present some of the key stages within the value chain that are necessary to achieve: the distribution and consumption of products, restrictions on the functioning of these chains, and opportunities for their development (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Zubair *et al.,* 2021; Nguyen *et al.,* 2021; Muir, 2021). The basic steps in the value chain that characterize the NWFP value chain from the time of their harvest up to the moment when they reach the final consumer can be divided into five segments (Dadebo *et al.,* 2024; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024; Novac, 2022; Nedeljković *et al.,* 2022; Jelena *et al.,* 2022):

- Resource Management & Harvesting (Collection)
- Primary Processing
- Value Addition & Transformation
- Distribution & Marketing
- Domestic and International Consumer Markets & End-Use

While presenting activities, special attention should be paid to five different stages because we believe that in the case of these products, there is a synergy between these five activities (Ahearne *et al.,* 2022; Christen *et al.,* 2022; Machová *et al.,* 2022).

4.1. Resource Management & Harvesting (Collection)

Key Products

- **South & Eastern Europe**: Wild mushrooms (porcini, chanterelles), berries (bilberries, lingonberries), medicinal plants, chestnuts.
- **Central Asia**: Pine nuts, wild pistachios, medicinal herbs, resins.
- **Caucasus**: Pine honey, walnuts, wild fruits, truffles, medicinal plants.

Particular NWFPs harvested in the region are listed in Table 1.

Table 1. Particular NWFPs harvested in the region

Country	Common NWFPs	Notable Uses/Exports
Albania	Medicinal herbs (sage, thyme), chestnuts, mushrooms	Export of dried herbs to EU; traditional medicines
Bosnia & Herzegovina	Wild mushrooms, forest berries, medicinal plants, honey	Informal trade, wild collection cooperatives
Bulgaria	Rose oil, herbs (lavender, mint), mushrooms, forest fruits	Global leader in rose oil, cosmetics, and aromatherapy
Georgia	Bay leaves, berries (barberry, hawthorn), chestnuts, honey, licorice	Herbal teas, wild food products, traditional medicine
Armenia	Thyme, wild pear, sea buckthorn, walnuts, rosehips	Organic food, herbal products, natural cosmetics
Azerbaijan	Nuts (hazelnut, chestnut), medicinal plants, pomegranate, honey	Traditional medicine, food industry exports
Türkiye	Pine honey, laurel, oregano, thyme, carob, wild mushrooms	Medicinal herbs, essential oils, pine resin
Serbia	Porcini mushrooms, forest fruits (blackberries, raspberries), medicinal herbs	Export to EU; strong tradition of wild mushroom trade
North Macedonia	Sage, thyme, mushrooms, juniper berries, rosehips	Used in herbal teas and medicinal industries
Kosovo	Mushrooms, forest fruits, linden flowers, nettles	Small-scale rural income generation
Montenegro	Forest berries, mushrooms, chestnuts	Informal market; potential for eco-certification
Kazakhstan	Sea buckthorn, licorice root, juniper, mushrooms, birch sap	Medicinal plant industry, export of botanicals
Kyrgyzstan	Walnuts, wild apples, medicinal plants, mountain honey	Traditional medicine, wild collection co-ops
Tajikistan	Juniper, wild almonds, herbs (mint, sage), resins	Traditional uses, low processing infrastructure
Turkmenistan	Desert herbs, camelthorn, licorice, gums	Medicinal and industrial applications
Uzbekistan	Wild fruits (hawthorn, barberry), herbs, licorice	Used in teas and natural remedies

Challenges

- Overharvesting and unsustainable collection methods.
- Limited regulations and enforcement for sustainable use.
- Land tenure uncertainties in some countries.
- Lack of training for collectors on best harvesting practices.
- Quality of the products.
- Cost for collection or managing the products.
- Low productivity.

Development Strategies

- **Sustainable Harvesting Guidelines**: Introduce community-based forest management models.
- **Training & Capacity Building**: Educate local collectors on ethical harvesting, post-harvest handling, and quality grading.
- **Certification & Legal Frameworks**: Promote FSC, organic, and fair-trade certifications.
- **Domestication & Agroforestry**: Develop cultivation systems for high-value NWFPs (i.e. truffle orchards, medicinal plant farms).

4.2. Primary Processing

Activities

- Drying, cleaning, sorting, grading, fermentation (for specific products like honey), and storage.
- Initial processing into raw materials (i.e. essential oils, dried mushrooms, herbal teas).

Challenges

- Lack of modern drying and storage facilities, leading to post-harvest losses.
- Limited access to technology for improving quality.
- Inconsistent grading standards reduce competitiveness in global markets.

Development Strategies

- **Investment in Processing Infrastructure**: Build cooperative drying and storage facilities.
- **Standardized Quality Control**: Develop regional quality standards for mushrooms, herbs, and honey.
- **Access to Finance**: Provide microloans or grants for small-scale processors.

4.3. Value Addition & Transformation

Activities

- Production of **high-value** NWFP-based goods such as herbal medicines, cosmetics, essential oils, gourmet food products, and nutraceuticals.
- Small-scale and cottage industry transformation.

Challenges

- Weak links between raw material suppliers and manufacturers.
- Limited technological know-how for value-added processing.
- Lack of regional branding and traceability systems.

Development Strategies

- **Product Diversification**: Develop innovative NWFP products (i.e. mushroom-based supplements, pine honey skincare).
- **Branding & Geographical Indications**: Establish **Protected Designation of Origin (PDO)** labels for premium products (i.e. Caucasus pine honey, Central Asian wild pistachios).
- **Technology Transfer**: Support knowledge-sharing between producers and research institutions.

4.4. Distribution & Marketing

Current Market Trends

- **Local markets**: Sold directly through local bazaars, cooperatives, and roadside vendors.
- **Export markets**: European Union (EU), Middle East, China, and North America are major buyers of NWFPs from the region.

Challenges

- Poor market access for small-scale producers.
- Limited logistics infrastructure and cold chain storage.
- Middlemen often capture most of the value.
- Weak e-commerce presence for regional NWFPs.

Development Strategies

- **Cooperative Market Models**: Strengthen producer cooperatives for direct market access.
- **Improved Supply Chains**: Develop better storage and transportation networks.

- **Digital Marketing & E-commerce**: Support online platforms for regional NWFP sales (i.e. Amazon, Etsy, regional websites).

4.5. Domestic and International Consumer Markets & End-Use

Trends in Consumer Demand

- **EU & The United States of America**: Growing demand for organic, sustainable, and wild-harvested products.
- **Regional Markets**: Increasing interest in natural remedies, herbal teas, and traditional forest products.
- **Luxury Segments**: Porcini mushrooms and truffles have high-end demand in gourmet cuisine.

Challenges

- Competition from cheaper, industrially produced alternatives.
- Lack of consumer awareness about the benefits of regional NWFPs.
- Need for better traceability and food safety compliance.

Development Strategies

- **Consumer Awareness Campaigns**: Promote the health and ecological benefits of NWFPs.
- **Export Facilitation**: Assist producers in meeting EU and international standards.
- **Premium Pricing through Certification**: Encourage organic, fair-trade, and sustainable labels for added value.

4.6. Cross-Cutting Recommendations for Regional Development

Repeatedly, in the descriptions of the peculiarity of NWFP and the essential points leading to the improvement and innovation of the current situation of NWFP processing and distribution on commodity markets, stakeholders in the value chain, the consulting team, draw attention to the level of constraints and challenges that each of the links in these chains must face. Moreover, it is noted that the quality and efficiency of one of these chains are particularly vulnerable to the low efficiency of these three elements. A steadily deteriorating climate is also part of the limitations at crop and tree production, meat processing, and logistics and transportation chains that have been identified and have influenced the delay in the evolution of these chains. Costly inputs will also affect the efficiency and profitability of these chains, as well as the heavy taxes imposed on products (Rovira *et al.,* 2022; Khaskheli *et al.,* 2023; Ismail *et al.,* 2023).

Policy & Governance

- Develop **national NWFP strategies** with clear sustainability policies.
- Strengthen **land tenure security** for collectors and small-scale producers.
- Align regulations with **EU food safety and organic certification standards**.

Research & Innovation

- **Develop new cultivation techniques** for high-demand NWFPs (i.e. truffles, medicinal herbs).
- **Invest in product innovation** (i.e. resin-based bioplastics, pine honey nutraceuticals).
- Support **academic-private sector partnerships** for product research.

Climate Resilience & Sustainability

- Promote **climate-smart forestry** for NWFP resilience.
- Introduce **reforestation programs** focusing on valuable NWFP species.
- Support **biodiversity conservation** through sustainable forest management.

Final Thoughts

Developing the NWFP value chain in **South & Eastern Europe, Central Asia, and the Caucasus** requires a **holistic approach** that integrates sustainability, value addition, market access, and strong governance. By leveraging **certification schemes, technology, cooperative models, and e-commerce**, the region can significantly enhance the economic and environmental benefits of NWFPs.

5. CRITICAL VALUE CHAIN STAGES IN SOUTH & EASTERN EUROPE, CENTRAL ASIA, AND THE CAUCASUS

KEY MESSAGES

1. Three Critical Value Chain Stages

The NWFP value chain hinges on three essential and interconnected stages:

- Resource Management & Harvesting
- Processing & Quality Control
- Market Access & Distribution

Failure in any one stage weakens the entire chain.

2. Sustainable Resource Management Is Essential

- Overharvesting and unclear land rights threaten long-term supply.
- Many countries (e.g., Ukraine, Türkiye, Georgia) are introducing quotas, forest plans, and community-based management.
- Best practices combine scientific quotas, traditional knowledge, and certification systems (e.g., FairWild, FSC).

3. Quality Control and Infrastructure Gaps Hurt Competitiveness

- Post-harvest losses are common due to poor drying, storage, and sorting.
- Lack of grading standards undermines product value in global markets.
- Solutions include:
  - Investment in processing hubs and cold storage.
  - National quality standards aligned with EU/global norms.
  - Training in hygiene, traceability, and value addition.

4. Market Access Is Constrained by Infrastructure and Intermediaries

- Small-scale producers lack direct market access and are undervalued by middlemen.
- There is limited branding, e-commerce presence, and digital literacy.
- Key actions include:
  - Strengthening logistics and regional trade hubs.
  - Supporting GI and certification (e.g., Caucasus Pine Honey PDO).
  - Promoting digital tools (e-commerce, social media, blockchain traceability).

5. Grading Systems Improve Marketability

- Standardized grading (e.g., mushrooms in Eastern Europe, pine nuts in Central Asia, medicinal herbs in the Caucasus) helps align with export market expectations and pricing structures.

6. Integrated Solutions Drive Value Chain Strengthening

- Combining policy support, investment in infrastructure, and digital marketing tools can transform NWFPs into sustainable income sources.
- Regional cooperation and knowledge-sharing are critical to scaling success stories.

KEY MESSAGES

The region has a rich diversity of **NWFPs,** such as **wild mushrooms (i.e. porcini), berries, medicinal plants, pine honey, nuts, and resins**. The value chain varies by product, but the key stages remain similar. In the region, the **most critical stages** in the **NWFPs value chain** are:

1. **Resource Management & Harvesting**
2. **Processing & Quality Control**
3. **Market Access & Distribution**

These stages face significant challenges that impact the sustainability, profitability, and competitiveness of NWFPs in domestic and international markets. Below is a breakdown of why these stages are critical and how to address the challenges effectively.

5.1. Resource Management & Harvesting

Why is this Critical?

- Overharvesting threatens long-term sustainability, especially for **wild mushrooms, medicinal plants, and pine nuts**.
- Poor harvesting techniques reduce quality and product lifespan.
- Unclear land tenure and weak regulations lead to **unsustainable collection** and conflicts over forest resources.

How to Counteract?

✅ **Sustainable Harvesting Guidelines**

- Establish **scientific harvesting quotas** based on ecosystem capacity.
- Implement **seasonal collection bans** and **rotational harvesting** to prevent resource depletion.

✅ **Local Community Involvement & Training**

- Develop **community-based forest management (CBFM) programs**.
- Train collectors in **best harvesting practices** to maximize quality and minimize environmental damage.

✅ **Policy & Certification Support**

- Strengthen government oversight through **resource monitoring systems**.
- Promote **Forest Stewardship Council (FSC), FairWild, and organic certifications** to ensure sustainability.
- Provide legal frameworks to **clarify land tenure rights** and access for local communities.

Examples of Harvesting Quotas and the Effects

Several countries in South and Eastern Europe, Central Asia, and the Caucasus countries have implemented harvesting quotas and regulatory frameworks for NWFPs to promote sustainability and prevent overexploitation. Below are some notable examples:

1. Ukraine: Regulated Harvesting of Medicinal Plants and Mushrooms

In Ukraine, the collection of NWFPs—referred to as "secondary forest products"—is governed by specific regulations aimed at protecting forest ecosystems. For instance, harvesting medicinal herbs and mushrooms listed in the Red Data Book of Ukraine is prohibited. Harvesting is permitted under strict guidelines for other species, such as collecting less than 10% of roots and 40% of leaves from a plant. Additionally, collection is allowed only if certain ground cover thresholds are met (i.e. berries comprising more than 10% of ground cover). These measures aim to ensure the sustainable use of NWFPs by controlling the quantity harvested and protecting endangered species.

2. Kazakhstan: Hunting Quotas for Migratory Waterfowl

In northern Kazakhstan, hunting quotas have been established for migratory waterfowl species, including the Lesser White-fronted Goose (LWfG), to prevent overharvesting. Despite these quotas, challenges persist due to accidental offtake and limited awareness among hunters regarding species protection statuses. Studies have shown that even with quotas in place, the LWfG population remains vulnerable, highlighting the need for improved enforcement and education.

3. Türkiye: Overharvesting of Medicinal and Aromatic Plants

Türkiye has faced issues with overharvesting NWFPs, particularly medicinal and aromatic plants like Laurus nobilis (bay leaves). While specific quotas are not detailed, the country has

recognized the need for sustainable harvesting practices. Efforts are being made to balance the economic benefits of NWFPs with conservation goals, including developing management strategies to regulate harvesting levels.

4. Georgia: Sustainable Forest Use Plans

In Georgia, sustainable forest use plans have been developed to balance resource utilization with conservation. These plans include guidelines for the sustainable harvesting of NWFPs, aiming to prevent overexploitation and promote alternative livelihoods such as beekeeping and small-scale tourism.
These examples illustrate the diverse approaches taken by countries in the region to implement NWFP harvesting quotas and regulations. While progress has been made, ongoing challenges such as enforcement, awareness, and data collection continue to impact the effectiveness of these measures.

For a more comprehensive analysis of national and multi-country strategies related to NWFPs, you may refer to the FAO's Bioeconomy Strategies Dashboard.

Best Harvesting Practices in the Region

Sustainable harvesting practices for NWFPs in South and Eastern Europe, Central Asia, and the Caucasus have been developed to balance ecological preservation with community livelihoods. Here are some notable examples:

1. FairWild Standard Implementation in Central Asia

In Kazakhstan and Uzbekistan, the FairWild Standard has been applied to harvesting wild licorice (Glycyrrhiza spp.). This standard ensures that plant populations are maintained in the wild and that collectors receive fair compensation. Practices include setting quotas, rotating harvesting areas, and providing training to collectors on sustainable methods.

2. Sustainable Wild Plant Harvesting in Central Europe

A "Traditional and Wild" project in countries like Hungary, Slovenia, and Poland focused on revitalizing traditional knowledge of wild plant harvesting. It promoted sustainable collection methods, such as selective harvesting and habitat conservation, while providing economic opportunities to marginalized groups.

3. Agroforestry Practices in Central Asia

In Tajikistan and Uzbekistan, agroforestry systems have been adopted to integrate trees with crops and livestock. This approach supports the sustainable production of NWFPs like nuts and medicinal plants, enhances biodiversity, and improves soil health.

4. Community-Based Wild Food Harvesting in the Caucasus

In the Greater Caucasus Range of Azerbaijan, communities engage in the sustainable collection of wild edible plants. Traditional knowledge guides practices such as seasonal harvesting and habitat preservation, ensuring the availability of these resources for future generations.

These examples illustrate the importance of combining traditional knowledge with modern sustainable practices to ensure the long-term viability of NWFPs in these regions.

Grading and Sorting Systems for Particular Products

Implementing grading and sorting systems for NWFPs ensures product quality, meets market standards, and promotes sustainable harvesting practices. Below are examples of grading systems applied to specific NWFPs:

1. Mushroom Grading in Eastern Europe

In countries like Poland and Romania, wild mushrooms such as chanterelles and porcini are graded based on size, color, and cleanliness:

- **Grade I:** Large, uniformly colored mushrooms with no blemishes or insect damage.
- **Grade II:** Medium-sized mushrooms with minor imperfections.
- **Grade III:** Smaller mushrooms or those with noticeable defects, suitable for processing.

This system helps in standardizing products for both domestic consumption and export markets.

2. Pine Nut Sorting in Central Asia

In regions like Kazakhstan and Kyrgyzstan, pine nuts are sorted using mechanical sieves and optical sorters:

- **Size Sorting:** Nuts are passed through sieves to separate them into different size categories.
- **Color Sorting:** Optical sorters detect and remove discolored or defective nuts, ensuring only high-quality nuts proceed to packaging.

These practices enhance product quality and meet international standards for export.

3. Medicinal Plant Grading in the Caucasus

In Georgia and Armenia, medicinal plants like chamomile and thyme are graded based on purity and active ingredient content:

- **Grade A:** High purity (over 95%), pungent aroma, and high concentration of active compounds.
- **Grade B:** Moderate purity (85-95%) with acceptable levels of active ingredients.
- **Grade C:** Lower purity, used primarily for extraction or processing.

Laboratory analyses are often conducted to determine the concentration of active compounds, ensuring efficacy and safety for consumers.

These grading systems play a crucial role in maintaining the quality and sustainability of NWFPs, benefiting producers and consumers across various regions.

5.2. Processing & Quality Control

A growing interest in NWFP products is related to the willingness of individual consumers to change their lifestyle, improve their quality of life, and not only focus on price (Rovira *et al.,* 2022). However, in addition to promoting products that are characterized by good quality properties because they appeal to a growing group of consumers, each manufacturer also must comply with the strict requirements of the market, which are recognized by individual clients (Rovira *et al.,* 2022; Khaskheli *et al.,* 2023). Regulations on the safety and quality of products, as well as the need to know 'where the product comes from,' are the primary determinants when modern agriculture and food products are promoted on the market (Rovira *et al.,* 2022; Khaskheli *et al.,* 2023; Ismail *et al.,* 2023). The quality assurance system is fundamental to meeting these requirements. It is an effective tool for identifying the risks of the development and implementation of the systems and a market communication tool (Rovira *et al.,* 2022; Khaskheli *et al.,* 2023; Ismail *et al.,* 2023). Tracing products at the production and distribution ends is now the primary determinant for selecting suppliers in the global market. Quality assurance is increasingly a requirement. Its use opens new possibilities for developing NWFP value chains and is a priority for improvement in this field.

Why is this Critical?

- Poor post-harvest handling leads to **spoilage and contamination**, especially for mushrooms, herbs, and honey.
- The lack of standardized **quality grading and sorting systems** affects market competitiveness.
- Insufficient **drying, storage, and processing facilities** force small producers to sell raw materials at low prices.

How to Counteract?

✅ **Investment in Infrastructure & Technology**

- Establish **regional drying, cleaning, and processing hubs** to ensure high-quality products.
- Provide access to **cold storage** for temperature-sensitive NWFPs like berries and mushrooms.
- Introduce small-scale **essential oil distillation and honey purification technologies**.

✅ **Quality Control & Standardization**

- Develop **national/regional quality standards** aligned with EU and global markets.
- Train producers in **hygienic handling, processing, and traceability systems**.

✅ **Cooperative Models & Value Addition**

- Encourage **producer cooperatives** to share processing facilities and negotiate better prices.
- Promote **value-added product development** (i.e. porcini powder, pine honey skincare products).

5.3. Market Access & Distribution

Why is this Critical?

- **Weak supply chain infrastructure** limits producers' ability to access profitable markets.
- **Middlemen and traders** capture most of the value, leaving small-scale collectors with minimal income.

- **Lack of branding and marketing** makes competing with larger international suppliers difficult.
- Limited **e-commerce and direct export** capabilities.

How to Counteract?

✅ **Improved Logistics & Distribution Channels**

- Invest in **better transportation networks** to improve access to urban and export markets.
- Develop **regional NWFP trade hubs** for better coordination of supply and demand.

✅ **Market Linkages & Branding**

- Support **geographical indications (GI)** and **certification labels** for high-value products like:
  - **Caucasus Pine Honey (PDO)**
  - **Central Asian Wild Pistachios (PGI)**
  - **Balkan Wild Mushrooms (FairWild Certified)**

✅ **Digitalization & E-Commerce**

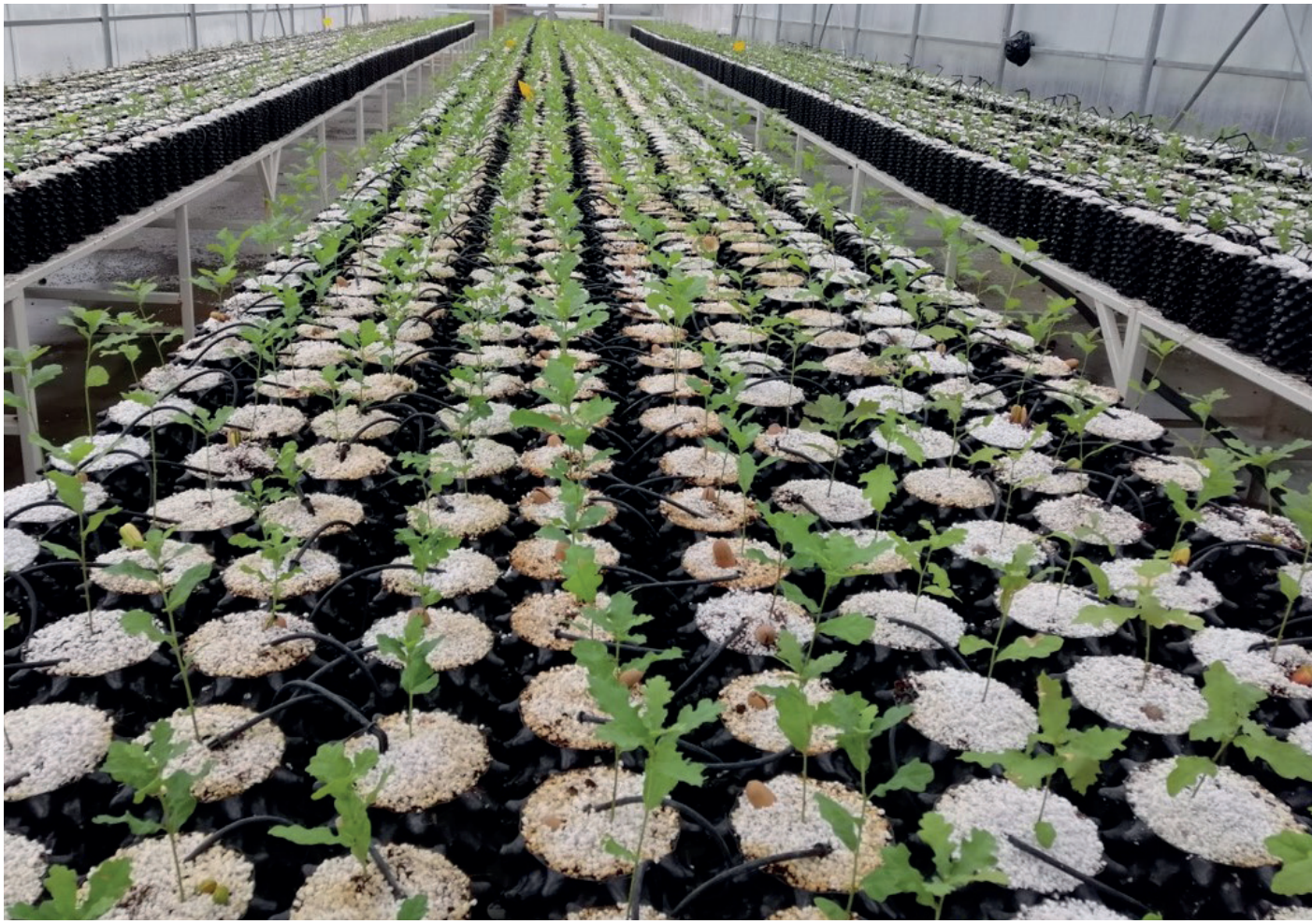
- Establish online **B2B platforms** for direct international sales.
- Train small producers on **social media and e-commerce marketing** (Amazon, Etsy, Alibaba).
- Support **blockchain-based traceability systems** to boost consumer trust.

Conclusion: Strengthening Key Stages for Regional Growth

To enhance the **NWFP sector in South & Eastern Europe, Central Asia, and the Caucasus**, the focus should be on:

- **Sustainability in Harvesting** – Implement **quotas, certification, and community management**.
- **Processing Infrastructure** – Build **drying, storage, and value-addition facilities**.

Market & Branding – Improve **export access, certification, and digital marketing**.



6. POLICIES AND INNOVATIONS FOR NWFP DEVELOPMENT

KEY MESSAGES

1. Flexible and Integrated Policy Instruments Are Crucial

- Policies must boost demand, improve trust in product quality, and ensure realistic pricing.
- Success depends on tailoring tools to local realities (e.g., social norms, trust levels, market maturity).
- Integrated strategies—rather than isolated efforts—deliver the best outcomes across the value chain.

2. Research & Development Gaps Limit Sector Growth

- Significant data gaps exist in species identification, market trends, ecological limits, and legal frameworks.
- Public sector support is essential, as private actors face capacity and funding constraints.
- Lack of R&D results in missed opportunities and high value losses for both producers and traders.

3. Product Diversification Enhances Sustainability and Resilience

- NWFPs are underrepresented in global trade statistics, but local economic diversification can strengthen resilience.
- Focusing on year-round, multi-product economies and value-added processing reduces risks and boosts local incomes.
- High-value, low-volume niche products (e.g., essential oils, extracts) can provide a competitive edge.

4. Value-Added Processing Creates Local Jobs and Incentives

- Local transformation increases product value, encourages forest conservation, and boosts rural employment.
- Small-scale processors need access to training, equipment, and capital to scale up sustainably.
- Knowledge transfer is vital to enable communities to move beyond raw material sales.

5. Stakeholder Mapping Is Essential for Effective Value Chain Development

- NWFP chains involve diverse actors—collectors, processors, middlemen, cooperatives, researchers, and policymakers.
- There's no "one-size-fits-all" model; success depends on inclusive and context-specific collaboration.
- Many value chains lack meaningful value addition between stages—highlighting an area for targeted intervention.

6. Global Networks and Multi-Level Coordination Are Needed

- Stakeholders span local to international levels: CSOs, universities, ethnic organizations, SMEs, and public bodies.
- Coordinated, multi-actor partnerships are necessary to improve efficiency, innovation, and sustainability throughout the chain.

KEY MESSAGES

The Stocktaking Report conducted a SWOT analysis highlighting the critical factors influencing the NWFP sector. By leveraging strengths and opportunities while addressing weaknesses and threats, stakeholders can achieve a more sustainable future for NWFPs. The following sections were developed in the Guidelines based on the SWOT analysis.

6.1. Policies, initiatives, tools, and technologies for value chain enhancement

Policy instruments in this field must be capable of being flexibly designed and directed. Choosing appropriate tools and policies can (1) increase interest, demand, and use of NWFPs; (2) reduce levels of mistrust in quality; and (3) develop realistic pricing models that will result in higher economic and environmental sustainability. Suppose a combination of tools is being used. In that case, they are best served if they are integrated into an overall strategy designed to provide the best balance of benefits for all partners in the forest sector (Shackleton *et al.,* 2024; Muir, 2021; Rovira *et al.,* 2022; Bhattarai and Acharya, 2021; Güngör, 2024). The choice of tools generally depends upon the initial conditions of the country involved -- level of trust, social acceptability, political support for sustainable non-wood forest exploitation, and market conditions. Options, presented with their advantages and disadvantages, reflect the diversity of conditions found in the economy of the category of countries involved (Betts *et al.,* 2021; Aza *et al.,* 2021; Blair *et al.,* 2021; Hansen and Juslin, 2018).

6.1.1. Research and development

There are significant gaps to be covered. Some of them could be approached through immediate research and technology development. In contrast, others must be filled using experience accumulated in other regions and modeling. Preliminary research is necessary to understand the capabilities and constraints of the marketing system and the needs of the producers, first at the local level, then at the regional level, and finally at the global level (Apasrawirote *et al.,* 2022). Such research can be conducted by the government or the private sector or through linkages between these two institutions. However, the public sector is often better equipped and has fewer financial barriers to conducting this research (Awan *et al.,* 2022; Sodhi *et al.,* 2023; Islam *et al.,* 2024; Hofstetter *et al.,* 2021; Zhang *et al.,* 2021; Wieland, 2021). Research topics include species identification and end uses, legal status and availability, production, and reproductive biology, potentially treated products, availability of all products in the area, proximity of local markets and potential export markets, price history, and marketing information (Lovrić *et al.,* 2021; Huber *et al.,* 2023; Baskent *et al.,* 2024; Muir, 2021; Musa *et al.,* 2023).

Unfortunately, resources for research are typically deficient. However, the market for NWFPs internally and externally keeps increasing while we are losing opportunities through our ability to capture only a tiny fraction of this diverse trade (Muttilainen and Vilko, 2022; Huber *et al.,* 2023; Weiss *et al.,* 2023; Musa *et al.,* 2023; Shackleton *et al.,* 2024; Muir, 2021; Adesina *et al.,* 2022; Pasaribu *et al.,* 2021; Purwestri *et al.,* 2023). The volume and value of the business losses associated with this inability are much too high, particularly for poorer producers and intermediate traders who rely mainly on these products for survival. On the other end of the chain is the Western consumer,

who is increasingly rejecting mass-produced, standard fuels and foods for products of higher quality and without residue problems (Bellemare *et al.,* 2022; Grant and Startz, 2022; Grabs and Carodenuto, 2021). Providing coordination, training opportunities at all levels, and investment facilitation to stimulate this growing demand effort is often beyond the ability of the private sector, particularly by the informal networks that make up many of the start-up businesses (Delmon, 2021; Auboin *et al.,* 2021; Lindsey *et al.,* 2021; Stern and Valero, 2021).

6.1.2. Product diversification

In trade statistics, trade-in NWFPs do not amount to more than a few percent of the traded volume (Musa *et al.,* 2023; Shackleton and de Vos, 2022; Muir, 2021). This makes it difficult to derive the export potential or international market demand for specific NWFPs (Shackleton *et al.,* 2024; Rovira *et al.,* 2022; Muir, 2021; Güngör, 2024; Taghouti *et al.,* 2022). However, diversifying a local economy by adding a plethora of products and services is an internationally known method of making local or regional economies sustainable. A diversity of crops, continuing all year, and a diversity of income-generating activities can increase the marketing potential of NWFPs (Rovira *et al.,* 2022; Rovira *et al.,* 2022; Baskent *et al.,* 2024; Muir, 2021; Muttilainen and Vilko, 2022). Moreover, processed NWFPs, in particular, can aid in concentrating on higher-value, lower-volume products and confer a price advantage. It also contributes to the sustainability of a forest operation by de-risking the impact of dependencies on single NWFP sales, enhancing overall economic and market competitiveness, contributing to the conservation of natural and cultural capital, and supporting sustainable forest management (SFM) (Lazaridou *et al.,* 2021; Khan *et al.,* 2024; Ameh, 2024; Abbasi *et al.,* 2021; Nambiar, 2021).

6.1.3. Value-added processing techniques

For most wild-collected NWFPs in the studied countries, harvesting is the most critical stage of the collection process (Güngör, 2024; Muir, 2021; Piras and Santoro, 2023; Schindler *et al.,* 2022; Lovrić *et al.,* 2022; Póvoa *et al.,* 2023; Kulcsar *et al.,* 2023; Rovira *et al.,* 2022). Adding value to products transformed at a local level or a fair distance from the collection area can significantly improve the income of local communities and impact the sustainable management of the resources being used. Local processing could also lead to the creation of new jobs in local areas and better support the conservation and protection of primary forests (Lo and Zhu, 2022; Campos-Silva *et al.,* 2021; Luby *et al.,* 2022; Octavia *et al.,* 2022). Selling value-added NWFPs could also generate interest in these products from the general public and increase the income of the particular group selling the items (Schimetka and Ingram, 2024; Rovira *et al.,*2022; Hintz *et al.,* 2021; Weiss *et al.,* 2023; Nabaloum *et al.,* 2025). People involved locally in the processing activity could organize their work better using efficient, cost-effective techniques. However, they do not have either processing expertise or possibilities for the regular purchase of equipment, and budget resources available for initiating a specific type of processing are limited (Govaerts *et al.,* 2021; Cvitanovic *et al.,* 2021; Sharma *et al.,* 2021). Brief knowledge transfer on these minor requirements would help lessen NWFPs' extinction (Akomaning *et al.,* 2023; Delgado *et al.,* 2023; Bhattarai and Acharya, 2021).

6.2. Mapping of stakeholders

Implementing a value chain development initiative in a target community or area is highly demanding. It requires the involvement of different actors with a variety of expertise. This is particularly true for NWFPs, an industry that generally lacks well-established collection, production, and marketing channels and requires technical and marketing support (Dwivedi *et al.,* 2021; Riccaboni *et al.,* 2021; Hofstetter *et al.,* 2021; Grabs and Carodenuto, 2021). The experience of various organizations on value chain development in different forest types, in multiple regions, and with different types of NWFPs has pointed out that there is no universal or "one-size-fits-all" approach (Di Cori *et al.,* 2024; Adesina *et al.,* 2022; Trigkas *et al.,* 2023; Di Cori *et al.,* 2021). Despite this diversity, the leading actors of a value chain can be categorized by their roles. Since the large majority of value chain development initiatives in the countries

have been initiated and/or supported by research institutions, forestry agencies, or National Forest Programmes, the first attempt to define and list the actors was based on the characteristics of the initiatives supported by these entities.

NWFPs go through several transformation steps, from tree or crop to end product, to reach the consumer. The development of value chains is one of the promising tools for a better understanding of the economics and general functioning of the NWFP sector (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Muttilainen and Vilko, 2022; Nguyen *et al.,* 2021; Zubair *et al.,* 2021; Baskent *et al.,* 2024; Magry *et al.,* 2024; Musa *et al.,* 2023). The main steps of the NWFP value chain are the following: 1) Harvesting (collection, growing, and protection); 2) Collection points; 3) Small-scale processing; 4) Marketing. The players in each step of the value chain change from local people in the first two to three steps of the value chain to local people in the final steps (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Novac, 2022; Muttilainen and Vilko, 2022; Jelena *et al.,* 2022; Nedeljković *et al.,* 2022; Muir, 2021).

Some main actors in the value chain can also be the same at several steps. For example, a private company that has a concession for the collection of raw material in the forest will use their private collectors or workers (Grabs and Carodenuto, 2021; Mangla *et al.,* 2022; Chauhan *et al.,* 2022; Katsikouli *et al.,* 2021). The value chain can also have loose stages or levels, where a collected raw material may be sold to a middleman who prepares it a bit, like drying or selecting, and then sells it as a dried product or raw material (Muir, 2021; Khairul Alam, 2022; Santos *et al.,* 2021; Pohl *et al.,* 2024; Nabaloum *et al.,* 2025). The extent of the value addition that is taking place between each stage is another vital issue to understand to get a handle on the economics of an NWFP. In general, not much value addition is taking place (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Dadebo *et al.,* 2024; Nguyen *et al.,* 2021; Bhattarai, 2022; Zubair *et al.,* 2021; Shackleton *et al.,* 2024). With this model, the collection of a raw product starts with the collection of raw NWFP from a forest resource through collecting, packing, labeling, marketing, and distributing until it reaches the end consumer (Novac, 2022; Bhattarai, 2022; Muir, 2021; Musa *et al.,* 2023; Schimetka and Ingram, 2024; Haque *et al.,* 2022).

In this regard, a global context for NWFP value chain development, which is being practiced by a diverse group of public institutions, cooperation partners, cooperatives, and associations, low-tech artisanal entrepreneurs, civil society organizations (CSOs), ethnic and marginalized people's organizations, research, and training bodies and universities that function at differentiated sub-national to international levels (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Muttilainen and Vilko, 2022).

7. NWFP CERTIFICATION AND SUSTAINABLE MANAGEMENT

KEY MESSAGES

1. Certification Enhances Market Access and Sustainability

- Certification and labeling of Non-Wood Forest Products (NWFPs) improve sustainability, traceability, and consumer confidence.
- Tailored certification schemes aligned with NWFP-specific characteristics are essential (e.g., mushrooms, nuts, berries).
- Certification offers a competitive edge, especially for producers in South and Eastern Europe, Central Asia, and the Caucasus.

2. Need for Improved NWFP Governance and Inventories

- Most NWFPs are poorly documented and lack standardized inventory systems compared to timber products.
- Existing inventories are fragmented and often incomplete; many countries (e.g., Georgia, Kyrgyzstan) have only partial coverage.
- Harmonized criteria and language-independent definitions (e.g., round wood equivalents for NWFPs) are needed for comparability.

3. Sustainable Harvesting Requires Local Adaptation

- Harvesting should not compromise regeneration or ecosystem dynamics.
- Sustainable harvest levels should be set conservatively (e.g., <10%) when data is scarce.
- Site-specific mapping and clear zoning are necessary to distinguish safe harvesting areas from sensitive zones.

4. Quality Standards Are Critical but Limited

- EU-level certification covers reproductive materials and forest certification, but dedicated NWFP standards are lacking.
- Some individual product standards exist (e.g., Codex for Brazil nuts, mushrooms, honey), but broader coverage is needed.
- Local quality standards and labeling can promote both biodiversity and economic value.

5. NWFPs Have Major Socio-Economic and Ecological Roles

- NWFPs contribute to rural incomes, food security, and poverty reduction, especially in marginal communities.
- Community-based forestry, agroforestry, and trade facilitation are vital for sustainable development.
- NWFPs often originate from biodiversity-rich ecosystems, emphasizing the need for ecological sustainability.

6. Policy and Legal Frameworks Need Strengthening

- Legal and institutional support for NWFPs is often fragmented, species-specific, or outdated.
- There is a need for integrated governance across biodiversity, environmental protection, trade, and rural development policies.
- Regulation should empower local communities and align with sustainable rural development strategies.

7. Monitoring, Education, and Traditional Knowledge Integration Are Key

- Monitoring systems and sustainable management plans must be developed and implemented.
- Education, training, and the inclusion of traditional ecological knowledge are essential to achieving holistic management.
- Investments in research and community-based conservation improve long-term resilience and product value.

KEY MESSAGES

7.1. Impact of certification schemes on NWFPs

To address consumer concerns regarding the proper management of non-forest tree resources, including mushrooms, nuts, and berries, as well as broader certification standards, it has been determined that tailored recommendations should be developed to align the implementation of these schemes with NWFPs (Baskent *et al.,* 2024; Schimetka and Ingram, 2024; Kohsaka and Miyake, 2021; Kadam, 2022). This initiative necessitates improved governance of NWFP resources and the creation of relevant policy incentives. It is essential to underscore the important role and potential advantages of certification and labeling for NWFPs (Schimetka and Ingram, 2024; Baskent *et al.,* 2024; Dadebo *et al.,* 2024; Nguyen *et al.,* 2021; Muttilainen and Vilko, 2022). Additionally, there is a need for more extensive discussions on incorporating NWFPs into voluntary certification schemes that go beyond the sustainability criteria currently applied to forest management frameworks. These frameworks also need to be refined and adapted to the specific characteristics of NWFP resources (Singh and Chatterjee, 2021; Muir, 2021; Weiss *et al.,* 2023; Baskent *et al.,* 2024; Sıvacıoğlu, 2020; Rovira *et al.,* 2023). Emphasis should be placed on establishing criteria for non-woody forest goods, methods for inventorying resources, and identifying both protected and unknown species, as well as site-specific certification procedures (Safitri and Sundawati, 2024; Miassi and Dossa, 2024).

Certification schemes for NWFPs can support sustainable harvesting and ensure the ecological, social, and economic viability of these resources. Here's an overview of the key certification schemes and their implications. Certification also plays a crucial role in enhancing market access for NWFPs by establishing standards that ensure sustainability, quality, and traceability.

The Stocktaking Report provides key certification schemes. The certification schemes collectively enhance market access for NWFPs by ensuring sustainable practices, improving product quality, and meeting consumer demand for ethically sourced products. Implementing such certifications can significantly benefit producers in South and Eastern Europe, Central Asia, and the Caucasus by providing them a competitive edge in local and global markets.

7.2. Sustainable harvesting and supply practices

Sustainable management of NWFP resources involves using the most current scientific methodologies and equipping producers with the necessary knowledge and technology to utilize the products (Ababa, 2024; Rosa and Martius, 2021; Anane *et al.,* 2023). This includes adaptation to local conditions considering the genetic range and capabilities of the local environment (Kwakye *et al.,* 2023; Gaitán-Espitia and Hobday, 2021). Users must differentiate between optimum, carefully monitored, well-designed, laid-out sites and criminally damaging, non-professional harvester irresponsible stands. Practitioners need clear maps of the sites with details of locations where each opportunity or risk is located and which are areas of minimum or no risk. Not only are such maps of value to NWFP users, but they are equally valuable to anybody interested in environmental monitoring.

7.2.1. NWFP inventory

Most of the NWFPs have not yet been described and inventoried using the same criteria and methods as those for wood products (Shackleton *et al.,* 2024; Muir, 2021; Huber *et al.,* 2023; Musa *et al.,* 2023; Bhattarai, 2022; Novac, 2022). Words like truffles and many others in many languages have been used for centuries but have never been scientifically described. They have also never been scientifically classified and taxonomically allocated (Muir, 2021; Posavec *et al.,* 2021; Di Cori *et al.,* 2024; Konstantinavičienė and Vitunskienė, 2023; Magry *et al.,* 2024; Moloro and Abebe, 2022). Surprisingly, the scientific inventory of timber species has been ongoing for centuries. It is quite clear that the use of criteria and methods developed for wood inventories has perhaps led to NWFP inventories underestimating the potential of these products (Shackleton *et al.,* 2024; Baskent *et al.,* 2024; Lovrić *et al.,* 2022; Ghanbari *et al.,* 2022). As the definition of many NWFPs is widely different in many languages, a straightforward transposition of the NWFP round wood equivalent concept has to be defined and proposed (Eszter, 2023). This way, data can be compared for non-harmonized products to improve the assessment and analysis of NWFP potential.

NWFP inventories are available for most Mediterranean countries, particularly in the EU, where standardized forest reporting frameworks exist. These inventories typically include data on species distribution, harvest volumes, and economic valuation of products such as cork, resin, mushrooms, and medicinal plants. For example, Spain and Italy maintain comprehensive databases through national forest inventories and regional forest plans. In contrast, relatively few ex-socialist countries in South-Eastern Europe, Central Asia, and the Caucasus have developed formal NWFP inventories or explicitly use the NWFP term in national documentation. However, there are notable exceptions—Serbia has incorporated NWFP categories such as forest fruits and medicinal herbs into national forest assessments. At the same time, Georgia and Kyrgyzstan have conducted partial inventories as part of donor-supported rural development and biodiversity conservation programs. These efforts remain fragmented and accessible; up-to-

date NWFP data are often limited (Table 2) (Picard and Garavaglia, 2021; Muir, 2021; Bhattarai, 2022; Baskent *et al.,* 2024; Güngör, 2024). Products have been inventoried only at the local/specific level, for particular categories, or even specific species within specific categories using similar related methods and criteria. In other cases, the criteria and methods used have been wrong or could not be compared for all types of products. This has led to information being listed using many undefined and inhomogeneous quantities, not providing consistent and comparable data on the economic and social value of NWFPs that can be considered across the various products (Shackleton *et al.,* 2024; Bhattarai, 2022; Lovrić *et al.,* 2021; Ohwo *et al.,* 2021; Di Cori *et al.,* 2024).

Table 2. Summary table for NWFP inventories for selected countries

Country/Region	NWFP Inventory Status	Notes
Spain	Full	Comprehensive databases via national forest inventories and regional forest plans.
Italy	Full	Maintains detailed NWFP data within national forest inventories.
Other Mediterranean EU countries	Mostly Full	Standardized forest reporting frameworks commonly include NWFP data.
Serbia	Partial	Incorporates NWFP categories like forest fruits and medicinal herbs in assessments.
Georgia	Partial	Conducted partial inventories supported by donor programs for rural development.
Kyrgyzstan	Partial	Partial inventories are done under donor-supported biodiversity conservation programs.
Other ex-socialist countries in South and Eastern Europe, Central Asia, and the Caucasus	Mostly None	Limited formal NWFP inventories or use of NWFP terminology in national documentation.

7.2.2. Resource-based management

While wood is often the main output of forests, NWFPs provide a number of goods that are also important to people. These include products such as mushrooms, berries, fruits, nuts, honey, medicinal plants, and plant-derived materials, such as handicrafts, shelter, or fuelwood, and have the potential to contribute to economic development, income, jobs, as well as environmental services (Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Musa *et al.,* 2023; Huber *et al.,* 2023; Saritaş and Türker, 2023; Muir, 2021). Furthermore, many NWFPs are under threat due to increasing demand, habitat destruction, changing land use, or mismanagement and hence have potential in terms of expansion, yet may need management to limit environmental damage if they are overexploited (Bhattarai, 2022; Patarkalashvili, 2023; Mehta *et al.,* 2021; Schindler *et al.,* 2022). The collection and sale of edible NWFPs, often used for human nutrition, provide a valuable source of income for some of the world's rural population, and this can be important in terms of guiding resources to some of the world's poorest communities (Muir, 2021; Derebe *et al.,* 2023; Musa *et al.,* 2023; Bhattarai and Acharya, 2021; Ghanbari *et al.,* 2022; Zubair *et al.,* 2021).

In many countries, NWFP use is regulated and managed by various pieces of legislation, which may include a variety of ad hoc organizations and legal forms. These organizations have a variety of institutional structures and capacities. However, they are often focused on a specific species or market and therefore lack the capacity and scope to ensure sustainable natural resource management (Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Huber *et al.,* 2023; Smith-Hall and Chamberlain, 2023; Shackleton *et al.,* 2024; Stoyanov, 2023; Muir, 2021; Tunón, 2022). In several countries, mechanisms for NWFP management and resource control have no traditional norms or mechanisms, leading to the rapid depletion of the resource base by a rapidly growing population. In the context of NWFP and other forest product management in the region, it is necessary to concentrate on the following issues: government regulation and competition between regulations on environmental conservation and biodiversity protection; weak joint activities of rural founding

actors; a low rate of implementation and appearance of innovations in the NWFP sector, and international trade; negative consequences and influences on the economic inequalities of formal laws, which allocate minimal and insignificant quotas of world and forest use to authorities, as well as their interference in the development of NWFP trading subjects and private forest ownership, as the regulation of these institutions within the framework of the law aims to convince them to realize an alternative rural development strategy, which provides personal income from sustainable forest use and contributes to reducing poverty and variable spatial development of origin (Wilson, 2021; Clapp, 2021; Nodirovna *et al.,* 2022; Kazancoglu *et al.,* 2021; Zhao *et al.,* 2022).

Sustainable management of NWFPs is crucial for the continuing viability of these products and for the ecosystems that support them. In this sense, innovative management models should be developed for forest areas where NWFPs are produced (Göksu *et al.,* 2024). Sustainable management practices must recognize the ecological, economic, and social conditions underpinning NWFP production (Bhattarai and Acharya, 2021; Saifullah and Jewel, 2021). In an environmental context, sustainability implies ensuring ecological balance within the ecosystem and the surrounding areas from which NWFP are sourced, conserving biological diversity and the ecological processes that form the basis for NWFP production (Shackleton *et al.,* 2024; Delgado *et al.,* 2023; Rovira *et al.,* 2022; Schimetka and Ingram, 2024; Magry *et al.,* 2024). In the socio-economic sense, ecological sustainability should be grounded in economic profitability and policies that ensure social equity and environmental protection (Kumar *et al.,* 2024). The emphasis on the sustainability of NWFPs has ensured a concentration of activities on strategies to develop harvesting methods for these products that can be considered 'sustainable.' In particular, several new or modified approaches have been designed to enhance the long-term viability of harvesting, including community-based forestry, trade facilitation and certification, certification of SFM, the development of agroforestry, and the identification of alternative income opportunities to sustain rural communities increasingly isolated from a shrinking resource (Baskent *et al.,* 2024; Delgado *et al.,* 2023; Smith-Hall and Chamberlain, 2023; Muir, 2021; Bhattarai and Acharya, 2021; Huber *et al.,* 2023; Musa *et al.,* 2023; Khairul Alam, 2022; Adesina *et al.,* 2022). Given that, a large number of NWFPs are a product of the high levels of biodiversity found in the ecosystems

in which they are found, primarily forests, an ecological approach to sustainable management is generally considered to be critical (Rashid *et al.,* 2022; Baskent *et al.,* 2024; Temphel, 2021; Biswas and Upadhyay, 2024; Handa and Mohapatra, 2021; Gaines *et al.,* 2022; Shackleton *et al.,* 2024; Baskent, 2024; Bhattarai and Acharya, 2021; Schimetka and Ingram, 2024). Consequently, monitoring and evaluation systems to assess the sustainability of NWFPs are just as necessary (Shackleton *et al.,* 2024; Baskent, 2021). Education and training are vehicles for effective communication. Integrated with traditional ecological knowledge, scientific research forms a foundation for developing good, holistic management (Jessen *et al.,* 2022; Tengö *et al.,* 2021). Ultimately, sustainability is largely seen to lead to a 'win-win' situation for the environment and the economy.

Fundamental economic analysis can help guide public investment and policy options to decide what is profitable. Development of a sector based on NWFPs entails many factors but helps ensure diverse local livelihoods for marginal communities and contributes to self-sufficiency (Bhattarai and Acharya, 2021; Rashid *et al.,* 2022; Derebe *et al.,* 2023; Muir, 2021; Musa *et al.,* 2023; Handa and Mohapatra, 2021). The total income contribution from NWFPs may be small. However, chances are good that most households of rural collectors will have at least someone earning some income from the collection and sale of NWFPs. So, it mitigates rural poverty in the areas of the Caucasus (Musa *et al.,* 2023; Lovrić *et al.,* 2021; Xess and Tiwari, 2023; Derebe and Alemu, 2023; Ahmed *et al.,* 2023; Zubair *et al.,* 2021; Shen *et al.,* 2022; Handa and Mohapatra, 2021). The economic analysis aids our understanding of the value chain of NWFPs and collection for harvest in study areas and their role in the local, regional, and international markets. Most NWFPs are locally held resources and include food, raw materials for minor industries, trader companies, craftspeople, and recreational uses. Only a few have a market for global trading (Temphel, 2021; Muir, 2021; Bhattarai and Acharya, 2021; Musa *et al.,* 2023; Rovira *et al.,* 2022; Schimetka and Ingram; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024). It is expected that income and production of NWFPs will grow because there is a high demand in the high-income markets of the European Union (EU), Middle East, and Russian Federation, as those markets have consumption of the retorted, dried, salted, canned, and conserved product (Musa *et al.,* 2023; Derebe *et al.,* 2023; Bhattarai, 2022; Bhattarai and Acharya, 2021; Shackleton *et al.,* 2024; Temphel, 2021; Zhang *et al.,* 2021).

7.2.3. Sustainable harvest levels

The principles of sustainable management of NWFPs were developed to recognize the importance of these products, explore their potential, and highlight the importance of their long-term productivity. The principles also provide insights regarding management strategies, landscape management, stakeholder roles, and the economic basis of NWFP management (Handa and Mohapatra, 2021; Schimetka and Ingram, 2024; Singh and Chatterjee, 2021; Weiss *et al.,* 2023; Verkerk *et al.,* 2021).

Under this perspective, one of the fundamental ideas related to sustainable harvesting has to do with not altering the regeneration and long-term survival of populations or resources from which products are extracted (Zhang *et al.,* 2021; Ticktin *et*

al., 2023). Thus, the non-weakening of the resource and the guarantee of permanence of populations are essential suggestions in the management process (Mondal and Palit, 2022). Respect for the principles of biodiversity, population conservation, and resource viability will ensure the protection of the ecosystem, meaning the maintenance of natural dynamics and ecosystem structures (Berglund and Kuuluvainen, 2021; Xu *et al.,* 2021).

Sustainable management practices can be undertaken at different levels: plant population, species, habitat, ecosystem, and landscape. Along with in situ conservation and ex-situ conservation, the sustainable management of ecosystems is vital to the conservation of species' genetic potentials (Tsumura, 2022; Salgotra and Chauhan, 2023; Nonić and Šijačić-Nikolić, 2021; Zhang *et al.,* 2022). Furthermore, promoting community-based conservation is a fundamental strategy for the conservation of ecosystems (Mahajan *et al.,* 2021; Hoffmann, 2022; Rampheri and Dube, 2021).

Given this background, developing management plans for the sustainable harvesting of NWFPs is essential for the resilience and sustainability of production because they include monitoring attempts to prevent resource depletion. In particular, conservation strategies may include the ecological zoning of production areas and prioritizing the least sensitive ones, which may also favor restoration programs. Additionally, promoting community-based initiatives to protect and promote the sustainable use of NWFPs is a pathway for the resilience of use. Integrating landscapes as a conservation strategy for NWFPs can lead to multiple conservation benefits and different types of payments according to the services or types of benefits they provide in terms of products and biodiversity to urban areas and the well-being of economically marginalized people. Another crucial strategic path lies within the recognition of traditional ecological knowledge as a way of consolidating not only sustainable management programs but also the scientific bases for the development of habitat management for the provision of NWFPs (Sarangi, 2022; Pohl *et al.,* 2024; Taghouti *et al.,* 2022; Peerzada *et al.,* 2021; Chamberlain *et al.,* 2022; Muir, 2021).

To ensure the conservation of NWFP-producing species, a sustainable level of harvest must be determined. In many cases, the information to do so is not available or is difficult to collect. Failing to find any precise figure, an initial rule of thumb is that NWFP can safely tolerate a much smaller harvest level than the true sustainable potential. This can be expressed in removing no more than – for example – 10% of NWFP volume while searching for more precise information (John, 2023; Padari *et al.,* 2023). Sample surveys and interviews can give a rough understanding of the uncertainties associated with estimates of volume, regeneration times, and barriers to entry that could contribute to sustainable harvest.

Sustainable harvest levels can be regulated through legal means, for example, in the form of permits or tethered to a pricing mechanism like taxes and quotas. User group rules, provided they are fair and equitable, can be very effective in tuning the rate of harvest to a sustainable level. When the NWFP-producing species are diffused, the free rider problem can be resolved through a series of organizations nested at several levels, the functions percolating from the bottom to the top.

7.2.4. Quality standards and monitoring

Two European standards address sustainable management issues: one establishes basic and supplementary rules governing the quality of forest reproductive material and its marketing, and the other is a certification tool that stands for the Programme for the Endorsement of Forest Certification. However, standards aimed at the sustainable collection of NWFPs do not exist. This places pressure on the marketing system (Lovrić *et al.,* 2021; Rashid *et al.,* 2022; Baskent *et al.,* 2024; Huber *et al.,* 2023; Muttilainen and Vilko, 2022; Delgado *et al.,* 2023; Posavec *et al.,* 2021; Di Cori *et al.,* 2022). Nevertheless, there are standards for individual products, such as the Codex standard for Brazil nuts, honey, and edible mushrooms and a regional standard for Shea.

Quality can also be supplied in the sustainability of collection and the 'added value' of the product from the origin by identifying and promoting good practices in management. It is, however, essential to ensure that such systems are workable in the context of the particular product, particularly if they are to be applied in areas of low skill levels (Khan *et al.,* 2021; Ciccullo *et al.,* 2021; Yang *et al.,* 2023; Gelderman *et al.,* 2021). Small and annual crafts of NWFPs constitute an interesting engine for development in environmentally critical areas, as their market will revolve around the intrinsic qualities of their products. It is important to keep products of local quality both in the interest of conserving local biodiversity and in the long-term added value and recognition through the product's label (Derebe and Alemu, 2023; Frey *et al.,* 2023; Asamoah *et al.,* 2023; Gurung *et al.,* 2021; Muir, 2021; Afonso *et al.,* 2022; Pohl *et al.,* 2024; Rosenfeld *et al.,* 2024).

Establishing robust quality standards and effective monitoring mechanisms is essential for ensuring the sustainability and marketability of NWFPs in South and Eastern Europe, Central Asia, and the Caucasus.

8. ADDING VALUE TO NWFPS

KEY MESSAGES

1. Simple Processing Adds Value

- Low-cost techniques like cleaning, cutting, drying, or assembling enhance storage, transport, and product versatility.
- Basic processing improves product quality and shelf-life, making NWFPs (e.g. berries, herbs, mushrooms) more marketable.

2. NWFP Value Chains Are Complex and Undercharacterized

- NWFPs move through diverse, often informal value chains involving multiple actors with limited available data.
- A value chain approach helps identify governance gaps, institutional arrangements, and sustainability risks.

3. Supply Chain Management Must Be Context-Specific

- NWFP supply chains are decentralized and mostly involve poor, rural collectors—often women.
- Effective management requires policy support, local incentives, and stakeholder engagement to avoid resource degradation.

4. Commercialization Requires Market Responsiveness

- NWFPs must meet market demands regarding quality, volume, price, and timing.
- Sustainable commercialization requires proper harvesting practices, traceability, and certification.

5. Market Dynamics Are Shaped by Land Use, Diversity, and Inequality

- Three forces shape NWFP markets: land value for collection, product diversity, and social alternatives (notably gender-related inequalities).
- Local cultural, ecological, and economic contexts heavily influence value chain viability.

6. Business Model Innovation and Co-management Are Crucial

- New models shift focus from pure profit to conservation and local stewardship.
- Co-management requires participatory design, reflecting local norms and avoiding institutional conflict.

7. Certification and Traceability Open Market Access

- Eco-certification and chain-of-custody systems help NWFP actors access high-value international markets.
- Yet many producers and governments lack awareness of these systems and their cost-benefit balance.

8. Technology Enhances Transparency, Efficiency, and Access

- Innovations (e.g. digital traceability, mobile apps, RFID, QR codes) improve NWFP processing, monitoring, and direct marketing.
- Tech can lower costs and improve competitiveness but must integrate traditional knowledge to avoid marginalizing smallholders.

9. Modernization Must Be Inclusive and Sustainable

- The NWFP sector is dominated by traditional family enterprises; ignoring local know-how risks failure.
- New technologies should be introduced with capacity building and social safeguards to avoid deepening poverty or ecological harm.

10. Holistic Approach Needed

- NWFP development must balance economics, forest ecology, and community well-being.
- Long-term sustainability—not short-term profit—should guide modernization and market expansion efforts.

KEY MESSAGES

This section introduced some key considerations for adding value to NWFPs. Here, we will look at various ways these products can be processed and marketed (Muttilainen and Vilko, 2022; Huber *et al.,* 2023; Lovrić *et al.,* 2021; Baskent *et al.,* 2024; Muir, 2021; Weiss *et al.,* 2023; Di Cori *et al.,* 2022; Di Cori *et al.,* 2024; Schimetka and Ingram, 2024; Rovira *et al.,* 2022). Some easy-to-implement, low-cost steps, such as cleaning, cutting, and assembling, are necessary to condition these products for storage, shipment, and further processing. Depending on the product, additional processing can often add value to the product, broaden the range of potential products, and broaden the range of uses to which the products can then be put (Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Baskent *et al.,* 2024; Muir, 2021; Asamoah *et al.,* 2023; Posavec *et al.,* 2021; Musa *et al.,* 2023; Delgado *et al.,* 2023; Di Cori *et al.,* 2022).

Some products (berries, herbs, medicinal plants) can be easily prepared for consumption. Others require several steps to transform them into a form that is stable and transportable: cleaning (removal of extraneous material such as leaves and dirt) and cutting (sufficiently small pieces to facilitate the exposure of the plant matrix to any water, chemicals, or energy that will be used to remove volatile, undesirable, or toxic components).

8.1. Value chains and market dynamics of NWFPs

NWFPs are involved in diverse, complex value chains that cross traditional and complex markets. Although the sector has recently begun being characterized, the data about market dynamics and value chain organization are still limited (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Bhattarai, 2022; Muttilainen and Vilko, 2022; Nguyen *et al.,* 2021; Musa *et al.,* 2023; Magry *et al.,* 2023). The Guidelines aim to analyze the roles of NWFPs in global and regional markets and investigate the market's evolution over time, highlighting the organization of value chains as key drivers of change. The value chain approach provides a valuable framework for understanding the institutional arrangements in NWFP sectors, enabling the identification of the leading actors involved and the goals they aim to achieve (Schimetka and Ingram, 2024; Muttilainen and Vilko, 2022; Loreggian *et al.,* 2023). The results show that the multiple relationships between producers, industrial buyers, and additional stakeholders impact the governance of value chains and NWFPs in relative market performance. Additionally, they highlight the prominent role of social and environmental considerations concerning both production and consumption that guide the supply and use of NWFPs (Schimetka and Ingram, 2024; Nguyen *et al.,* 2021; Dadebo *et al.,* 2024).

8.1.1. Supply chain management

Effectively managing the supply chain of NWFPs is not a simple and straightforward task due to their complex origin, spatial distribution, and usually an informal sector of production, which is also characterized by small-scale societal involvement (Safitri and Sundawati, 2024; Miassi and Dossa, 2024; Mondo *et al.,* 2024). However, different types of non-woody fuels and minor forest products are largely collected in the wild. They are mainly gathered by the poorest elements of society, often women, for use as food, medicine, and raw materials for cooking, heating, construction of shelter and fencing, handicrafts, and religious practices (Mondo *et al.,* 2024). This sets the economic potential of non-wood as a crucial component of any forest products control program and its related supply chain management strategies, threatening the existence of local forest resources, and is mostly driven by both production and consumer behavior unless a sufficient level of management is achieved, which is hard to reach through sole local-level action (Baskent *et al.,* 2024; Huber *et al.,* 2023; Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Weiss *et al.,* 2023; Shackleton *et al.,* 2024; Rashid *et al.,* 2022).

Different elements must necessarily be considered for the effective management of non-wood supply chains, especially when the focus is on policy intervention, research, and sometimes well-targeted collective action (Baskent *et al.,* 2024; Huber *et al.,* 2023; Muttilainen and Vilko, 2022). The Guidelines have identified the most critical factors for successful supply chain management, considering the possible risks and benefits of the activities (Kazancoglu *et al.,* 2021). Adequate and efficient supply chain management strategies are complex and require different types of instrument mixes, carefully considering the peculiarities of the goods involved and all the market specificities created by different demands and possible alternative sources (Hugos, 2024). First of all, the issue of small-scale societal involvement must be addressed, and enough flexibility must be assured, involving the proper stakeholders and considering the long-term sustainability of forest production. For this reason, to avoid possible range collapses or other environmental negative externalities, policies supporting NWFPs should be based on either the simplification of the internationally recognized access rules or the provision of structural incentives for traditional dwellers (Safitri and Sundawati, 2024; Miassi and Dossa, 2024). Promoting NWFPs and suggesting better marketing procedures imply recognizing local

primacies of both information and knowledge. A good dynamic equilibrium level of the NWFPs supply chain system can be established, properly playing the buffer role between supply-driven and demand-driven economic opportunities. The proposed policy strategy would qualitatively support the locally wise use of the considerable potential of NWFPs.

8.1.2. Market trends and opportunities

For many years, using numerous forest products has been a local practice. However, today, NWFPs are being commercialized (Bhattarai, 2022; Rashid *et al.,* 2022; Muir, 2021; Shackleton *et al.,* 2024; Saifullah and Jewel, 2021; Temphel, 2021; Muttilainen and Vilko, 2022; Musa *et al.,* 2023; Lovrić *et al.,* 2021). What we consider to be commercialized is the effort of the actors—gatherers, collectors, and processors—taking into account the market characteristics and overcoming social or institutional forces that tend to make a technically superior enterprise non-capitalistic (Okunlola *et al.,* 2023; Pohl *et al.,* 2024). NWFPs need to meet market demands of quality, quantity, price, and moment of delivery. Also, to take advantage of seasonality, for some products, the distribution of collected NWFPs throughout the year may be fundamental to the development of a commercial enterprise (Shackleton *et al.,* 2024; Muir, 2021; Baskent *et al.,* 2024; Obonyo *et al.,* 2021; Handa and Mohapatra, 2021; Trigkas *et al.,* 2023; Singer and Özşahin, 2024; Posavec *et al.,* 2021; Hossain and Rashid, 2022). Besides commercializing products, actors need management practices that are adequate from an environmental point of view for resources, allowing both sustainability and enhancement perception. Additionally, value chain actors that want to commercialize NWFPs sustainably need to carry out practices related to certification, resource maintenance, and product traceability (Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Baskent *et al.,* 2024; Muttilainen and Vilko, 2022; Bhattarai and Acharya, 2021; Nguyen *et al.,* 2021; Muir, 2021).

Three general market dynamics influence NWFP management. Firstly, the value of the land for gathering and collecting activities; secondly, the vast and diverse product menu from which gatherers and collectors may choose to gather and collect; and thirdly, the available alternatives between activities, taking into account the existing inequalities, especially those related to gender (Baskent *et al.,* 2024; Rovira *et al.,* 2022; Muttilainen and Vilko, 2022; Schimetka and Ingram, 2024; Salas, 2021; Güngör, 2024). Each gatherer/collector has an intricate context that possesses attractive variables for the activity. These can be summarized into three main categories: biological-ecological, socio-economic-cultural, and technical-organizational. In the first category, supply factors are important territory characteristics that make gathering, collecting, or NWFP production possible. Secondly, consumption values are derived from the local population that acquires commercial or non-commercial NWFPs, which are economically and/or culturally significant. The third category contains public or private structures that support source management and commercial modules configured productively and socially (Nguyen *et al.,* 2021; Navarrete-Segueda *et al.,* 2021; Delgado *et al.,* 2023; Derebe and Alemu, 2023; Dou *et al.,* 2023; Frey *et al.,* 2023; Pohl *et al.,* 2024).

8.2. Business model innovations and co-management practices

A business model innovation can be defined as an essential change within one or more model dimensions: who the targets are, what the products, services, or experiences are, how the product or service is produced, or how the company or other stakeholders appropriate value. This simplifies developing and implementing new business models (Burström *et al.,* 2021; Trischler and Li-Ying, 2023). In the case of NWFPs, such a business model innovation can also refer to a shift in emphasis from economic utilization to conservation and restoration of NWFP species and their habitats. In general, when co-management arrangements are involved, these shifts are also called 'institutional change' and should not be neglected while concentrating on economic and business model change (Atinga and Bannor, 2024; Delgado *et al.,* 2023; Shackleton and de Vos, 2022; Asamoah *et al.,* 2024; Peerzada *et al.,* 2021; Rosenfeld *et al.,* 2024; Magry *et al.,* 2024). Since NWFP results in cultural and multiple ecosystem services, traditional economic models based on standards of financial profit are not appropriate (Di Cori *et al.,* 2021; Atinga and Bannor, 2024; Başkent 2022; Baskent, 2024; Pohl *et al.,* 2024; Schimetka and Ingram, 2024).

No congruent tailor-made implementation exists with respect to the complex transactional structure, the character of mutual dependencies, and the long-lasting time perspective of co-management

practices. Developing new business models in the area of co-management practices of NWFP cannot be reduced to financial or managerial protocols (de Bruyn *et al.,* 2022). First, the market and partner constellation should be described and investigated in a participatory process (Hydle and Billington, 2021). Only when identifying the relevant actors as legal entities and their (economic and/or non-economic) activities should an offer regarding their respective needs be defined and communicated. Such communication needs to be adapted to the respective sensitivities and preconditions of all stakeholders, including cultural and lifestyle patterns, restrictions, and economic constraints. Furthermore, an institutional conflict that sorting is combined in the most promising way can be prevented. If necessary, business strategies can be used that target low-cost competition united with price differentiation (Farida and Setiawan, 2022).

8.3. Certification and traceability systems to enhance market access

As the perception of consumers becomes more sophisticated, it is vital to have non-wood value chain actors comply with international standards and eco-certifications. Such certifications could open consumer markets and create new business opportunities for non-wood actors (Rosa and Martius, 2021). This increasing interest of developed countries in related products can be a window for new business opportunities for many actors in South and Eastern Europe, Central Asia, and the Caucasus (Gafarlı, 2024; Klasen *et al.,* 2024; Ayvazyan, 2023). Used wisely, these opportunities can create a virtuous circle to help deliver improved environmental services through more effective local management of forest resources. However, several constraints have been identified in each region that prevent more NWFP businesses from becoming eco-labeled.

Both NWFP value chain actors and the governments in South and Eastern Europe, Central Asia, and the Caucasus require a better understanding of certification systems and their potential impacts, including the likely costs and benefits (Vogelpohl, 2023; Bhattarai, 2022; Grabs and Carodenuto, 2021; Schimetka and Ingram, 2024). Non-wood actors who are planning to sell their non-wood output in foreign markets can add value to their products through certification and then sell their products at a higher price than an equivalent non-certified product (Muttilainen and Vilko, 2022; Baskent *et al.,* 2024; Schimetka and Ingram, 2024). Furthermore, policymakers should search for certification schemes or voluntary forest management and non-wood product chain of custody systems as sources of advice, review possible impacts, and consider the costs and benefits of certification (Lovrić *et al.,* 2022; Klarić *et al.,* 2023).

8.4. Technology's role in creating social and ecological value

Technological innovations play an essential role in developing NWFP value chain activities, focusing on efficient harvesting, processing, and marketing operations. A range of new, innovative technologies have appeared with the potential to open new opportunities, providing access to new markets. Technologies used during the harvesting, processing, and marketing of NWFP can bring benefits such as efficiency and product quality improvements while eventually reducing transaction costs for the consumer with stable prices even under intense volatility.

For example, the BPRACTICES[1] project aims to develop a sustainable beekeeping breeding system by implementing innovative Good Beekeeping Practices. A key component is integrating an advanced traceability system into the Hivelog web application, enabling beekeepers to track honey production from flower to consumer using QRCode and RFID technology. This system allows the recording of harvest data, colony details, and analytical results, enhancing transparency and product traceability.

Hivelog is a user-friendly, free application available in nine languages that helps beekeepers log essential apiary management activities such as colony strength, queen performance, feeding, honey harvest, varroa treatments, and sanitary status. The program is planned to become open source to allow further development by beekeeper groups.

The traceability system also aims to educate consumers about responsible consumption and the benefits of environmentally friendly, local honey production. Consumer panels will support its implementation using social research techniques during the project's later stages.

Overall, the BPRACTICES project highlights the combination of technology, sustainable practices, and consumer engagement to improve the sustainability and transparency of honey bee product production.

In the NWFP market value chains, the smart business that emerges with the help of information and communication technology creates business potential with shared value. Moreover, the Internet has allowed small producers to sell their products and value-added plans to national and/or international markets through digital marketing and e-commerce. Applications of these new technologies can provide a powerful instrument for the local management of NWFP (Schimetka

1 https://www.izslt.it/wp-content/uploads/sites/11/2018/09/ghent-2.pdf

and Ingram, 2024; Muttilainen and Vilko, 2022; Bhattarai and Acharya, 2021; Muir, 2021; Weiss *et al.,* 2023; Delgado *et al.,* 2023; Jelena *et al.,* 2022; Rovira *et al.,* 2022; Shackleton *et al.,* 2024; Ziółkowska, 2021; Kadir and Shaikh, 2023; Jain *et al.,* 2021).

Adopting these innovations can provide access to new markets and add product value. It also allows farmers and growers to reach customers directly, reducing their reliance on the retail sector. Consequently, technologies can improve the market potential of agricultural products, linking producers with consumers. For NWFPs, the social and ecological functions of the forest play a significant environmental role, ensuring that the value of the forest is used efficiently. As one of the key technologies, data analytics are helping stakeholders in agriculture, forestry, and related enterprises sell their products more efficiently and predict crop yields. Furthermore, training and capacity building on digital and precision farm technologies are essential for NWFP stakeholders to promote the use of technology in extraction and value addition. This modernization process of the value chain needs to be considered not just from an economic but also from an ecological and social point of view (Weiss *et al.,* 2023; Baskent *et al.,* 2024; Asamoah *et al.,* 2023; Lovrić *et al.,* 2021; Musa *et al.,* 2023; Trigkas *et al.,* 2023; Qiao *et al.,* 2024; Rashid *et al.,* 2022; Bhattarai, 2022; Chamberlain and Smith-Hall, 2024; Novac, 2022; Singh *et al.,* 2022; Rejeb *et al.,* 2021; SS *et al.,* 2024).

Moreover, it must be recognized that the NWFP sector mainly consists of traditional family businesses. Dismissing or negating established practices, thereby depreciating the know-how and experience of stakeholders, would lead the process to failure. Every modernization process must also consider traditional values and practices and integrate them with new approaches. Although modern technology has considerable potential, success in improving income through contemporary technologies in the NWFP sector is sensitive to multiple factors. Furthermore, while adopting modern technologies could enhance the profitability of enterprises, it could also exacerbate poverty and vulnerability, as inefficiencies and losses are eliminated in a newly competitive environment. Therefore, the development of the NWFP value chain must be approached holistically, considering not only economic factors but also forest ecology preservation and social considerations. In conclusion, technology plays a significant role in NWFP trading; at the same time, every step of progress and change should be evaluated from a perspective that considers not only short-term profits but also long-term sustainability (Muttilainen and Vilko, 2022; Trigkas *et al.,* 2023; Shackleton *et al.,* 2024; Güngör, 2024; Baskent *et al.,* 2024; Muir, 2021; Rovira *et al.,* 2022; Pohl *et al.,* 2024; Temphel, 2021; Zhang *et al.,* 2021; Schimetka and Ingram, 2024).

9. CREATING AN ENABLING ENVIRONMENT FOR NWFP GROWTH

KEY MESSAGES

1. NWFPs Are Vital to Local Economies but Face Structural Challenges

- NWFPs contribute significantly to rural household incomes and local economies.
- Their full potential is hindered by:
  - High transaction and marketing costs.
  - Weak integration in supply chains.
  - Limited infrastructure and investment incentives.
  - Poor legal and institutional support in many regions.

2. Enabling Policies Are Crucial for Sector Development

- Effective NWFP policy must work at household, business, and regional levels.
- Recommended actions include:
  - Investing in transportation, market infrastructure, and credit access.
  - Offering direct support (e.g., tax breaks) and indirect incentives (e.g., awareness, R&D).
  - Aligning sectoral laws to clearly define and support NWFPs.

3. Legal Frameworks Must Be Updated and Harmonized

- Many countries lack clear legal definitions or regulatory frameworks for NWFPs.
- This regulatory vacuum creates obstacles for investment, trade, and sustainable use.
- Comprehensive legal reforms are needed to:
  - Support biodiversity goals.
  - Facilitate forest-based businesses.
  - Promote inclusive economic growth.

4. Strategic Recommendations for Economies with High NWFP Potential

- Countries in South and Eastern Europe, Central Asia, and the Caucasus should:
  - Develop NWFP databases and legal updates.
  - Conduct value chain and climate resilience assessments.
  - Improve consumer awareness and sustainability practices.
  - Encourage local entrepreneurship and market diversification.

5. Knowledge Gaps Limit Investment and Policy Impact

- NWFP data is fragmented, outdated, or inaccessible.
- There's an urgent need to:
  - Create centralized, searchable NWFP databases.
  - Systematize existing research.
  - Promote public and policymaker awareness through tailored dissemination tools.

6. Sustainable Harvesting and Trade Need Stronger Governance

- Overharvesting, unclear property rights, and poor enforcement threaten sustainability.
- Recommendations include:
  - Establishing clear land tenure and user rights.
  - Creating locally adapted harvesting guidelines.
  - Encouraging regulatory designs that reduce transaction costs and encourage long-term investment..

KEY MESSAGES

The income level of households greatly influences the contribution of NWFPs to economies and highlights their potential for widespread implementation. The availability of labor facilitates NWFP production, while transaction costs and difficulties in marketing NWFP negatively impact production and market integration, raising concerns about the sector's sustainability. The contribution of NWFP to the local economy, negotiated among stakeholders, should be a key target for policy development to address these challenges in production and trade. Additionally, the lack of support in integrating NWFP from the supply chain to the market level remains a critical concern (Muttilainen and Vilko, 2022; Shackleton *et al.,* 2024; Musa *et al.,* 2023; Muir, 2021; Schimetka and Ingram, 2024; Baskent *et al.,* 2024; Maisharou and Larwanou, 2022; Handa and Mohapatra, 2021; Rashid *et al.,* 2022; Rovira el al., 2022; Güngör, 2024; Magry *et al.,* 2024).

NWFP incentives can be strengthened through policy support at various levels: regional, household, and business. Policy support for households, for instance, can help them meet non-commercial consumption needs, contribute to household income, and bolster local economies. Additionally, households and businesses can be encouraged to integrate NWFP into production processes, assess local NWFP values, and introduce these products to the market within a sustainable development framework. Such support can be provided through direct or indirect policy instruments. Among direct policy measures, investments in forest transportation infrastructure and tax reductions can directly benefit households. Meanwhile, supply and demand businesses can receive incentives such as awareness programs, technology transfers, regulatory reinforcements, organizational support, and resource allocations. Furthermore, indirect policy incentives, such as expanding credit lines, can also play a crucial role. These policy supports can strengthen NWFP-related relationships, stimulate rural economies, and foster sustainable regional development. However, their success depends on market dynamics and other challenges affecting NWFP production and marketing (Rovira *et al.,* 2022; Muttilainen and Vilko, 2022; Ohwo *et al.,* 2021; Baskent *et al.,* 2024; Shackleton *et al.,* 2024; Musa *et al.,* 2023; Bhattarai and Acharya, 2021; Muir, 2021; Rashid *et al.,* 2022; Trigkas *et al.,* 2023).

9.1. Strengthening policies, legal frameworks, and investments

Policies, legal frameworks, and investments need to be improved to provide an enabling environment for NWFP development in all the target countries (Di Cori *et al.,* 2022; Huber *et al.,* 2023; Weiss *et al.,* 2023; Akomaning *et al.,* 2023; Miassi and Dossa, 2024; Chamberlain and Smith-Hall, 2024). In most cases, NWFPs are only marginally covered by current sectoral planning. The improvement of their current status will require the recognition of the importance of NWFPs in poverty alleviation strategies, in protected area management, and the integration of business aspects in the planning and decision-making process (Di Cori *et al.,* 2022; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Di Cori *et al.,* 2024; Shackleton *et al.,* 2024; Muir, 2021; Schimetka and Ingram, 2024; Şen, 2022; Shackleton and de Vos, 2022). The regulatory framework must be simplified and aligned with current ecological, social, and market dynamics. The institutional frameworks for forest management need to be reviewed at national and local levels to facilitate the handling of commercial non-wood activities (Schimetka and Ingram, 2024; Atinga and Bannor, 2024; Bhattarai and Acharya, 2021; Temphel, 2021; Huber *et al.,* 2023). Investments in processing facilities, marketing strategies, and central services/infrastructure are not yet attractive for private investors. However, they would benefit from being enabled by proper access to microcredit and establishing partnerships through the development of small and medium enterprises.

At various time scales, some or all of the following actions should or will influence the promotion of an enabling environment to assist NWFP development in all the countries: characterizing and tuning the enabling environment; developing a common understanding of enabling frameworks on NWFPs; disseminating and collecting evidence-based information on enabling frameworks on NWFPs; financing enabling frameworks; political commitment and public awareness; developing supportive fiscal incentives; effectively addressing the contradictory or incomplete legislative/policy frameworks; and raising awareness of the value of the sustainable use of NWFPs (Rashid *et al.,* 2022; Rovira *et al.,* 2022; Muttilainen and Vilko, 2022; Schimetka and Ingram, 2024; de Bruyn *et al.,* 2022). Making the necessary adjustments so that regulations and markets mobilize their inherent potential while ensuring their ecological and social sustainability is crucial at the moment — their contribution is essential to local development and in support of food and economic security, particularly for the poor living in remote or isolated areas.

The economic opportunities provided by the management and sustainable use of forest resources in Albania, Bulgaria, Georgia, and Türkiye enabled innovative laws and policies in place that stimulate the use of NWFPs. There is unfavorable legislation concerning NWFPs in some areas of Armenia, Bosnia and Herzegovina, Montenegro, Romania, Serbia, and Croatia. In other countries of the region, this issue is not regulated or is regulated indirectly through

forestry legislation. There is also no clear-cut definition of NWFPs in the region countries. This lack of clarity hinders the development of appropriate policies and investment strategies aimed at promoting the sustainable use of these resources. To address this issue, it is essential to establish comprehensive legal frameworks that clearly define NWFP and outline their role within the broader context of forest management. Therefore, it seems fundamental to encourage the countries to create legislation for NWFPs (Rashid *et al.,* 2022; Baskent *et al.,* 2024; Rovira *et al.,* 2022; Shackleton *et al.,* 2024; Schimetka and Ingram, 2024).

NWFPs represent an activity in South and Eastern Europe, Central Asia, and the Caucasus, creating the means for hundreds of thousands of families to make a living. Alongside the economic and social functions, the growing importance of forests in the development and quality of life of people is noted. To ensure a high quality of life, the forests in the region have to fulfill ecological and social functions and supply the necessary resources to regional and local markets. The relationships of NWFPs with the socio-economic conditions, conservation, and management of the forest, as well as the internal and international trade, need to be carefully analyzed in this context.

Based on the findings of the evaluation of the link between NWFP production and regional economies in South and Eastern Europe, Central Asia, and the Caucasus, the Guidelines provide the following recommendations to enhance the contributions of NWFPs to regional economies. Regarding economies with high contributions, there is a need to update and align the legal frameworks of the NWFPs sub-sectors, mainly of NWFPs, and establish and update the relevant databases (Rashid *et al.,* 2022; Di Cori *et al.,* 2022; Baskent *et al.,* 2024; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Shackleton *et al.,* 2024). It is also recommended that these economies develop NWFP promotion and marketing strategies, invest in capacity building, conduct NWFP assessments, and analyze NWFP business potential for sustainable and feasible NWFP value chain development, as well as assess the climate change resilience of NWFP value chains in the economy, and develop measures to ensure that the NWFP business ecosystem exhibits resilience traits and traits enhancing economic diversification (Baskent *et al.,* 2024; Muttilainen and Vilko, 2022; Rovira *et al.,* 2022; Trigkas *et al.,* 2023; Rovira *et al.,* 2022; Schimetka and Ingram, 2024).

Moreover, economies with high contributions to regional gross value added are advised to develop measures to improve consumer perception and ensure that NWFP production measures in the country exhibit sustainable and nature-conducive traits. It is recommended that economies without a significant contribution to gross value added invest in human resources and conduct NWFP assessments and analyses (Di Cori *et al.,* 2022; Huber *et al.,* 2023; Muttilainen and Vilko, 2022; Li *et al.,* 2022; Muir, 2021; Di Cori *et al.,* 2024). It is also recommended that environmental regulation measures be established and that measures to protect NWFP production should be developed (Rashid *et al.,* 2022; Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Di Cori *et al.,* 2022). There is a need for information sharing and capacity building. Finally, overall implementation across the region should be fostered and increased.

9.2. Enhancing data generation, knowledge sharing, and capacity building

Better information and knowledge would lead to increased and more effective investments in NWFPs, as well as policy and regulatory reforms conducive to expanding the role of these products in forest management and local development (Zubair *et al.,* 2021; Güngör, 2024).

9.2.1. Improving and making information available

Considerable knowledge, available in different forms, can be used or produced at relatively low cost. However, information is widely dispersed, and quality is variable. It is often inaccessible, not updated, or its exact content is unknown. It is crucial to expand current research and knowledge-sharing activities related to NWFP and,

at the same time, to make available the wealth of existing but insufficiently valued research findings and good practices (Rovira *et al.,* 2022; Güngör, 2024). A searchable and interactive database on NWFP from the region should be developed. A user-friendly and practical compendium of information on NWFP would provide a valuable service to those concerned with the sustainable management of the region's forest resources. Interpretation tools could be most useful in this respect, enabling users to adapt and understand the implications of research and good practices for their specific needs and priorities (Shackleton *et al.,* 2024; Rashid *et al.,* 2022; Rovira *et al.,* 2022).

9.2.2. Raising awareness of the increasing importance of NWFP, including in relation to public thinking on forests and trees

It is essential to document and disseminate good practices in the sustainable management of forests for NWFPs and to encourage further practice through training, information, and capacity-building measures at all levels. These would help decision-makers to understand public needs and expectations concerning NWFPs and support quality improvement efforts (Rangel-Lynch, 2023; Bhattarai and Acharya, 2021; Lange *et al.,* 2022; Dadebo *et al.,* 2024; Baskent, 2024; Schimetka and Ingram, 2024).

9.2.3. Generating new information

Not enough is known about the extent of production, the added value attached to different NWFP, forest sector linkages, the various governance contexts, and their impacts, as well as production trends, costs, vulnerabilities, and identified constraints (Lovrić *et al.,* 2021; Weiss *et al.,* 2023; Huber *et al.,* 2023; Shackleton *et al.,* 2024; Muttilainen and Vilko, 2022; Stoyanov, 2023; Di Cori *et al.,* 2021; Muir, 2021; Novac, 2022; Di Cori *et al.,* 2024). Efforts are made to help rectify this by systematizing information that is already or partially available and, in selected areas, providing new insights and benchmarks. The existing data will be updated regularly. The aim is to harness research to policy and the policy process by providing new ideas and practical guidelines for decision-makers at different levels. In addition, it is vital to build trust that science and market analysis serve public interests. The main focus is on the needs and aspirations of people living in the vicinity and/or working in or with forest ecosystems (Pohl *et al.,* 2024; Fridén *et al.,* 2024; Rawat and Tekleyohannes, 2021; Volkova *et al.,* 2021; Del Gatto and Marshall, 2021; Furdychko *et al.,* 2022; Richter *et al.,* 2023).

9.2.4. Disseminating information

Good practices, research work, experiences, practical tools, and results should be disseminated to stakeholders to build their capacity to use and/or replicate where appropriately needed. Efforts should be made to (a) utilize visual and oral communication methods, (b) share results and practical tools in an easy-to-understand form, (c) use multiple channels to reach the end users, and (d) adapt the content and approach to suit the expectations, needs, and habits of the end-users.

9.3. Sustainable harvesting and trade regulations

Sustainable harvest and trade regulations are important when it comes to the conservation of NWFPs (Lovrić *et al.,* 2021; Bhattarai and Acharya, 2021; Muir, 2021; Shackleton *et al.,* 2024; Handa and Mohapatra, 2021; Musa *et al.,* 2023; Singh and Chatterjee, 2021). Most of the NWFPs are overharvested, which usually leads to the extinction of the source. The applicability of SFM in regulating production in the forest also promotes the stock of NWFPs (Bhattarai and Acharya, 2021; Delgado *et al.,* 2023). Toward this aim, scientists realize the sustainable use of NWFPs in the forest by applying modern and traditional knowledge conversion. Many of the NWFP-relevant stakeholders reflect sustainable management in their activities (Temphel, 2021; Khairul Alam, 2022; Handa and Mohapatra, 2021; Muir, 2021; Upadhyay *et al.,* 2024). Trade regulations and business practices also support it. The policies in some developed countries, along with limited trade barriers on NWFP products, have emerged as a key challenge due to the sustainable development promoted by consumers (Muttilainen and Vilko, 2022; Muir, 2021; Magry *et al.,* 2024; Weiss *et al.,* 2023; Schimetka and Ingram, 2024; Delgado *et al.,* 2023).

The common obstacles to the sustainable harvest and trade regulation of NWFPs can be seen in the definition of a lack of property rights. The transaction costs of controlling the production and quality of a NWFP are too high. If no property rights exist, the products are often available as a common pool resource. Due to the lack of property rights, it wouldn't fit as a basis for trading; therefore, the failure to create a profitable business took place (Bhattarai, 2022; Schimetka and Ingram, 2024; Temphel, 2021; Shackleton *et al.,* 2024; Delgado *et al.,* 2023; Muir, 2021; Bhattarai and Acharya, 2021; Nguyen *et al.,* 2021). Localized regulations are also considered necessary in this context. Governments should recognize people's rights over the forest and plant NWFPs. Unfortunately, in many cases, the lack of rights is a "poverty trap"

that inhibits current regeneration and has negative consequences for the products (Muttilainen *et al.,* 2023; Rashid *et al.,* 2022; Delgado *et al.,* 2023; Pasaribu *et al.,* 2021; Kohsaka and Miyake, 2021; Rosenfeld *et al.,* 2024). Sociopolitical states are also important, and there should be regulations such as conservation laws and forest acts that are directed to counter the negative impact of the lack of property rights and variable market conditions on the ability of NWFP production (Rashid *et al.,* 2022; Temphel, 2021; Piras and Santoro, 2023).

The role of regulatory governance should be acknowledged to create the willingness to invest in resource stock and sustainable supply (Chatterjee and Chaudhuri, 2022; Khan *et al.,* 2024). Good governance guidelines involve the importance of flexible approaches in combination with creating effectively implemented rights (Brown and Marsden, 2023; Meuleman, 2021). The definition of the rights should reflect the goals of NWFP gathering (Rashid *et al.,* 2022; Schimetka and Ingram, 2024; Shackleton *et al.,* 2024; Posavec *et al.,* 2021). If the commercialization of the NWFPs is discouraged for environmental reasons, a simpler land tenure framework is required. However, if the NWFPs will be commercially exploited, they should occur in a commercial arrangement. The rights should be clearly formulated to reflect that sustainable management is desirable in all aspects of biodiversity use (Rashid *et al.,* 2022; Bhattarai and Acharya, 2021; Saifullah and Jewel, 2021; Novac, 2022; Zubair *et al.,* 2021; Hintz *et al.,* 2021; Schimetka and Ingram, 2024; Dadebo *et al.,* 2024; Trigkas *et al.,* 2023).

Regulatory design should aim to reduce transaction costs. If the transaction costs are too high, the NWFP users can bear the cost of managing resources sustainably (Shackleton *et al.,* 2024; Muttilainen and Vilko, 2022). Yields from sustainable resource management are likely insufficient for members to switch cultivation practices. However, introducing new regulatory frameworks could reduce the size of the trading floor and open the door to trade. Regulatory design also implies the presence of long-term commercial benefits, especially if the products are currently used for the market in the future. If this happens, investment related to the creation of sustainable source determination is viable (Weiss *et al.,* 2023; Schimetka and Ingram, 2024; Stoyanov, 2023; Muir, 2021). Larger trade actions can also streamline the policy and local enforcement of rules on harvesting practices.

In conclusion, more attention to the sustainable harvest and trade of NWFPs can be seen in a state's framework by examining the supply side of NWFPs (Rashid *et al.,* 2022; Delgado *et al.,* 2023; Muir, 2021; Magry *et al.,* 2024; Baskent *et al.,* 2024; Adewumi, 2021; Muttilainen and Vilko, 2022; Nguyen *et al.,* 2021). The welfare of subsistence producers and the sustainable and market-based supply of the products (Bokoro and Kyamakya, 2023; Nath, 2022).

10. STRATEGIES FOR NWFP VALUE CHAIN DEVELOPMENT AND IMPROVEMENT

KEY MESSAGES

1. Sector Overview & Challenges

- NWFPs—such as resin, mushrooms, berries, and medicinal plants—play vital ecological, economic, and cultural roles.
- The sector faces complex challenges:
  - Environmental: overharvesting, deforestation, habitat fragmentation, and climate change.
  - Economic & Regulatory: poor market access, lack of cohesive policy frameworks, and undervaluation of NWFPs in national economies.
  - Supply Chain Weakness: lack of integration from local to global scales threatens viability.

2. Opportunities for Growth

- Rising demand for eco-friendly products, natural cosmetics, and nutraceuticals.
- Development potential in eco-tourism and local branding.
- Certification schemes and community-based forest management can enhance sustainability and market trust.
- Research and innovation in sustainable harvesting and cultivation offer high returns and resilience.

3. Policy and Bioeconomy Integration

- Current forest policies prioritize timber, overlooking NWFPs' broader value.
- A shift to integrated woodland economy policies is necessary for inclusive rural development.
- Strategic investments, local capacity building, and equitable resource access are critical to supporting a resilient forest-based bioeconomy.

4. Marketing and Value Recognition

- NWFPs should be positioned as premium, knowledge-intensive products, not commodities competing on price.
- Carbon finance and ecosystem service markets can provide new income streams.
- Governments must define biological value more broadly and adjust trade regulations accordingly.

5. Capacity Building & Knowledge Gaps

- Traditional ecological knowledge is crucial but often marginalized or at risk of extinction.
- Promoting and preserving such knowledge is essential for sustainable use and cultural continuity.
- Multidisciplinary education, formal and informal, must be strengthened to raise awareness and support innovation.

6. Market Access and Economic Inclusion

- NWFP marketing is mostly informal, localized, and led by communities.
- Markets need to be diversified—not just focused on high-price products—to support both conservation and inclusive economic growth.
- International and domestic institutions are increasingly recognizing NWFPs' commercial and ecological value, prompting research and policy engagement.

KEY MESSAGES

10.1. Addressing regional opportunities and challenges

The NWFP sector draws on the goods and services that forests produce without extracting wood, like resin, cork, nuts, fruits, berries, mushrooms, or medicinal plants. The sector is facing multiple intermeshing challenges at the environmental, economic, and social levels, such as overharvesting, deforestation, and habitat fragmentation in many of the world's forests, raising concerns about the sustainability of NWFPs (Muir, 2021; Bhattarai and Acharya, 2021; Delgado *et al.,* 2023). Climate change is added to the list of issues with potential impacts likely to negatively affect the production of some of the most iconic NWFPs, like resin (Muir, 2021; Musa *et al.,* 2023; Tunón, 2022). The sector also faces market access and regulatory issues, taking into account that generally, NWFPs do not fall under a specific use or regulatory framework, and so their related issues and data are elusive (Shackleton *et al.,* 2024; Baskent *et al.,* 2024; Weiss *et al.,* 2023; Schimetka and Ingram, 2024; Piras and Santoro, 2023; Malovrh and Avdibegović, 2021; Güngör, 2024; Elomina and Pülzl, 2021). In addition, although the local populations see economic benefits at the local scale, the contribution of harvested products to the NWFP supply chain is underestimated, with NWFPs often undervalued at the national level (Shackleton *et al.,* 2024; Schimetka and Ingram, 2024; Muir, 2021; Lovrić *et al.,* 2021; Baskent *et al.,* 2024; Muttilainen and Vilko, 2022). Finally, a lack of supply chain input from local to global scales is a threat to the economic viability of the sector (LeBaron and Lister, 2021; Ivanov and Dolgui, 2022; Karmaker *et al.,* 2023).

Opportunities for the NWFP sector include growing consumer concern over social economy and ecology; the potential development of an eco-tourism market targeting relatively pristine forest ecosystems for related services; new products trending that could substitute actual ones with a trend to use natural cosmetics and nutraceuticals and/or healing; local branding of NWFPs, supported by consumers' willingness to pay for a guarantee of product sustainability; certification, provided that local and global stakeholders can agree on a valid sustainable production standard; community empowerment through participatory forest management can be enhanced in the presence of a clear definition of local benefits from NWFPs, mainly a reduction of transaction costs when local people are involved; the potential role of research can be crucial by developing sustainable harvesting practices and evaluating and designing in situ sustainable management of natural resources; and innovation in wild plant cultivation techniques can provide a high rate of return on investment (Muir, 2021; Weiss *et al.,* 2023; den Herder *et al.,* 2022; Tong, 2024).

10.2. Action prioritization for a sustainable bioeconomy

If we are to harness NWFPs' role in the bioeconomy, we need new policies and conversations. Current policies often overlook the combined contribution of timber and NWFPs to a diverse, resilient, and sustainable woodland economy. While timber is typically prioritized in forest management strategies, the holistic value of NWFPs—including their economic, cultural, and ecological roles—is frequently underrecognized. A more integrated policy approach is needed to support the full range of woodland products and the communities that depend on them. To ensure that woodland-dependent communities can fully benefit from the opportunities of a bioeconomy, targeted policy reforms, increased public and private investment, and context-specific scientific research are needed. This includes policies that support equitable access to forest resources, investment in value-added processing of NWFPs and sustainable forest products, and research focused on locally adapted management practices, market development, and climate resilience. Such measures can help unlock the social and economic potential of bio-based industries while preserving ecological integrity (Rashid *et al.,* 2022; Muttilainen and Vilko, 2022; Baskent *et al.,* 2024; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Delgado *et al.,* 2023; Di Cori *et al.,* 2022; Weiss *et al.,* 2023; Shackleton *et al.,* 2024; Di Cori *et al.,* 2023). The contribution of NWFPs to the bioeconomy goes far beyond the immediate commercial enterprise of production to the long-term sustainable economy of rural communities. NWFPs) can support the development of specialized skills and local expertise in harvesting and processing and complementary sectors such as sustainable timber production. When markets are developed for diverse woodland products, they create new economic opportunities that strengthen local economies and forest-based value chains. In addition, these markets can help preserve and revitalize rural traditions and cultural practices, supporting a rural lifestyle that is closely tied to the sustainable use of forest resources (Musa *et al.,* 2023; Baskent *et al.,* 2024; Temphel, 2021; Rovira *et al.,* 2022; Bhattarai and Acharya, 2021; Saritaş and Türker, 2023; Muir, 2021; Taghouti *et al.,* 2021).

Marketing strategies in the bioeconomy should reflect the distinct nature of non-wood forest products (NWFPs) rather than imitating the standardized and industrialized approaches used in the petrochemical and biotechnology sectors (Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Huber *et al.,* 2023; Muir, 2021; Posavec *et al.,* 2021; Smith-Hall and Chamberlain, 2023; Shackleton *et al.,* 2024; Delgado *et al.,* 2023). NWFPs should not be viewed merely as cheap natural resources competing on price with mass-produced goods. Instead, their value often lies in the traditional knowledge, expert consultancy, and innovation

involved in sustainable harvesting, processing, and marketing. This added value can position NWFPs as premium products that support local economies and promote ecological stewardship. If NWFPs are forced to compete solely based on price and volume, the bioeconomy risks abandoning its core principles. For example, while a cellulosic plant might be valued for producing bioplastics, a fiber-rich NWFP may also offer critical ecological services, such as providing habitat for wildlife. Both economic and environmental values must be acknowledged in a thriving bioeconomy. Carbon credits can further enhance the financial viability of NWFPs by rewarding sustainable forest management practices that contribute to carbon sequestration. In both developing and developed countries, linking NWFP value chains to climate finance mechanisms—such as carbon markets—can promote conservation, reward ecosystem services, and provide new income streams for forest-dependent communities (Smith-Hall and Chamberlain, 2022a, b; Maximo *et al.,* 2022; Piplani and Smith-Hall, 2021; Amusa *et al.,* 2024; Bansal, 2024). To realize this potential, governments must reassert their role in defining what holds biological and economic value, for example, recognizing woody NWFPs on par with timber trees (Bansal, 2024; Katila *et al.,* 2024; Verkerk *et al.,* 2022; Rosa and Martius, 2021; Alder, 2023). International trade regulations must also become more accommodating and responsive to the unique needs of the bioeconomy, just as they are for the petrochemical and gene technology sectors (Iriarte *et al.,* 2021; Vogelpohl, 2023; Donner and de Vries, 2021). Small-scale producers must have fair access to local, regional, and national markets alongside large industrial players

10.2.1. Sustainability and conservation concerns

Research on NWFPs and their role within the bioeconomy is a growing field. Typically, research has focused on NWFPs at the local level, either as an economic activity used for subsistence and small-scale income generation or as a way to support particular land uses and claim land rights for the administration and management of natural resources (Weiss *et al.,* 2023; Huber *et al.,* 2023; Di Cori et aI., 2024; Di Cori *et al.,* 2022; Posavec *et al.,* 2021; Chamberlain and Smith-Hall, 2024; Stoyanov, 2023; Miassi and Dossa, 2024; Smith-Hall and Chamberlain, 2023). The distinction between wood and non-wood products is an arbitrary classification used for analytical purposes. The development of the bioeconomy has seen the idea of harvesting and using low-value residues for increased economic performance extended to a broader array of crops, including NWFPs (Verkerk *et al.,* 2021; Aalmo *et al.,* 2023; Piplani and Smith-Hall, 2021; Kacprzak, 2023; Hassegawa *et al.,* 2022a, b; Chamberlain and Smith-Hall, 2022; Piras and Santoro, 2023). This chapter outlines some conceptual perspectives on NWFPs and their role in sustainable development, the promotion of bioeconomies, and their role in national and international economies. It next outlines the role of NWFPs in supporting healthy and productive landscapes and has implications for commercial activity in terms of collection policy and practice (Rashid *et al.,* 2022; Temphel, 2021; Xess and Tiwari, 2023; Bhattarai and Acharya, 2021; Wang *et al.,* 2023a, b; Dorji, 2022; Musa *et al.,* 2023; Posavec *et al.,* 2021).

With the growing global interest in the bioeconomy and the attention being focused on harvesting and using low-value residues for increased economic performance, studies have outlined

some conceptual perspectives on NWFPs and the role they can play in sustainable development, the promotion of bioeconomies, and their role in national and international economies (Delgado *et al.,* 2023; Rovira *et al.,* 2022; Baskent *et al.,* 2024; Muir, 2021; Verkerk *et al.,* 2021; Trigkas *et al.,* 2023; Dadebo *et al.,* 2024; Di Cori *et al.,* 2022). The selection of some NWFPs moves from traditional non-wood products such as resin, cork, and honey to definitions of NWFPs, including oilseeds, essential oils, and colorants (Primaningtyas and Gheewala, 2023). There is continued growth in the sector, with increased use of non-lumber wood products and the development of NWFP economies in developed and transitioning economies. However, the worldview of NWFPs as non-timber forest products (NTFPs) can create institutions that manage a particular subset of NWFPs to the detriment of both ecological conditions and human use of the landscape (Muttilainen and Vilko, 2022; Lovrić *et al.,* 2021; Shackleton *et al.,* 2024; Adesina *et al.,* 2022; Baskent *et al.,* 2024; Huber *et al.,* 2023; Musa *et al.,* 2023; Weiss *et al.,* 2023).

10.2.2. Capacity building and knowledge gaps

Current knowledge is still limited and fragmented, but its expansion is difficult, given the transdisciplinary and multidimensional nature of NWFP folklore knowledge, encompassing skills, and competencies involved in harvesting and processing techniques, culinary and nutritional uses, ecological functions, cultural and religious beliefs and customs, and social relations and power dynamics (Tunón, 2022; den Herder *et al.,* 2022; Bhattarai and Acharya, 2021). Generating this knowledge can promote sustainable management of NWFPs while recognizing value and reducing poverty, particularly for marginalized users, as well as fostering traditional food knowledge and practices, conserving commercial wild edibles, and reducing the pressures of overharvesting wild resources (Temphel, 2021; Wang *et al.,* 2023a, b; Delgado *et al.,* 2023). Yet this knowledge system has been overlooked or marginalized, depriving diverse peoples and societies, particularly those in need and at risk, of its potential benefits. This represents an example of the neglect traditional ecological knowledge systems suffered, preventing their dissemination and transmission and putting them at risk of extinction. Economic, medicinal, or food interests may protect traditional knowledge systems and communities from losing oral ecological knowledge, the cultural body of knowledge that individuals gather over their lifetime through diverse ways of interacting with the environment. However, respecting communities and preventing traditional knowledge exploitation must always be done. Formal education and traditional institutions, such as schools, universities, and local stakeholders, like farmers, breeders, or veterinary services, play crucial roles in raising awareness and improving knowledge about NWFP attributes, use, and sustainable development and conservation (Shackleton *et al.,* 2024; Baskent *et al.,* 2024). Promoting knowledge about NWFPs contributes to building awareness and fostering conservation and sustainable use inside and outside the local communities that rely on NWFPs to ensure their legitimacy and credibility (Baskent *et al.,* 2024; Xess and Tiwari, 2023; Rovira *et al.,* 2022; Handa and Mohapatra, 2021).

To reflect the increasing importance and interest in NWFPs, specific knowledge and capabilities about them are gradually being inserted into public programs and strategies; however, there is not even a common acknowledgment of what typical and specific NWFP knowledge is, characterized by high ecological and social relevance and little diffusion among scientists, technologists, and cultural brokers (Rashid *et al.,* 2022; Shackleton *et al.,* 2024; Weiss *et al.,* 2023; Baskent *et al.,* 2024; Schimetka and Ingram, 2024; Lovrić *et al.,* 2021). It is essential to increase the widespread level of information and make NWFPs a part of scientific

research and technological dissemination to generate economic enhancement. The effort will surely be intense due to the great variety of NWFPs and related knowledge, civilizations, and schools involved. Nevertheless, there is no alternative, if not morally erroneous, to accept the current state, and especially to maintain and perpetuate existing conditions of farming poverty (Shackleton *et al.,* 2024; Zubair *et al.,* 2021; Newaz *et al.,* 2007; Musa *et al.,* 2023; Rovira *et al.,* 2022; Xess and Tiwari, 2023; Derebe *et al.,* 2023; Muir, 2021; Khairul Alam, 2022; Lovrić *et al.,* 2021). Furthermore, awareness and contextualization will have a precautionary function, preventing traditional NWFP resources from becoming threatened types because the land of cause prevents the local socio-cultures and traditions of association within established territories, safeguarding valuable and threatened cultural heritage (Baskent, 2021; Salas, 2021). Enhanced capacities for recognizing natural resources and valuing ecosystem services will reduce the anthropogenic exploitation of natural resources consumed in urban interest, which contradicts the present environmental context (Mondal and Palit, 2022; Lee *et al.,* 2022). The concern is not only recognizing the effects of sustainable use of NWFPs in cultural identity and territoriality, hence agri-food policies too, but how, at the local level, districts embedded in local traditions have morality and maintain ethical responsibilities (Rovira *et al.,* 2022; Rovira *et al.,* 2022; Baskent *et al.,* 2024; Trigkas *et al.,* 2023). Raised interest and developed multidisciplinary research can establish the extra protective functions of NWFPs, supporting economic revivals that feed urban social networks and represent the new frontier model of enhancement and landscape regeneration.

10.3. Improving market access opportunities

The central importance of NWFPs and their contribution to the local and regional economy depends on the overall utility of NWFPs utilized and the geographical location of the population using these products (Bhattarai, 2022; Shackleton *et al.,* 2024; Toda *et al.,* 2023; Schimetka and Ingram, 2024; Etxegarai-Legarreta and Sanchez-Famoso, 2022; Muttilainen and Vilko, 2022). Although from the economic point of view, it would be best to promote only those NWFPs whose prices are high, thus limiting the share of the population participating in the NWFP economy, from the perspective of preserving biological diversity, NWFP utilization must be equally beneficial to all concerned segments of the population (Zubair *et al.,* 2021; Shackleton *et al.,* 2024; Xess and Tiwari, 2023; Musa *et al.,* 2023; Temphel, 2021; Muir, 2021; Lovrić *et al.,* 2021; Derebe *et al.,* 2023). While marketing strategies for NWFPs determined by high prices alone support profit maximization, they do not necessarily ensure optimal use of the full spectrum of NWFPs. The marketing of all other price categories promotes diversified NWFPs, the longitudinal effect of which is the improvement of national and public economies as well as the preservation of sustainable natural resources (Muttilainen and Vilko, 2022; Rovira *et al.,* 2022; Trigkas *et al.,* 2023; Rovira *et al.,* 2022; Muir, 2021; Schimetka and Ingram, 2024; Maisharou and Larwanou, 2022).

Marketing in NWFPs is much less formalized and organized than in timber products. Generally, goods are collected, processed, and marketed mainly by locals and consumed in local surroundings, where benefits are retained and shared among local communities, while locally grown NWFPs are marketed more widely (Pohl *et al.,* 2024; Bargah *et al.,* 2024; Andrews and Mulder, 2022; Dorji, 2022; Loreggian *et al.,* 2023; Zhu *et al.,* 2022; Santos *et al.,* 2021).

Over the past few decades, interest in NWFPs has grown, which is reflected in the increasing number of scientific papers, books focusing on the general state of knowledge, country-specific publications, as well as research focusing on certain aspects, including prices, limitations, and development prospects (Shackleton *et al.,* 2024; Bhattarai, 2022; Temphel, 2021; Musa *et al.,* 2023; Muir, 2021; Bhattarai and Acharya, 2021; Baskent *et al.,* 2024; Rovira *et al.,* 2022). Various international institutions undertook or initiated research in the field of NWFPs. These efforts provide a global overview of the marketed NWFPs (Rovira *et al.,* 2022; Bhattarai and Acharya, 2021; Muir, 2021; Schimetka and Ingram, 2024; Lovrić *et al.,* 2021; Taghouti *et al.,* 2022; Weiss *et al.,* 2023). To a similar extent, domestic governments and organizations invest in monitoring NWFP markets and related policies. Recognizing the commercial potential of NWFPs and considering the increasing number of failed forest plantations and secondary forests over the past few years, many analysts suggest promoting goods with substitutional characteristics. With a diversified offering, NWFPs will be able to satisfy the ventilatory effects of society and meet the increased demands that would influence their networking capabilities.

11. RECOMMENDATIONS FOR COMPETITIVE NWFP VALUE CHAINS

KEY MESSAGES

1. Innovations Driving Competitiveness

- Technological advances in NWFP processing (e.g., extraction, purification, smart delivery systems) are improving product quality and marketability.
- Emphasis is shifting from basic raw product use to high-value processing and product development, including eco-friendly and cost-effective methods.
- Innovations are creating new product categories (e.g., herbal food/ supplements) aligned with health, wellness, and sustainability trends.

2. Digital Solutions & Traceability

- Mobile apps, blockchain, and crowd-sourcing tools are transforming forest product traceability and management.
- Digital tools enhance transparency, build consumer trust, and promote legal, sustainable sourcing.
- "Forest chemical passports" and phytochemical traceability can differentiate products and ensure authenticity.

3. Market Access & Value Chains

- NWFP markets are currently fragmented and informal, limiting consistent access and growth potential.
- Developing coherent value chains, product branding, and direct market links is crucial.
- Emphasis on processed NWFPs increases profitability and supports niche marketing strategies.

4. Maximizing Environmental & Social Value

- NWFPs contribute to rural incomes, ecological conservation, and green tourism.
- Properly managed NWFPs support ecosystem restoration, reduce deforestation, and enhance biodiversity.
- They also deliver key ecosystem services, like climate regulation and soil protection, essential for sustainable forest management.

5. Strategic Alignment and Future Steps

- Align NWFP use with bioeconomy goals: balance exploitation with conservation and long-term benefits.
- Encourage public-private partnerships, innovation diffusion, and capacity-building at local levels.
- Ensure technology integration respects local traditions and indigenous knowledge while boosting economic opportunities.

KEY MESSAGES

11.1 Systematic interventions to enhance competitiveness

The environmental and socioeconomic importance of NWFPs goes beyond the benefits that traditional populations extract; it is essential to pay attention to the regular use of these products to create balanced exploitation, maintaining the resources for future generations, with continuous production of benefits and supporting the bioeconomic goals (Lovrić *et al.,* 2021; Muttilainen and Vilko, 2022; Di Cori *et al.,* 2024; Baskent *et al.,* 2024; Huber *et al.,* 2023; Musa *et al.,* 2023; Di Cori *et al.,* 2022).

This chapter presents some recent innovations and technologies in the production of NWFPs. Recent innovations and technological developments in NWFP production and processing can significantly change the way NWFPs are processed how value is added to the products, and can thus lead to an increased market acceptance for NWFPs (Baskent *et al.,* 2024; Weiss *et al.,* 2023; Rovira *et al.,* 2022; Musa *et al.,* 2023; Mahmood *et al.,* 2025; Stoyanov, 2023). The new methods and products make NWFP processing different, purer, more special, highly developed, and definitely better regarding sensory characteristics. In this way, new technologies and trends can renew interest in NWFP as natural, high-quality products (Rovira *et al.,* 2022; Spina *et al.,* 2023; Piras and Santoro, 2023; den Herder *et al.,* 2022; Tong *et al.,* 2024; Singer and Özşahin, 2024). The following three major innovations are covered in this part: digital technologies, advancements in market access and product traceability; new technologies and products that improve raw material and product properties and consequently create new market opportunities, add value, and increase the competitiveness of NWFP; methods of intensification that are based on NWFP production to improve economic and environmental benefits.

Research has shown that local populations face limitations in terms of their access to markets. Thus, the use of NWFPs can create an advantage in terms of economic, social, sustainable, and ecological aspects (Lopez-Ridaura *et al.,* 2021; Blazy *et al.,* 2021; O'Hara and Toussaint, 2021; Kubatko *et al.,* 2023). In the 21st century, the politics of NWFPs has become not just an advocacy challenge, but a challenge of building a new image of local populations that have comparative and competitive advantages versus qualitative, sustainable, and organic products compared to other nations (Rashid *et al.,* 2022; Rovira *et al.,* 2022; Temphel, 2021; Musa *et al.,* 2023; Lacuna-Richman, 2021; Laaribya, 2023; Baskent *et al.,* 2024; de Bruyn *et al.,* 2022; Taghouti *et al.,* 2021; Bhattarai and Acharya, 2021). Innovations in NWFP products could mean real achievements. However, they can also attract the populations of these regions, creating conditions of sustainability, intensification, remuneration, and economic valorization. This change is related to the processes of innovation in products and methods for raw material valorization to overcome the barriers, making a connection between advanced research, environmental management, and local specificities (Baskent *et al.,* 2024; Weiss *et al.,* 2023; Schimetka and Ingram, 2024; Muir, 2021; Huber *et al.,* 2023; Di Cori *et al.,* 2021; Takahashi *et al.,* 2024).

11.1.1. Processing and product development innovations

The use of environmentally friendly and cost-effective processing methods, alongside innovative product development strategies, is essential to stimulate and consolidate the expansion of a scientifically supported, high-added-value, and sustainable bioeconomy industry (Escobar and Laibach, 2021; Lange *et al.,* 2021; Bennich *et al.,* 2021). While research and development into advanced technologies—such as dry and/or wet extraction methodologies, purification of bioactive or value-added compounds, smart formulation and delivery systems, and functional resolved extracts—remains important (Wei *et al.,* 2022; Hodgson *et al.,* 2022; Kardung *et al.,* 2021; Gatto *et al.,* 2021; Fava *et al.,* 2021; Wilde and Hermans, 2021). NWFPs will also greatly benefit from the application of simple, accessible technologies. These include primary processing methods such as drying, cracking, de-pulping (particularly for fruits and nuts), and achieving basic quality standards regarding safety, handling, and hygiene. These foundational steps are critical to improving shelf life, reducing post-harvest losses, and meeting market requirements, as illustrated in the commercial processing methods for *Canarium indicum* (galip nuts) in Papua New Guinea (Wallace *et al.,* 2022). Adopting such practical approaches, in combination with targeted innovations, will be key to unlocking the potential of NWFPs in sustainable bioeconomic development.

Currently, the traditional use of plant and fungal resources and the preparation of more sophisticated herbal food and beverage products is in consensual agreement with recent consumer trends, even if these trends should have a more holistic and clear understanding (Obahiagbon and Ogwu, 2023; Jayathunga *et al.,* 2024; Hassan *et al.,* 2024; Dalbanjan *et al.,* 2024; Srivastava *et al.,* 2024; Sangeeta *et al.,* 2024). The new European market approach to herbal preparations, labeled as a distinctly new category, Food/Supplement products, adds value to the practical use of NWFPs. Notably, it requires the development of guidelines for beneficial compound quantification and product quality standardization of NWFPs (Weiss *et al.,* 2023; Rovira *et al.,* 2022; Lovrić *et al.,* 2021; Di Cori *et al.,* 2022; Huber *et al.,* 2023; Di Cori

et al., 2021; Muttilainen and Vilko, 2022; Di Cori *et al.,* 2024; Rashid *et al.,* 2022; Rovira *et al.,* 2022). Only in this way can the development of incipient regional herbal products be ensured, including other technological breakthroughs such as nanoformulations, microencapsulation, and plant and fungal biotechnologies. These factors can positively impact and counteract the persistent pressure on regional sectors and support the bioeconomy. It is essential to materialize these important multidisciplinary scientific and intersectoral resource synergies (Wang *et al.,* 2023a, b; Hossain *et al.,* 2022; Saggar *et al.,* 2022; Chaachouay and Zidane, 2024; Liu, 2021; Izah *et al.,* 2024; Fayiah *et al.,* 2024; Śmiechowska *et al.,* 2021).

11.1.2. Digital solutions and traceability

There is a wealth of digital innovations and tools that can support the collection and use of information on NWFPs and offer great potential to support the NWFP sector (Singer and Özşahin, 2024; Razal, 2022; Huber *et al.,* 2023; Di Cori *et al.,* 2024). Examples of such digital innovations include mobile phone technologies to improve the accuracy of forest management, crowd-sourcing systems, and blockchain-based systems with the potential to track the origin and journey of a forest product from the forest to the end consumer (Keefe *et al.,* 2022; Singh *et al.,* 2022; Holzinger *et al.,* 2022; Weiss *et al.,* 2021; Peng and Huang, 2022; Koukouvinou *et al.,* 2023; Torresan *et al.,* 2021). These technologies can therefore help raise the profile of NWFPs and ensure not only their greater visibility in these processes but also provide an electronic means to monitor and encourage sound management of the resources involved (Trigkas *et al.,* 2023; Novac, 2022; Weiss *et al.,* 2023; Martínez-Rodrigo *et al.,* 2024; Baskent *et al.,* 2021; Shackleton *et al.,* 2024; Baskent *et al.,* 2021; Taghouti *et al.,* 2022).

Digital solutions can provide unique traceability based on phytochemical data as a 'forest chemical passport approach.' They offer exceptional potential for consumer communication and brand protection, ensuring transparency along these value chains (Salsabila, 2024; Khan *et al.,* 2025; Aslam *et al.,* 2021; Mahmood *et al.,* 2024; Sousa *et al.,* 2024). With an ongoing trend towards connecting consumers with the origin of the products they purchase and the necessity of clearly ensuring transparency and sustainability, the use of blockchains in this context is a logical next step (Sousa *et al.,* 2024; Salsabila, 2024). They offer the possibility to create a high-tech leap in ensuring legal and sustainable sourcing practices for NWFP stakeholders that could build trust with consumers and, most importantly, policymakers (Hussain *et al.,* 2024; Jabbie, 2021). At the same time, however, it is not guaranteed that time-honored practices and traditions hold long enough for people to accept blockchain-enforced routine information disclosures on indigenous organizing systems, processes, and transactions. Long-term reconciliation between technology innovation and ecological market protection, and the utilization and access rights of rural communities and indigenous peoples, is required (Khan *et al.,* 2021; Li *et al.,* 2022; Tomashuk and Baldynyuk, 2023; Golub *et al.,* 2021; Xin and Senin, 2022).

11.2. Steps to improve market access and streamline value chains

NWFP market dynamics are usually characterized by a relatively high number of production and distribution channels and even more consumption channels (Muir, 2021; Güngör, 2024; Trigkas *et al.,* 2023; Singer and Özşahin, 2024; Tong, 2024). NWFPs can be distributed as raw materials or semi-finished products in various stages or can be marketed directly. Producers continuously face numerous challenges. Firstly, they need to access the market. They must find a buyer for their NWFPs and often face the problem of weak marketing links, prohibitive entry costs to national or international markets, and forest policy constraints at different levels. They also often face the absence of NWFP branding and quality and difficulty finding a stable, regular market for their products. Indeed, most marketing channels for NWFP are not organized in a coherent or planned way and are generally very weak, informal, and chain-driven without proper post-harvest and handling infrastructure (Bhattarai, 2022; Muttilainen and Vilko, 2022; Bhattarai and Acharya, 2021; Weiss *et al.,* 2023; Khairul Alam, 2022).

Developing value chains for specific NWFP can make an essential economic contribution to rural economies. Meeting a market niche, enabling producer groups and networks to create their own brands and label products, and being able to reach direct market links can enlarge the value of NWFPs and increase the benefit of chains

(Schimetka and Ingram, 2024; Nguyen *et al.,* 2021; Dadebo *et al.,* 2024; Musa *et al.,* 2023; Bhattarai and Acharya, 2021; Temphel, 2021; Baskent *et al.,* 2024; Bhattarai, 2022; Muttilainen and Vilko, 2022). More processed NWFPs reach greater profitability and quality levels and can meet the health and well-being claims of the population (Muir, 2021; Schimetka and Ingram, 2024). It is necessary to apply good marketing principles and transact to exploit market opportunities. A product portfolio with strategy and position must be developed. However, a competitive advantage must also be provided to command the highest return (Rovira *et al.,* 2022; Muttilainen and Vilko, 2022; Güngör, 2024; Trigkas *et al.,* 2023; Weiss *et al.,* 2023). Therefore, a systematic approach to finding a commercial niche or unique market is necessary. Emphasizing the exceptional qualities of an NWFP, either in a particular niche market or in a broader fashion, generally dictates a higher product price (Muir, 2021; Weiss *et al.,* 2023; Rovira *et al.,* 2022; Trigkas *et al.,* 2023; Biswas and Upadhyay, 2024; Huber *et al.,* 2023; Delgado *et al.,* 2023; Ohwo *et al.,* 2021; Chamberlain *et al.,* 2022; Stoyanov, 2023). Marketing research is needed regularly to guide firms in the product marketing process. Also, cooperative and local/national organizations can help promote and market NWFPs and obtain a fair sale of them and other forest products (Bhattarai and Acharya, 2021; Schimetka and Ingram, 2024; Nakanyete *et al.,* 2024; Xess and Tiwari, 2023). The private sector is mainly responsible for commercial marketing. Proper branding and labeling may increase value by adding quality and credibility. Nursery plants generally have a clean stock guarantee, which increases their commercial value (Rovira *et al.,* 2022; Muttilainen and Vilko, 2022; Bhattarai, 2022; Maisharou and Larwanou, 2022).

11.3. Maximizing the benefits of NWFPs

The contribution of NWFPs to the social and economic development of countries in South and Eastern Europe, Central Asia, and the Caucasus is significant for two main reasons. First, the provision of NWFPs represents a potential source of cash income for poor rural households dependent on natural resources. Second, if properly managed, NWFPs provide opportunities not only for the involvement of local and national communities in the maintenance of healthy ecosystems but also for the expansion of green and community-based ecotourism, a development that governments and international donor organizations are increasingly pursuing as a way of promoting sustainable rural development (Rashid *et al.,* 2022; Xess and Tiwari, 2023; Musa *et al.,* 2023; Temphel, 2021; Baskent *et al.,* 2024; USMAN, 2024; Saritaş and Türker, 2023; Muir, 2021; Zubair *et al.,* 2021).

NWFPs, though less quantified than wood resources, provide a wide range of environmental and social benefits. Ecological benefits are tied to sustainable ecosystem management and inclusive conservation strategies (Temphel, 2021; Baskent *et al.,* 2024; Di Cori *et al.,* 2022; Dadebo *et al.,* 2024; Weiss *et al.,* 2023; Purwestri *et al.,* 2023; Xess and Tiwari, 2023; Singer and Özşahin, 2024). In addition to directly contributing to multi-functionality and the economic sustainability of forest ecosystems, recent studies have shown that the conservation of biodiverse forests would not be economically viable without the sets of environmental services that NWFP production supports (Rashid *et al.,* 2022; Bhattarai and Acharya, 2021; Dadebo *et al.,* 2024; Shackleton *et al.,* 2024; Temphel, 2021; Bhattarai, 2022; Saifullah and Jewel, 2021; Muir, 2021; Derebe *et al.,* 2023; Schimetka and Ingram, 2024). The presence of diverse NWFPs is strongly tied to a set of critical 'latent' ecosystem services. One such group is the interaction of soil properties and hydrological connectivity, which determine the fields of physical properties and functions that define the boundary between soil with remainder values and soil with economic value (Di Cori *et al.,* 2021; Plevnik and Japelj, 2023; Di Cori *et al.,* 2024; Başkent, 2022; Huber *et al.,* 2023). The NWFP-wood bundle is economically critical for protecting soils so they can deliver desirable ecosystem services such as climate change mitigation and sustainable food production.

NWFP production often accelerates the recovery of degraded soils for ecosystem service supply. It converts secondary agricultural land back to forest, reducing the need for new deforestation (Delgado *et al.,* 2023; Haddad *et al.,* 2021). The favorable effects of NWFP gathering include reducing invasive species on millions of hectares due to the collection of nitrogen-fixing legume forage. Social benefits refer to the non-market values of local environmental management, the resurgence of traditional ecological knowledge, the reintroduction of land withdrawal and stewardship, and the increasing quality of life and social cohesion in rural and urban communities.

12. CONCLUSION

The "Regional Guidelines on Value Chain Development and Market Access for Non-Wood Forest Products (NWFPs) in South and Eastern Europe, Central Asia, and the Caucasus" provide a strategic framework for enhancing the economic potential of NWFPs while ensuring sustainability and inclusivity. The Guidelines attempt to unravel the interconnected relationships between forest management, NWFP value chain development, and market access, particularly in the context of policy and decision-making processes. It combines knowledge from various disciplines to confirm that forest-enabling capacities may trigger innovative capacity in the marketing and developing value chains around NWFPs. It clarifies the perceptions of each while emphasizing the importance of an integrated approach toward each item to achieve sustainable positive socio-economic and environmental outcomes. The Guidelines emphasize the importance of value chain integration, improved market access, and policy interventions to support local producers and rural communities.

The Guidelines are based on numerous examples of successful value chain development; however, the results are demonstration projects, not a comprehensive list of NWFPs that can be developed, nor are they specific models that can be used in other regions or development scenarios. The Guidelines are meant to be a foundational tool for the reader to build their pathways to better markets. The first step was to examine NWFP development and sustainable management concepts.

Key recommendations include strengthening institutional frameworks, promoting capacity-building initiatives, and encouraging public-private partnerships to enhance the competitiveness of NWFPs in domestic and international markets. Additionally, the Guidelines highlight the need for certification schemes, sustainable harvesting practices, and transparent supply chains to meet the growing consumer demand for environmentally responsible products.

Despite the opportunities, challenges such as limited infrastructure, lack of NWFP inventory, regulatory barriers, and climate change impacts remain. Addressing these challenges requires a multi-stakeholder approach, including active participation from governments, private sector actors, and local communities.

A guiding set of steps was designed to renew interest, focus on regional guidelines for specific product categories, and connect to SFM policy development. The final recommendation was to prepare for the future by creating meaningful state policies for value addition and market access.

In conclusion, the effective implementation of these Guidelines can contribute to economic diversification, rural development, and biodiversity conservation, ensuring that NWFPs play a vital role in the sustainable bioeconomy of the region. By fostering State policies, innovation, investment, value addition, market access, and sustainable management practices, countries in South and Eastern Europe, Central Asia, and the Caucasus can unlock the full potential of their NWFP resources while securing long-term benefits for both people and the environment.

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14. ANNEX: GLOBAL AND REGIONAL BEST PRACTICES

14.1. Global case studies on NWFP value chain development

14.1.1. Case study 1: Carob value chain analysis in Türkiye

Non-Wood Forest Products: Carob Value Chain Research Report (YADA, 2018) provides an overview of the carob value chain in Türkiye, focusing on the production process from forest to market. Here's a summary of the key sections related to the value chain:

Major Actors in the Carob Value Chain

1. Forest Regional Directorates' Non-Wood Products and Services Sections
   - **Role:** These sections manage and regulate the collection and use of non-wood forest products, including carob. They oversee permits, sustainability, and environmental impact.
   - **Influence:** They set policies and guidelines for sustainable harvesting practices.
2. Forest District Directorates
   - **Role:** These directorates implement policies at the local level, ensuring that carob collection is conducted in accordance with regulations.
   - **Influence:** They enforce rules and monitor forest health.
3. Forest Villagers
   - **Role:** Villagers are often involved in collecting carobs from wild trees. They may also be involved in initial processing steps.
   - **Influence:** They are crucial for the supply of raw carob.
4. Gatherers
   - **Role:** Gatherers collect carob from the forest floor or trees. This role can overlap with forest villagers.
   - **Influence:** They are essential for the initial step of the value chain.
5. Mukhtars
   - **Role:** Mukhtars are local community leaders who may facilitate communication between villagers and other stakeholders in the value chain.
   - **Influence:** They can help organize collection efforts and resolve local issues.
6. Middlemen
   - **Role:** Middlemen purchase carob from gatherers or villagers and sell it to processors or traders. They play a key role in connecting supply and demand.
   - **Influence:** They can affect pricing and market access.
7. Spice Traders
   - **Role:** These traders specialize in buying and selling carob, often to larger processors or exporters.
   - **Influence:** They help distribute carob to various markets.
8. Managers of Drying-Processing Facilities
   - **Role:** These facilities are crucial for processing raw carob into usable products like carob powder or syrup.
   - **Influence:** They transform raw materials into marketable products.
9. Aegean Exporters' Association
   - **Role:** This association supports exporters by providing market information, facilitating trade agreements, and promoting Turkish products abroad.
   - **Influence:** They enhance Türkiye's export capabilities and market presence.
10. Spice Sellers at Spice Bazaar in Istanbul
    - **Role:** These sellers are involved in the final retail stage, offering carob and its by-products to consumers.
    - **Influence:** They provide a direct link to the consumer market.

Each of these actors plays a vital role in ensuring the carob moves efficiently from the forest to the consumer, contributing to the overall success of the carob value chain. Key steps in the value chain are presented in Table 3.

From the Tree to the Market: Carob Value Chain

1. Carob Collection Planning and Organization
   - **Process:** Carob trees are naturally distributed in the Mediterranean region of Türkiye. The collection process involves planning and organization by local communities, often facilitated by mukhtars or local leaders.
   - **Challenges:** Traditional methods can be labor-intensive and damage trees if not managed properly.
2. Carob Collection
   - **Method:** Most carob is collected from wild trees using traditional methods. Gatherers use sticks to

knock down ripe carobs, which can sometimes damage tree branches.
   - **Yield:** The productivity per tree is around 45 kg.
   - **Seasonality:** Collection typically occurs during specific seasons when carobs are ripe.
3. The Logistics of Carob and Carob Processing
   - **Traditional Processing:** Carob is processed in small amounts using traditional methods. This includes drying and cleaning the carobs.
   - **Industrial Processing:** Larger producers are involved in making carob syrup and other processed products. This requires more advanced facilities and equipment.
   - **Challenges:** Standardization and quality control can be issues due to the variability in processing methods.
4. Carob and Its By-Products in the Market
   - **Products:** Carob has various by-products, including carob powder, syrup, and seeds. The quality of carob affects its unit price and market demand.
   - **Market Dynamics:** The market for carob products is influenced by consumer preferences for natural alternatives to chocolate and other food products.
   - **Challenges:** Lack of standardization in by-products can affect marketability and pricing.

Table 3. Key steps in the value chain

Step	Description	Actors Involved
Collection	Gathering carob from wild trees.	Gatherers, Forest Villagers
Processing	Drying, cleaning, and transforming carob into usable products.	Managers of Drying-Processing Facilities
Trading	Buying and selling carob to processors or exporters.	Middlemen, Spice Traders
Export	Selling carob products internationally.	Aegean Exporters' Association
Retail	Selling carob products to consumers.	Spice Sellers at Spice Bazaar in Istanbul

Challenges in the Carob Value Chain

- **Traditional Harvesting Methods:** The use of sticks to knock down ripe carobs can damage tree branches, reducing productivity over time.
- **Lack of Standardization:** By-products of carob, such as carob powder and syrup, face challenges in standardization, affecting marketability and pricing.
- **Low Productivity and Supply Bottlenecks:** In some regions, like the Turkish Cypriot community, carob farming is neglected, leading to low productivity and supply bottlenecks for processors.
- **Weak Competitiveness:** Factors such as limited access to credit, lack of skilled labor, and unfavorable business environments hinder competitiveness.
- **Land Use and Fragmentation:** The abandonment of carob farming and land fragmentation are significant challenges in maintaining sustainable carob production.

Recommendations for Improving the Carob Value Chain

- **Modernize Harvesting Techniques:** Implement mechanical harvesting methods to reduce tree damage and increase efficiency.
- **Promote Best Practices:** Encourage the adoption of best practices in carob farming, including deliberate orchard layouts and better input management.
- **Strengthen Linkages:** Foster stronger connections between producers and processors through strategies like contract

farming.
- **Modify Public Support:** Shift public support from area-based payments to grants or loans encouraging modern farming techniques and new plantations.
- **Incentivize Certifications:** Incentivize producers to obtain certifications (i.e. organic) to enhance competitiveness.
- **Support Research and Development:** Conduct research to improve carob productivity and identify suitable cultivars for profitable international markets.
- **Diversify Economic Activities:** Explore opportunities for agri-tourism, rural tourism, and ecosystem services to enhance local economic development.
- **Local Processing of By-Products:** Encourage local processing of carob seeds into products like locust bean gum to add value before export.

14.1.2. Case study 2: Honey value chain analysis in Lebanon

The honey value chain analysis in Lebanon, as outlined in the FAO report (Hamade, 2016), involves several key components.

Overview

The honey value chain in Lebanon involves several key stages and actors. The sector has seen significant growth and interventions, particularly through projects like the Lebanon Industry Value Chain Development project. This project aimed to enhance the competitiveness of Lebanese honey by improving production quality, market access, and branding. Challenges include competition from imported honey, limited access to markets for medium and large beekeepers, and the need for better beekeeping practices.

Value Chain Map

The honey value chain can be mapped as follows:

1. **Production Stage**
   - Beekeepers: They are the primary producers, managing beehives and extracting honey.
   - Inputs: Beekeeping equipment, queen bees, and training on best practices.
2. **Aggregation and Processing Stage**
   - Aggregators: Collect honey from beekeepers.
   - Processors: Engage in honey extraction, packaging, and wax processing.
   - Investments: Upgrading equipment for extraction and packaging.
3. **Marketing and Distribution Stage**
   - Wholesalers/Distributors: Purchase honey from processors and supply it to retailers.
   - Retailers: Sell honey directly to consumers through various channels (supermarkets, local markets).
   - Branding and Labeling: Enhancing the visibility and quality perception of Lebanese honey.
4. **Export Stage**
   - Exporters: Facilitate the sale of honey to international markets.
   - Market Access Strategies: Develop marketing plans to enter new distribution channels.
5. **Consumers**
   - Domestic Consumers: Prefer buying directly from beekeepers or through local markets.
   - International Consumers: Targeted through export strategies.

Key Interventions and Challenges

- **Project Interventions**: Improve market access, aggregation, and processing facilities. They also emphasize quality improvement and branding to enhance competitiveness.
- **Challenges**: Competition from imported honey, lack of scientific knowledge, limited access to quality queen bees, and good market channels.

Overall, the honey value chain in Lebanon is characterized by a mix of traditional practices and modern interventions aimed at enhancing productivity and market competitiveness.

Production Base

Beekeeping Practices

- **Traditional and Modern Practices**: Beekeeping in Lebanon is primarily traditional, with some modern practices being adopted. However, there is a need for more modern equipment and procedures to enhance productivity and adapt to changing environmental conditions.
- **Bee Species**: Lebanon hosts indigenous and non-endemic bee species, including *Apis mellifera syriaca*, *Apis mellifera ligustica*, and *Apis mellifera caucasica*. The import of queen bees has influenced the characteristics of local breeds.

Floral Sources

- **Diverse Flora**: Lebanon's diverse flora allows for producing various types of honey, including orange blossom, oak, wildflower, thistle blossom, thyme,

juniper, lavender, cedar, and eucalyptus honey.
- **Seasonal Variations**: Honey production follows the flower blooming seasons, with citrus blossom honey produced in winter and spring and mountain poly-floral honey produced at higher altitudes during summer.

Challenges

- **Climate Variability**: Climate changes affect honey production, leading to fluctuations in yield and economic instability for beekeepers.
- **Pesticide Use**: High pesticide use, especially in citrus orchards, poses risks to bee health and honey quality.
- **Bee Pastures Degradation**: The degradation of bee pastures due to intensive grazing, herbicides, and forest fires threatens honey production.

Opportunities

- **Diversification**: Beekeepers diversify their products to include pollen, propolis, and royal jelly, offering additional income streams.
- **Training and Support**: Initiatives like Anera's training programs aim to enhance beekeeping skills and promote sustainable practices.

Trade and Market Prices Structure

Trade Structure

- **Imports**: Lebanon is a net importer of honey, with imports significantly exceeding exports. In 2011, imports were valued at USD 1,520,000, primarily sourced from countries like Saudi Arabia, which often re-export Chinese honey.
- **Exports**: Lebanese honey exports have grown. In 2011, exports were valued at USD 334,000, with 82% going to Middle Eastern markets. By 2016, exports increased, with a focus on branded honey in high-value markets.

Market Prices Structure

- **Domestic Market**: The domestic market is divided between direct sales of unbranded honey and branded honey sold through supermarkets. Consumers pay a premium for high-quality, unbranded honey directly from beekeepers, often around USD 25/kg. Branded honey is priced lower but still considered expensive compared to imported honey.
- **Export Market**: Lebanese honey is sold at a premium in export markets, particularly in the U.S., where it targets niche and ethnic markets. The average export price varies significantly, ranging from USD 1 to USD 23/kg, reflecting the high quality and branding efforts.
- **Price Trends**: Prices have fluctuated due to economic conditions. Prior to the dollar crisis, honey sold for USD 25 to USD 30 per kg, but prices have adjusted due to inflation and currency fluctuations.

Challenges and Opportunities

Competition from Imports: The domestic market faces competition from cheaper imported honey, which affects local sales1.

Export Opportunities: There are opportunities to expand exports by enhancing quality and branding, particularly in high-value markets.

Overall, the honey market in Lebanon is characterized by a strong demand for high-quality, branded honey both domestically and internationally, despite challenges from imported honey and economic fluctuations.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis and Recommendations

SWOT Analysis

Strengths

- **Diverse Floral Sources**: Lebanon's diverse flora allows for producing various types of honey, enhancing its quality and flavor profile.
- **Traditional Beekeeping Knowledge**: Local beekeepers possess traditional knowledge and skills, which can be leveraged to improve production practices.
- **Growing Market Demand**: There is an increasing demand for Lebanese honey both domestically and internationally, driven by awareness campaigns and quality improvements.

Weaknesses

- **Limited Production Capacity**: Despite growth, honey production remains limited compared to demand, partly due to environmental factors and a lack of modern beekeeping practices.
- **Competition from Imports**: The domestic market faces significant competition from cheaper imported honey.
- **Lack of Scientific Knowledge**: Limited access to scientific knowledge on best beekeeping practices hampers productivity and quality.

Opportunities

- **Export Market Expansion**: There is potential for increasing exports by enhancing branding and quality.
- **Diversification of Products**: Beekeepers can diversify their products to include pollen, propolis, and royal jelly, offering additional income streams.
- **Investment in Quality Improvement**: Opportunities exist for investing in quality testing facilities and improving queen bee breeds to enhance honey quality.

Threats

- **Climate Change**: Climate variability affects honey production, leading to fluctuations in yield and economic instability for beekeepers.
- **Pesticide Use**: High pesticide use poses risks to bee health and honey quality.
- **Market Competition**: Competition from imported honey continues to threaten local sales.

Recommendations

1. **Enhance Quality and Branding**
   - Invest in quality testing facilities to ensure compliance with international standards.
   - Develop strong branding strategies to differentiate Lebanese honey in domestic and export markets.
2. **Improve Beekeeping Practices**
   - Provide training programs for beekeepers to adopt modern practices and improve productivity.
   - Increase access to high-quality queen bees to enhance honey yield and quality.
3. **Market Access and Promotion**
   - Develop marketing strategies to increase exports to high-value markets.
   - Implement promotional campaigns to raise awareness and demand for Lebanese honey domestically.
4. **Regulatory Support**
   - Enforce regulations on honey imports to protect local producers and ensure quality standards.
   - Collaborate with government agencies to support the honey sector through policies and incentives.
5. **Diversification and Sustainability**
   - Encourage beekeepers to diversify their products to reduce dependence on honey alone.
   - Promote sustainable beekeeping practices to preserve natural resources and enhance environmental resilience.

14.1.3. Case study 3: Gum Arabic value chain analysis in Sudan

The Gum Arabic value chain in Sudan (Mahmoud, 2016) involves several actors and processes, from cropping patterns and tapping to marketing and processing.

Key Stages

1. **Production/Tapping**
   - **Farmers/Tappers**: Sudanese farmers tend to protect *Acacia senegal* trees throughout the year. They tap the trees around mid-October, and the gum is collected in several rounds over the following months.
   - **Gum Yield**: The yield varies based on factors like tree age and environmental conditions.
2. **Collection and Auction**
   - **Farmers**: Transport the collected gum to auction markets, where it is sold to local merchants at an agreed floor price or higher.
   - **Local Merchants**: Buy the gum and deliver it to cleaning sheds for grading.
3. **Processing and Grading**
   - **Cleaning Sheds**: The gum is cleaned, selected, and graded into different types, such as clean amber sorts, siftings, and dust.
   - **Processors**: Further process the gum into various forms like mechanical or spray-dried powder for industrial applications.
4. **Marketing and Export**
   - **Gum Arabic Company (GAC)**: Purchases and exports the graded gum, often through international agents.
   - **Exporters**: Sell processed gum to global markets, particularly Europe and the United States.

Key Actors

1. **Farmers/Producers**
   - Small-scale farmers in traditional rainfed areas represent a significant portion of Sudan's population.
2. **Local Merchants/Traders**
   - Buy gum from farmers at auction markets and sell it to processors or the GAC.
3. **Gum Arabic Company (GAC)**
   - Holds an exclusive concession for exporting raw Gum Arabic and plays a crucial role in setting floor

prices and managing exports.

4. **Processors**
   - Engage in cleaning, grading, and further gum processing for various industrial applications.
5. **Exporters and International Agents**
   - Purchase processed gum from GAC or processors and sell it to global markets.

Key Considerations

1. **Impact of Conflict**
   - **Production Disruption**: The ongoing conflict in Sudan has significantly disrupted gum Arabic production, leading to a 50% reduction in output. This affects the local economy and global supplies, as Sudan is the largest producer of gum arabic.
   - **Supply Chain Challenges**: Disruptions in transportation routes and blockages of feeder roads and national highways have increased costs and hindered the movement of gum Arabic from production areas to Port Sudan.
2. **Economic and Social Impacts**
   - **Livelihoods Affected**: Approximately 6 million people in Sudan depend on gum Arabic production for their livelihoods. The conflict threatens these livelihoods and exacerbates economic instability.
   - **Market Disturbances**: The conflict has led to market disturbances, including price volatility and reduced access to financing for farmers and processors.
3. **Environmental Concerns**
   - **Deforestation and Desertification**: The conflict has accelerated the destruction of acacia trees, contributing to desertification and soil degradation. This poses long-term threats to the sustainability of gum Arabic production.
   - **Loss of Biodiversity**: The removal of acacia trees can lead to biodiversity loss, further impacting ecosystems and local ecosystem services.
4. **Opportunities for Recovery and Growth**
   - **International Support**: Initiatives like the EU-funded project aim to enhance the resilience of rural populations and improve production practices. This includes training farmers and supporting producer associations.
   - **Diversification and Value Addition**: There is potential for diversifying income streams through value-added products and promoting sustainable practices to ensure the long-term viability of the industry.
5. **Global Market Implications**
   - **Supply Chain Vulnerability**: The disruption in Sudanese gum Arabic supplies has created opportunities for other African producers to fill the gap. However, this also poses challenges for industries reliant on high-quality Arabic gum from Sudan.
   - **Quality and Consistency**: Sudanese gum Arabic is considered the "gold standard" due to its superior quality. Maintaining this quality is crucial for maintaining market share and meeting international demand.

14.1.4. Thoughts on the applicability of the global case studies to the region

Based on the three global case studies provided — **carob in Türkiye**, **honey in Lebanon**, and **gum Arabic in Sudan** — an analysis of their **applicability to South and Eastern Europe, Central Asia, and the Caucasus** in terms of improving NWFP value chains are provided below, including cross-cutting insights for the region in Table 4:

Key Lessons and Regional Applicability

1. Carob in Türkiye: Institutional Coordination & Processing Challenges

Relevance to South and Eastern Europe and the Caucasus

- **Local community roles (mukhtars, gatherers, villagers)** mirror traditional governance structures in many Caucasus and Balkan communities.
- **Lack of standardization and traditional harvesting techniques** are common issues across the region. For instance, similar inefficiencies are seen in wild mushroom or medicinal plant collections in Bosnia, Georgia, or Armenia.
- **Recommendation transfer**: Mechanical harvesting, better linkages between producers and processors, and investment in local processing (i.e. gum from carob seeds) are highly relevant for NWFPs like walnuts, rosehips, and berries in the Balkans and Caucasus.

2. Honey in Lebanon: Branding, Floral Diversity & Export Strategy

Relevance to Caucasus, Central Asia, and Balkans

- Many countries (i.e. Georgia, Armenia, Kyrgyzstan) share **floral diversity** and **traditional beekeeping knowledge**.
- Lebanon's **branding and quality control initiatives** offer a strong model. Countries in this region often suffer from **low-quality packaging**, lack of **branding**, and **fragmented marketing**—precisely the gaps the Lebanese interventions addressed.
- **Direct applicability**:
    - Training on modern practices for small-scale producers.
    - Expanding products (i.e. pollen, royal jelly).
    - Developing Protected Geographical Indications (PGIs) for honey linked to place and floral origin.

3. Gum Arabic in Sudan: Climate Vulnerability, Export Structure & Livelihood Dependence

Relevance to Central Asia

- The **economic and environmental vulnerability** highlighted in Sudan's case mirrors conditions in parts of **dryland Kazakhstan, Uzbekistan**, and **Tajikistan,** where resinous trees and shrub-derived NWFPs (i.e. ferula, licorice) are harvested.
- The **auction model** used in Sudan could inform **transparent market structures** for wild plant and root products in Central Asia, where opaque pricing and intermediaries dominate.
- **Important caveat**: Central Asia has a high risk of political or climate disruptions in value chains. The Sudan case emphasizes the need for **local processing, resilience planning**, and **community benefit-sharing** — priorities equally urgent for Central Asian NWFP development.

Table 4. Cross-Cutting Insights for the Region

Lesson	Application
Decentralized but coordinated governance (i.e. Türkiye's forest directorates)	Strengthen village forest committees in Balkan/Caucasus countries for NWFP governance.
Investment in basic post-harvest processing	Promote low-cost equipment (dryers, hullers, sorters) for products like rosehips, thyme, and juniper berries.
Market access and branding (Lebanon)	Develop regional brands and certification schemes for honey, herbs, and mushrooms.
Transparency and auction models (Sudan)	Introduce cooperative-based pricing and digital marketplaces.
Climate sensitivity and supply shocks (Sudan)	Diversify income, encourage agroforestry and community-based restoration efforts.

14.2. Regional case studies on NWFP value chain development

14.2.1. Case study 1: Chestnut value chain analysis in Albania

Chestnut production in Albania plays a crucial role in rural economic development, particularly in mountain and marginalized areas. The main chestnut-producing regions include Tropoja, Malësia e Madhe, Shkodër, Dibër, Bulqizë, Pukë, Fushë Arrës, Vau i Dejës, Librazhd, and Pogradec. Despite the vast chestnut forests, challenges such as forest renewal, disease management, and value chain inefficiencies hinder the full potential of the sector (Skreli, 2024).
Just a few years ago, Albania was a range with high potential for chestnut exports. Now, production has dipped due to poor management practices and diseases. Most chestnut fruits are exported as fresh products to Italy, Hungary, and other countries, often without processing, packaging, or labeling. This incomplete value chain and lack of value-adding capability result in a significant loss of potential income for rural communities. FAO Albania works under the OCOP – One Country One Product initiative in communion with local institutions and actors. It has implemented significant achievements focusing on the chestnut value chain regarding green production (chestnut management, pest, and disease management), storage (post-harvest treatment), and processing (value-added processing) (Skreli, 2024).

This section provides an in-depth analysis of the chestnut value chain, including economic, environmental, and social factors. It offers strategic recommendations for improvement (Skreli, 2024).

Value Chain Stages

1. Harvesting
Chestnut collection primarily occurs in existing forest massifs. However, inadequate forest

management, pest infestations (i.e. the Asian Chestnut Gall Wasp), and a lack of modern harvesting techniques pose challenges to sustainable production.

2. Consolidation

Harvested chestnuts are gathered and organized for further processing or sale. The lack of infrastructure, such as modern storage and drying facilities, affects the quality and marketability of chestnuts.

3. Processing

Processing remains underdeveloped in Albania. Most chestnuts are exported fresh to Italy and Hungary without value addition. Limited investment in processing facilities reduces the profitability of the sector. However, some local companies, such as AK+AC and the Reçi Cooperative, have invested in sorting and storage facilities.

4. Marketing

Albanian chestnuts primarily target the European market. However, declining exports and increasing competition from Italy and Spain have impacted their profitability: weak branding and the absence of GI certification limit Albania's competitiveness in high-value markets.

Enabling Environment

1. Policy and Regulatory Framework

- National programs such as the Instrument for Pre–Accession Assistance Rural Development (IPARD) and National Support Schemes (NSS) offer financial support to farmers and processors.
- Lack of clear property rights prevents long-term investments in forest management and maintenance.
- Bureaucratic processes hinder infrastructure development for storage and processing.

2. Drivers of Competitiveness

- **Services and Finance:** Limited access to credit prevents small farmers from investing in better production techniques.
- **Sector Governance:** Weak coordination between stakeholders leads to inefficiencies in the supply chain.

SWOT Analysis

1. Economic and Policy Environment

Strengths

- **National Policies and Funding**: The government provides financial support through programs like IPARD and NSS. These funds help farmers and processors invest in storage, sorting, and drying technologies.
- **Organic Certification Potential**: Certain chestnut forests, such as those in Tropoja, have already been certified organic, which provides a competitive advantage in export markets.

Weaknesses

- **Property Rights Issues**: Chestnut forests are owned by municipalities, and farmers do not have ownership rights, discouraging investment in maintenance, silviculture, and infrastructure.
- **Underfunded Forest Management**: Public resources for forest management are minimal (only 1.3% of government transfers to municipalities), limiting pest control and maintenance.
- **Regulatory Complexity**: The bureaucratic process for obtaining construction permits hinders the development of storage and processing facilities.

Opportunities

- **Policy Reforms**: Clarifying land tenure and allowing long-term leasing to farmers can attract more investments.
- **Public-Private Partnerships (PPP)**: Successful silvicultural projects, like the one in Tropoja (2017–2020), demonstrate that PPPs can effectively improve forest management.

Threats

- **Market Instability**: Export prices fluctuate due to competition from EU producers, affecting profitability.
- **Environmental Risks**: Pest infestations, such as the Asian Chestnut Gall Wasp, could reduce production by up to 80% without proper biological control.

2. Private Sector Involvement

Primary Producers/Harvesters

- **Strengths**: Chestnut collection is a crucial income source for rural communities, with some families earning between € 3,000 and € 5,000 per year.
- **Weaknesses**: Farmers lack incentives to invest in silvicultural maintenance since they do not own the land.

- **Opportunities**: Training programs on pest management, pruning, and post-harvest handling could enhance productivity.
- **Threats**: Labor shortages occur when prices are too low, as non-resident harvesters (who traditionally participate) seek alternative employment.

Consolidators

- **Strengths**: Around 30 traders/consolidators ensure competitive buying prices.
- **Weaknesses**: Most consolidators only use basic sorting and storage; only a few invest in value-added processing.
- **Opportunities**: Investments in drying and packaging technologies could increase market competitiveness.
- **Threats**: The reliance on spot-market transactions rather than long-term contracts makes the supply chain unpredictable.

Processors and Exporters

- **Strengths**: Some companies, such as AK+AC and Reçi Cooperative, have invested in cold storage, sorting, and high-value products like chestnut jam.
- **Weaknesses**: Most exports are bulk raw chestnuts, limiting profit margins.
- **Opportunities**: Expansion into value-added markets (i.e. roasted chestnuts, purees) could increase revenues.
- **Threats**: Albania has lost market share in exports, dropping from the world's 9th largest exporter in 2012-2016 to insignificance by 2023.

3. Access to Services and Finance

Strengths

- **International Donor Support**: Programs like FAO's "One Country, One Product" initiative and German-funded SRD projects provide funding for rural development.
- **Emerging Interest in Agro-tourism**: Rural tourism initiatives can generate additional income for farmers.

Weaknesses

- **Limited Credit Access**: Farmers and processors struggle to secure loans due to a lack of property ownership.
- **Fragmented Development Programs**: Many projects are short-term and lack coordination at a national level.

Opportunities

- **Microfinance for Smallholders**: Introducing targeted financial schemes for small-scale harvesters could encourage investment.
- **Strengthening Cooperative Models**: Successful cooperatives like Reçi could be replicated to enhance collective bargaining.

Threats

- **Low Investor Confidence**: Unclear policies and financial risks deter private sector investments.

4. Social and Environmental Factors

Strengths

- **Environmental Benefits**: Chestnut forests prevent soil erosion and provide habitats for pollinators.
- **Cultural Significance**: Chestnuts hold historical and economic importance, encouraging community engagement.

Weaknesses

- **Pest and Disease Threats**: Infestations have severely reduced production, and biological pest control initiatives are only in the pilot stages.
- **Aging Workforce**: Younger generations migrate to cities, leading to labor shortages.

Opportunities

- **Sustainable Forest Management**: Expanding the FAO biological control program could restore productivity.
- **Promoting Chestnut-Based Eco-Tourism**: Creating tourism routes like the "Chestnut Road" in Tropoja could generate additional income.

Threats

- **Climate Change**: Unpredictable weather conditions may further reduce yields.

5. Value Chain Governance & Market Linkages

Strengths

- **Successful Cooperative Models**: The Reçi cooperative demonstrates that well-organized value chains can improve farmer incomes and market access.

- **Growing Domestic Demand**: Albanians strongly prefer local chestnuts and chestnut honey, providing a stable domestic market.

Weaknesses

- **Weak Coordination Among Stakeholders**: Value chain actors operate independently, leading to inefficiencies.
- **Low Market Differentiation**: Lack of branding and quality certification prevents access to premium markets.

Opportunities

- **Strengthening B2B Linkages**: Facilitating trade partnerships could increase sales and market access.
- **Leveraging GIs**: Restoring PGI status for chestnuts and honey can improve Albania's export positioning.

Threats

- **Increasing Competition from EU Producers**: Countries like Italy and Spain dominate the European chestnut market, limiting Albania's share.

Key Strategic Interventions

1. **Clarify Land Tenure:** Implement usufruct rights or long-term leases to encourage private investment in forest management.
2. **Expand Value-Added Processing:** Support businesses in diversifying chestnut products (i.e. roasted, dried, or vacuum-packed chestnuts).
3. **Improve Market Linkages:** Strengthen partnerships between farmers, consolidators, and exporters.
4. **Invest in Pest Management:** Scale up biological control initiatives to combat infestations.
5. **Enhance Access to Finance:** Develop microcredit programs for chestnut harvesters and small processors.
6. **Leverage Eco-Tourism Potential:** Develop agro-tourism routes and branding for chestnut products.
7. **Promote GI Certification: Support re-establishing geographical indication labels for chestnuts and chestnut honey.**

Conclusion

The report provides a solid foundation for understanding the Albanian chestnut value chain and offers valuable strategic insights. Albania's chestnut value chain has significant potential for economic growth and sustainability. However, strategic interventions in land rights, processing infrastructure, financial support, and stakeholder coordination are essential for strengthening the sector. By addressing these challenges and leveraging Albania's strengths, the chestnut industry can regain its competitive position in the global market (Skreli, 2024).

14.2.2. Case study 2: Bee products value chain analysis in Europe, the Caucasus, and Central Asia

1. Introduction

Beekeeping is crucial in **agriculture, biodiversity, and rural economies** across **Europe, the Caucasus, and Central Asia**. Bee products include **honey, beeswax, propolis, royal jelly, pollen, and bee venom** used in **food, cosmetics, pharmaceuticals, and traditional medicine**. The region has a long history of beekeeping, and its diverse flora supports high-quality honey production. However, challenges such as **climate change, disease outbreaks, and market access** impact the value chain.

This report examines the **value chain of bee products**, focusing on **key actors, processing, trade dynamics, and opportunities for improvement**.

2. Production

2.1 Major Producing Regions

- **South and Eastern Europe**: Leading producers include **Poland and Romania**.
- **Caucasus**: **Georgia, Armenia, and Azerbaijan** are known for their unique honey varieties.
- **Central Asia**: **Kazakhstan, Uzbekistan, and Kyrgyzstan** have growing beekeeping industries.

2.2 Beekeeping Systems

- **Traditional Beekeeping**: Small-scale, family-run apiaries using natural methods.
- **Commercial Beekeeping**: Larger-scale, mechanized honey production with modern hives.
- **Wild Honey Collection**: Practiced in some mountainous areas, such as Georgia and Kyrgyzstan.

2.3 Key Challenges

- **Climate Change**: Unpredictable weather affects nectar flow and honey yields.
- **Bee Health Issues**: Diseases like **Varroa mite infestations** threaten colonies.
- **Pesticide Use**: Harmful chemicals reduce bee populations and honey quality.
- **Land Use Changes**: Deforestation and monoculture farming reduce forage availability.

3. Processing & Value Addition

3.1 Processing Stages

- **Primary Processing**: Honey extraction, straining, and bottling.
- **Advanced Processing**: Filtration, pasteurization, and blending for consistency.
- **Value-Added Products**: Beeswax candles, propolis extracts, royal jelly supplements, and cosmetic products.

3.2 Challenges in Processing

- **Quality Control**: Ensuring compliance with **EU food safety standards**.
- **Adulteration Risks**: Honey fraud (i.e. sugar syrup mixing) is a concern in global trade.
- **Limited Infrastructure**: Small producers lack access to modern processing facilities.

4. Market & Trade

4.1 Domestic Markets

- High local demand for raw honey, traditional medicine, and cosmetic products.
- Premium **organic and mountain honey** fetches higher prices.

4.2 Export Markets

- **Europe**: Germany, France, and the UK are major importers of high-quality honey.
- **China & Middle East**: Increasing demand for premium and medicinal honey.
- **Russia**: A key market for honey from Central Asia and the Caucasus.

4.3 Challenges in Marketing & Trade

- **Strict EU Regulations**: Exporting honey to Europe requires certification (i.e. organic, residue-free).
- **Price Fluctuations**: Market volatility due to supply variations and global demand shifts.
- **Competition from Large Producers**: China and Argentina dominate the global honey market.

5. Policy & Institutional Support

5.1 Government & Nongovernmental Organization (NGO) Initiatives

- **Beekeeping Subsidies**: Some countries provide financial support to beekeepers.
- **Organic Certification Support**: Helping producers meet EU organic standards.
- **Sustainable Beekeeping Programs**: Encouraging biodiversity-friendly practices.

5.2 Challenges in Policy Implementation

- **Weak Regulations in Some Regions**: Honey adulteration is a persistent issue.
- **Lack of Organized Cooperatives**: Small producers struggle to access markets independently.
- **Limited Research & Development**: Need for improved disease-resistant bee breeds.

6. Key Opportunities for Value Chain Improvement

6.1 Expanding Organic & Specialty Honey Markets

- Certification for **organic, raw, and medicinal honey** can increase export value.
- Marketing **geographically indicated honey** (i.e. Caucasian Mountain Honey).

6.2 Strengthening Processing & Branding

- Developing **modern honey processing facilities** to meet export standards.
- Promoting **value-added bee products** like **propolis, royal jelly, and beeswax-based cosmetics**.

6.3 Supporting Beekeeping Cooperatives

- Encouraging **cooperative honey production** to improve bargaining power.
- Strengthening **direct market linkages** with international buyers.

6.4 Sustainable Beekeeping & Environmental Protection

- Promoting **pesticide-free farming** to protect pollinators.
- Supporting **reforestation and wildflower initiatives** to improve nectar sources.

7. Bee Products Value Chain Map

7.1 Value Chain Stages & Key Actors

1. **Production Stage**
   - **Actors**: Smallholder beekeepers, commercial apiaries, traditional wild honey collectors.
   - **Challenges**: Bee health threats, climate impacts, land use changes.
2. **Collection & Aggregation**
   - **Actors**: Cooperatives, honey traders, local markets.
   - **Challenges**: Price instability, quality inconsistencies.
3. **Processing & Value Addition**
   - **Actors**: Processing plants, honey packaging firms, cosmetics manufacturers.
   - **Challenges**: Meeting food safety standards, limited investment in processing.
4. **Distribution & Marketing**
   - **Actors**: Exporters, wholesalers, supermarkets, specialty stores.
   - **Challenges**: Competition with large-scale producers, certification requirements.
5. **End Markets**
   - **Domestic Consumption**: Honey for food, cosmetics, and health products.
   - **Export Markets**: EU, Russia, China, and the Middle East.
   - **Challenges**: Price volatility, certification barriers, logistical costs.

8. Conclusion

The bee products sector in **Europe, the Caucasus, and Central Asia** has **strong growth potential**, but challenges in **sustainability, processing, and trade regulations** must be addressed. Key actions for value chain improvement include:

- **Strengthening sustainable beekeeping** to improve productivity and environmental impact.
- **Investing in modern processing and certification** for international market access.
- **Developing premium honey brands** (organic, raw, medicinal) to enhance competitiveness.
- **Supporting beekeeper cooperatives** to improve livelihoods and fair trade opportunities.

By addressing these challenges, **the bee products value chain can become more sustainable, competitive, and profitable** for regional producers and traders.

14.2.3. Case study 3: Walnut value chain analysis in Central Asia

1. Introduction

Walnut production is an important agricultural and economic activity in Central Asia, particularly in Kyrgyzstan, Uzbekistan, Kazakhstan, and Tajikistan. The region is home to vast natural walnut forests, notably in Kyrgyzstan, and smallholder farms contribute significantly to production. This report analyzes the walnut value chain in-depth, highlighting challenges and opportunities from production to market distribution.

2. Production

2.1 Major Producing Countries

- **Kyrgyzstan:** Home to the world's most extensive natural walnut forests, especially in Arslanbob.
- **Uzbekistan:** Increasing commercial walnut orchards and exports.
- **Tajikistan:** Smallholder farmers dominate production.
- **Kazakhstan:** Expanding walnut plantations due to rising demand.

2.2 Production Systems

- **Natural Walnut Forests:** These forests are found mainly in Kyrgyzstan and Tajikistan, providing wild walnuts harvested by local communities.
- **Smallholder Farms:** Traditional production methods with limited inputs.
- **Commercial Orchards:** Emerging in Uzbekistan and Kazakhstan with improved varieties and irrigation systems.

2.3 Key Challenges

- Low productivity due to aging trees and lack of improved varieties.
- Climate change affecting yields and quality.
- Limited mechanization and modern farming techniques.
- Land tenure issues, particularly in natural forests.

3. Processing & Value Addition

3.1 Processing Stages

- **Primary Processing:** Harvesting, drying, shelling, and grading.
- **Advanced Processing:** Walnut oil extraction, walnut flour, and processed snack foods.
- **Packaging & Storage:** Often underdeveloped, leading to post-harvest losses.

3.2 Challenges in Processing

- Insufficient modern processing facilities.
- Lack of compliance with international food safety and quality standards.
- High post-harvest losses due to poor handling and storage conditions.

4. Market & Trade

4.1 Domestic Market

- Walnuts are widely consumed in local diets and used in traditional medicine.
- Increasing demand for processed walnut products such as oils and confectionery.

4.2 Export Markets

- **Major Buyers:** China, EU (Germany, France), Türkiye, and Russia.
- **Market Channels:** Informal trade networks dominate, but formal exports are growing.

4.3 Challenges in Marketing & Trade

- Price volatility due to yield fluctuations.
- High dependence on intermediaries, reducing farmer profits.
- Limited certification (i.e. organic, fair-trade) restricting access to premium markets.

5. Policy & Institutional Support

5.1 Government Initiatives

- Afforestation and sustainable management programs.
- Subsidies for orchard development and irrigation.
- Trade policies supporting walnut exports.

5.2 Role of NGOs and Development Partners

- **FAO, GIZ, United Nations Development Programme:** Supporting sustainable forestry and farmer training.
- **Local Cooperatives:** Enhancing bargaining power of smallholder farmers.

5.3 Challenges in Policy Implementation

- Weak enforcement of sustainable harvesting regulations.
- Inadequate financial support for smallholder farmers.
- Lack of extension services for capacity building.

6. Key Opportunities for Value Chain Improvement

6.1 Expanding Organic & Fair-Trade Certification

- Helps access high-value markets and ensures environmental sustainability.

6.2 Investing in Processing & Branding

- Development of premium walnut-based products such as oils and snacks.
- Improved packaging and quality control for international competitiveness.

6.3 Strengthening Farmer Cooperatives & Market Access

- Enhancing collective bargaining power and reducing reliance on intermediaries.
- Improving linkages between farmers, processors, and exporters.

6.4 Promoting Sustainable Agroforestry Practices

- Increasing productivity while preserving natural walnut forests.
- Government incentives for reforestation and sustainable harvesting.

7. Walnut Value Chain Map

7.1 Value Chain Stages & Key Actors

1. **Production Stage**
    - **Actors:** Smallholder farmers, natural forest harvesters, commercial orchard owners.
    - **Inputs:** Seeds, irrigation, fertilizers, land, labor.
    - **Challenges:** Low productivity, aging trees, climate impact, limited mechanization.
2. **Collection & Aggregation**
    - **Actors:** Cooperatives, middlemen, local traders.
    - **Activities:** Bulk purchasing, initial grading, transportation.
    - **Challenges:** Price fluctuation, lack of bargaining power, informal trade.
3. **Processing & Value Addition**
    - **Actors:** Processing plants, small-scale processors, cottage industries.
    - **Activities:** Drying, shelling, sorting, oil extraction, packaging.
    - **Challenges:** Outdated technology, compliance with safety standards, post-harvest losses.
4. **Distribution & Marketing**
    - **Actors:** Exporters, wholesalers, retailers.

- **Activities:** Bulk sales, contract agreements, branding, market expansion.
- **Challenges:** Market access, trade restrictions, certification issues.

5. **End Markets**
   - **Domestic Consumption:** Households, bakeries, restaurants.
   - **Export Markets:** China, EU, Türkiye, Russia.
   - **Challenges:** High logistics costs and dependency on intermediaries.

8. Conclusion

Central Asia has significant potential to develop a sustainable and profitable walnut value chain. Addressing challenges in production, processing, market access, and policy implementation will enhance the sector's competitiveness. Investment in modernization, certification, and farmer capacity building is essential for long-term growth.

14.2.4. Case study 4: Porcini value chain analysis in Europe, Central Asia, and the Caucasus

1. Introduction

Porcini mushrooms (Boletus edulis) are among the most valuable wild mushrooms in **Europe, the Caucasus, and Central Asia**. They are widely consumed in **Italy, France, Germany, and Russia**. They are exported globally in **fresh, dried, frozen, and processed forms**. The value chain involves wild foraging, collection, processing, and international trade. This report analyzes the Porcini value chain, identifying key actors, challenges, and opportunities.

2. Production

2.1 Major Producing Regions

- **South and Eastern Europe**: Italy, France, Poland, and the Balkans are major suppliers.
- **Caucasus**: Georgia, Armenia, and Azerbaijan have significant wild porcini resources.
- **Central Asia**: Kyrgyzstan and Kazakhstan have emerging porcini industries, often relying on wild foraging.

2.2 Production Systems

- **Wild Foraging**: The primary method relies on traditional knowledge and seasonal harvesting.
- **Small-Scale Farming**: Limited cultivation due to porcini's complex symbiotic relationship with trees.
- **Community-Based Collection**: Organized collection by rural communities, often involving middlemen.

2.3 Key Challenges

- **Seasonal & Weather-Dependent Yields**: Production fluctuates based on rainfall and temperature.
- **Overharvesting & Sustainability Issues**: Risk of depletion due to unsustainable practices.
- **Lack of Organized Collection Systems**: Many collectors operate informally, limiting supply chain efficiency.

3. Processing & Value Addition

3.1 Processing Stages

- **Primary Processing**: Sorting, cleaning, and drying (sun-drying or industrial drying).
- **Advanced Processing**: Powdering, canning, and vacuum-sealed packaging for extended shelf life.
- **Quality Control & Certification**: High-end markets require organic or geographic indication labels.

3.2 Challenges in Processing

- **Post-Harvest Losses**: Poor drying and storage conditions lead to spoilage.
- **Food Safety & Quality Standards**: Meeting EU regulations for mycotoxins and contaminants is crucial.
- **Limited Value Addition**: Most porcini are exported raw or dried, missing higher-value processing opportunities.

4. Market & Trade

4.1 Domestic Markets

- **Italy, France, and Germany** are top consumers, with strong demand for fresh and dried porcini.
- **Russia and Eastern Europe** also have significant domestic consumption.

4.2 Export Markets

- **Major Importers**: EU (especially Italy and France), the USA, China, and Japan.
- **Trade Routes**: Many Caucasus and Central Asian porcini are exported via Türkiye or Russia.

4.3 Challenges in Marketing & Trade

- **Price Volatility**: Prices fluctuate based on annual yields and demand.
- **Informal Trade Networks**: Many porcini are exported without proper documentation.
- **Certification Barriers**: EU and US import markets require strict food safety compliance.

5. Policy & Institutional Support

5.1 Government & NGO Initiatives

- **Sustainable Foraging Policies**: Some European countries regulate harvesting through quotas.
- **Export Incentives**: Countries like Georgia and Kyrgyzstan promote mushroom exports.
- **Fair-Trade & Organic Certification Support**: Encouraging sustainable and ethical trade.

5.2 Challenges in Policy Implementation

- **Weak Regulation in Some Regions**: Many porcini are harvested and traded informally.
- **Limited Access to Finance**: Small-scale collectors lack investment for improved processing.
- **Lack of Cooperative Development**: Few organized producer groups to improve bargaining power.

6. Key Opportunities for Value Chain Improvement

6.1 Sustainable Foraging & Certification

- Implementing **fair-trade and organic certification** can improve market access.
- Encouraging **forest management practices** to prevent overharvesting.

6.2 Investment in Processing & Branding

- Promoting **local drying and packaging industries** to increase value-added products.
- Developing **premium porcini brands** with geographical indications.

6.3 Strengthening Producer Organizations

- Encouraging **cooperatives and collective bargaining** to secure better prices.
- Reducing dependency on middlemen through **direct sales to buyers**.

7. Porcini Value Chain Map

7.1 Value Chain Stages & Key Actors

1. **Foraging & Collection**
    - **Actors**: Independent mushroom hunters, rural communities, small farmers.
    - **Challenges**: Lack of organized collection points and sustainability concerns.
2. **Aggregation & Trading**
    - **Actors**: Middlemen, cooperatives, wholesalers.
    - **Challenges**: Informal markets dominate, and there are price fluctuations.
3. **Processing & Value Addition**
    - **Actors**: Small processors, industrial drying facilities.
    - **Challenges**: Lack of modern processing infrastructure and strict EU food safety standards.
4. **Distribution & Marketing**
    - **Actors**: Exporters, international buyers, specialty food markets.
    - **Challenges**: Market access issues and certification costs.
5. **End Markets**
    - **Domestic Consumption**: Fresh and dried porcini used in gourmet cuisine.
    - **Export Markets**: High demand from the EU, USA, and Japan.
    - **Challenges**: Competition from other wild mushroom varieties.

8. Conclusion

The porcini mushroom value chain in **Europe, the Caucasus, and Central Asia** presents **significant opportunities for economic growth** but also faces **challenges in sustainability, processing, and market access**. Key areas for improvement include:

- **Sustainable harvesting practices** to preserve porcini populations.
- **Investments in processing infrastructure** to reduce post-harvest losses.
- **Certification and branding** to enhance market competitiveness.
- **Strengthening producer organizations** to improve profitability for collectors.

The porcini industry can maximize its potential while ensuring long-term sustainability by addressing these issues.

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