

1 Why focus on non-timber forest products in the bioeconomy?

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Reality check: hidden products and emerging opportunities

We know little about most forest products in the world. Production of a limited number of commercial (mainly timber) species is well investigated and supported by detailed inventory data, silvicultural systems and specific management guidelines, with well-established value chains. But the distribution, ecology, and management of most species supplying forest products remain poorly understood, as do the associated production networks. For instance, of more than 50,000 plant species used for medicine globally, about 2500 are internationally traded in value chains that are, for the most part, unknown, with very few species in cultivation (Schippmann et al, 2006). For almost all wild-harvested species (mainly non-timber), there is no or little data on harvest volumes, available stock, possible yields, or sustainable harvest levels. Knowledge about management interventions, production network structures, and demand drivers is severely lacking. This is true, even though more than 1.6 billion people in the world are forest-proximate (Newton et al, 2020), that forest income makes up an astonishing 22% of total household income for rural people in the tropics and subtropics (Angelsen et al, 2014), and that forest products may be important in filling income gaps and providing safety nets (Wunder et al, 2014). The generation of species-level data is impaired by the objectives and financial limitations of many research studies leading to the collection of aggregated data, e.g. on fuelwood income, not allowing breakdown to the species level. This is further compounded by the difficulties in collecting data on a wide variety of products available at different times of the year, although recent advances in developing methods at the household and national levels (Angelsen et al, 2011; FAO, 2016) are evident. The result is that most species and associated products remain invisible. Consequently, and paradoxically, most species and products are overlooked when developing forest-related policies and programmes. This is true also for recent advances to define and implement the bioeconomy.

The result is a lack of focus on emerging opportunities. Unlocking the bioeconomy to include all forest products and users may contribute to solving global challenges. Arguably, making non-timber forest products (NTFPs)

visible would increase the value of standing forests, which could reduce deforestation and biodiversity losses, adverse climate effects, and decreases in environmental incomes. Existing bioeconomic strategies pay limited attention to combining economic growth and sustainable natural resource management (Georgeson et al, 2017) while forests continue to be degraded and disappear (Vancutsem et al, 2021), with tropical forest carbon loss a major source of global emissions (Feng et al, 2022) and driving biodiversity decline (Maxwell et al, 2016). As many as five billion people may use NTFPs (Shackleton and Vos, 2022), and these products provide significant income sources in tropical and temperate regions (Angelsen et al, 2014; Lovrić et al, 2020). This provides a solid argument for doing better with what we have – non-timber forest products have a substantial and unrealised role in contributing to a greener and more sustainable future.

Much more than the current approach: the allure of a forest-based bioeconomy

Interest in the bioeconomy is increasing rapidly, as evident by the annual number of peer-reviewed publications in the past decade (Fig. 1.1). This interest is found across a large number of (Web of Science) categories, dominated by green sustainable science technology, environmental sciences, biotechnology applied microbiology, and energy fuels. Also, there is increasing interest in the bioeconomy within forestry, with the annual number of forest-based bioeconomy publications rising from 0 in 2014 to 40 in 2020.

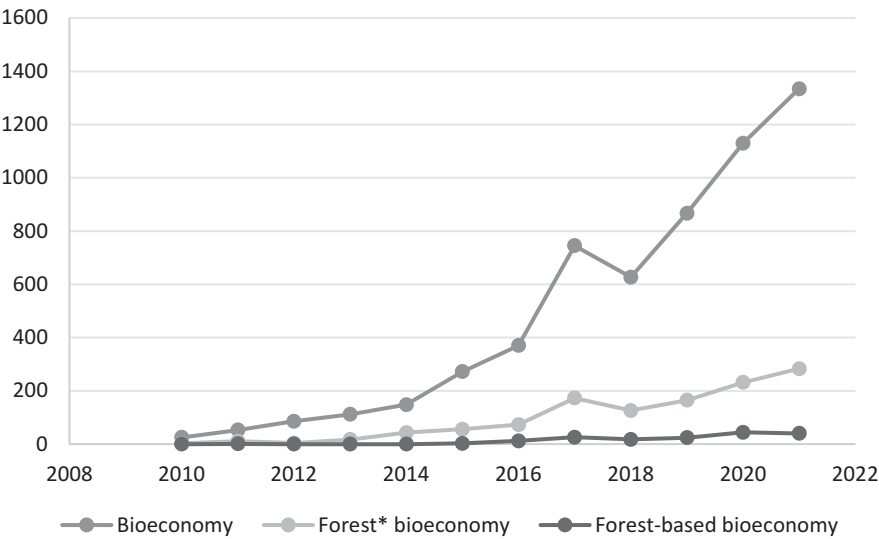


Figure 1.1. The number of publications registered in Web of Science 2010–2021 on “bioeconomy” (n=5769), “forest* bioeconomy” (n=1186), and “forest-based bioeconomy” (n=168).

Despite the growing interest in the bioeconomy, it is not well defined. This has advantages and disadvantages. The main benefit is that many different stakeholders can identify with the concept that is then applied across a wide range of sectors (D'Amato et al, 2017), resulting in broader attention to the bioeconomy. The main disadvantage is that two bioeconomy studies (or researchers) may focus on topics so far apart that it is hard to spot common ground. For instance, two of the most cited bioeconomy publications are Vaaje-Kolstad et al (2010), describing an enzyme acting on the surface of crystalline chitin, and McMichael (2012), providing a Marxist inspired criticism of neoliberal responses to rising food prices. The bioeconomy can thus appear in many guises, ranging from being indistinguishable from the regular market economy to being an integrated part of a decoupling circular economy concept, addressed by widely different lines of thinking and methods from both the natural and social sciences.

This book focuses on the emerging subject of the forest-based bioeconomy, recently defined as “the set of economic activities to grow, harvest, process, reuse, recycle, and sell forest products and associated forest ecosystem services” (Piplani and Smith-Hall, 2021: 3). This is more operational and tangible than wider bioeconomy definitions, including that proposed by the European Union (EU, 2018) leading to the above-outlined difficulties in creating a common understanding of the bioeconomy, while still allowing for a broad range of approaches. Piplani and Smith-Hall (2021) identified five distinct approaches to a forest-based bioeconomy, varying across seven variables (the paradigmatic belief system, public policy goals, final product or service sold, key stakeholders, transition pathways, the informal economy, and the strength of the link to environmental sustainability). Approaches range from the technocratic biotechnology school emphasising economic growth, development of new high-value products, large companies, and weak sustainability linkage to the eco-society school focused on degrowth, organic products, sustainable consumption, and strong sustainability attention. However, the past focus in the forest-based bioeconomy literature has been overwhelmingly on biotechnological approaches (Jančokský et al, 2021).

A forest-based bioeconomy is thus much more than the opportunity to use bio-based materials to replace fossil energy sources or wood products to substitute greenhouse gas-intensive products. A forest-based bioeconomy is an opportunity to rethink, reinvent, and reposition the forest sector in relation to the global mega-challenges – halting biodiversity losses and eliminating poverty. This menu of possible positive outcomes makes a forest-based bioeconomy attractive. Realising these positive outcomes requires a renewed focus on sustainable forest management, sustainable forest incomes and industries, and sustainable forest products consumption (recognising that an important initial step is the need to develop and agree on operational sustainability measures). These sustainability outcomes cannot be achieved as long as most forest products are ignored. Increased attention must be paid

to the vast group of non-timber forest products. There are isolated examples of the nationwide economic importance of NTFPs, including shea (*Vitellaria paradoxa* C.F. Gaertn.) nuts in Burkina Faso (Wardell et al, 2021) and the Chinese caterpillar fungus in the Himalayas and Tibet (Smith-Hall and Bennike, 2022). But these have not been integrated into any explicit bioeconomic thinking or analysis.

We can do better with what we have! A forest-based bioeconomy with non-timber products

We acknowledge the widespread dissatisfaction with the term “non-timber forest products”. While this term (and its allied versions, such as non-wood forest products) has been used for decades to group a wide range of products, ranging from fungi to medicinal plants and firewood, there is no common agreement on definitions and what products are/should be included. There have been many attempts to clarify the term (Belcher, 2003; Ahenkan and Boon, 2011; Muir et al, 2020) and move towards a unified definition (Mantau et al, 2007; Shackleton et al, 2011). However, challenges remain. For instance, the sectoral limitation of the term to forests is artificial for many products harvested both inside and outside forests, particularly in places where the latter may be significantly more important such as in sub-Saharan West Africa (Pouliot and Treue, 2013). However, resolving the NTFP definitional issue is not the purpose of this book. Our emphasis is on investigating the links between non-timber products and a forest-based bioeconomy, not providing a general delimitation of the NTFP term. The product cases included in the chapters of this book are all forest harvested. The authors of this chapter view NTFPs as “all biological materials other than timber which are extracted from forests for human use” (De Beer and McDermott, 1996: 24), while subsequent individual chapters may present other (allied) definitions. Following the Global Forest Resources Assessment 2020 (FAO, 2018: 4), this book considers forests as “land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use”.

While being used throughout the world (e.g. Shackleton et al, 2011; Angelsen et al, 2014; Lovrić et al, 2020), NTFPs are mostly not considered in official policies (Laird et al, 2011; Muir et al, 2020). Hence, the NTFP Paradox. As many as five billion people may use NTFPs (Shackleton and Vos, 2022), their global annual value has been conservatively estimated at USD 7.7 billion (FAO, 2020), and rural household-level NTFP income in the tropics and subtropics is almost as important as agricultural income (Angelsen et al, 2014) – so why are these products not given more attention? Part of the explanation lies in the huge number of products; their aggregated importance may be high, although individual product groups and species may be

of low importance. For instance, in a study of 8000 households in 24 countries, Hickey et al (2016) found that 77% were involved in wild food collection even if the wild food income only averaged 4% of total household income. Also, products are dispersed spatially and temporally and thus hard to capture in surveys. This makes official estimates too low, whether in national or global statistics. In addition, many NTFP uses and values are hard to capture, such as for sacred goods (Wunder et al, 2011). Coupling NTFPs to the emerging forest-based bioeconomies around the world is an opportunity to improve the collection of their statistics to make these products more visible and integrate them into new initiatives receiving recognition and funding.

Attention to NTFPs in the forest-based bioeconomy has increased in the last couple of years. The Food and Agriculture Organization of the United Nations (FAO) recently published a report on forest products in the global bioeconomy (Verkerk et al, 2022); while the emphasis is on timber and related traditional products such as wood pulp, the report includes a box on NTFPs and a section dedicated to global resin production, trade, and consumption. The Center for International Forestry Research (CIFOR) report on the forest-based bioeconomy in sub-Saharan Africa (Rosa and Martius, 2021) found NTFPs to constitute an important pathway to the bioeconomy, noting challenges in terms of governance structures, the informality of tenure and trade, widespread rent-seeking, and lack of skills to promote sustainable production networks. NTFPs in the EU bioeconomy have been briefly treated in Wolfslehner et al (2019) and touched upon for the Czech Republic in Purwestri et al (2020), while Di Cori et al (2022) progress to propose a framework for quantifying the bioeconomic importance of NTFPs in the EU. The body of knowledge that combines NTFPs and the bioeconomy is minimal, while there is considerable separate literature on NTFPs and bioeconomies, indicating substantial scope for learning using existing studies by bringing these fields together in joint analyses.

The purpose of this book

This book provides the first explicit in-depth investigation of how non-timber forest products are part of local, national, and global bioeconomies, and a concerted effort to identify interventions to support the transition to a forest-based bioeconomy. Each chapter ends by drawing out the key messages for the bioeconomy with NTFPs.

The book examines three central themes:

- Theme 1: Where are we? Using examples from five continents, this assesses approaches to integrating NTFPs into bioeconomic strategies and provides national and supranational level overviews of the current acknowledgement and importance of NTFPs in the bioeconomy. The theme details recent advances as well as ongoing changes.

- Theme 2: How do we move on? Using examples from Africa, Asia, and Latin America, this part delves into transition pathways, providing examples of bundles of NTFP related activities that support sectors and countries in moving towards the bioeconomy.
- Theme 3: What tools and technologies can help transitions? These texts identify and exemplify interventions supporting NTFP-based transitions to the bioeconomy, such as integrating NTFP and timber objectives in forest management or using mobile technologies to increase production.

The book has four distinctive features relative to the existing literature:

- It enters and maps unknown territory as scholarship on the bioeconomy with non-timber forest products is virtually non-existent.
- Through its integrative approach (covering and integrating assessment of bioeconomy resources and strategies, identifying and describing bioeconomic transition pathways, and presenting tools and technologies to assist transitions) and inclusion of diverse studies, it moves beyond the dominant biotechnological approach to the bioeconomy, expanding scholarship to other ways of thinking about and approaching the bioeconomy.
- Through its global coverage, the book expands the scholarship on the bioeconomy beyond the current primary focus on Western and Northern Europe.
- The methods in the chapters are centred on literature reviews that combine knowledge on NTFP-bioeconomy linkages and/or new empirical in-depth data at a fine scale. The book thus grounds advances in new reviews and empirically derived knowledge, explicitly focusing on operationalising a forest-based bioeconomy, including sustainable forest management interventions and embracing social and cultural integrity issues.

The book is built around a string of (empirical) cases from five continents that engage with the bioeconomy relative to non-timber forest products: (i) *theoretically*, to define and characterise the role of these products in transitioning to a bioeconomy; (ii) *empirically*, through analysis of how and to what degree the products contribute to a bioeconomy, and; (iii) *practically*, by identifying interventions to support the integration of the products into bioeconomy strategies.

The primary audience is professionals interested in non-timber forest products and the sustainable management of these resources to enhance the biological and economic dynamics of their harvests, in this process contributing to establishing a bioeconomy that embraces more than the wood products from forests. This may include students, researchers, forestland managers, and policymakers interested in interdisciplinary studies, across the natural and social sciences divide. In terms of disciplines, the book is relevant to agronomists, anthropologists, economists, environmental scientists, foresters, geographers, and other resource management fields.

A secondary audience is practitioners in government agencies, international aid agencies, and NGOs involved in project implementation. The book speaks directly to policymakers working toward integrating NTFPs into the sustainable management of forests and promoting a forest-based bioeconomy.

Getting together. The IUFRO Global Task Force: unlocking the bioeconomy and non-timber forest products

In June 2019, the Board of the International Union of Forest Research Organizations (IUFRO) commissioned a Global Task Force to investigate whether and how non-timber forest products have been integrated into global and national efforts to transition to and expand the bioeconomy and how such efforts can be supported. The Global Task Force comprises over 70 experts (from more than 20 countries) charged with reviewing the state of knowledge, identifying research gaps, advancing empirical analysis, examining challenges and opportunities, and developing recommendations to advance the harmonised integration of non-timber forest products into the national and global bioeconomies. More than 40 authors from six continents, primarily drawn from this pool of experts representing the leading scholars in this area, have contributed to this book. The task force is facilitating dialogue with a global interdisciplinary and cross-sectoral network of researchers working on the interfaces of markets, products, policies, and forest resources and engaging colleagues in discussions and examinations of issues related to non-timber forest products and the bioeconomy, including through an open monthly webinar series.

Structure and content of this book

Changing a country's economic trajectory to embrace elements of the bioeconomy is challenging. Nations and people must seek new ways to produce and consume resources sustainably. The forest-based bioeconomy offers an opportunity to reduce the environmental impacts of economic growth through science-based management facilitating sustainable utilisation, including of NTFPs. In pursuit of this, the book focuses on the above three themes. Fig. 1.2 presents an overview of bioeconomic themes, chapters, featured NTFPs, geographical coverage, and methods.

Theme 1 presents studies looking into the present state of the bioeconomy in a range of locations (countries or regions) to visualise and illustrate the importance of NTFPs and the linkages between these products and the bioeconomy. In Chapter 2, Marko Lovrić and co-authors draw on work on NTFPs in Europe, from Portugal to Russia, to identify commonalities and patterns that can inform the integration of NTFPs into the ongoing work to develop European bioeconomies. In Chapter 3, Sen Wang and co-authors document the lack of focus on NTFPs in developing the Canadian

Where are we – the starting point	How do we move on – specific examples	Helpful tools and technologies – tricks of the trade
• Ch 2: all NTFPs, Europe, review • Ch 3: syrup and mushrooms, Canada, review • Ch 4: mushrooms, China, review • Ch 5: all NTFPs, Brazil, review • Ch 6: açaí, The Guiana Shield, empirical • Ch 7: all NTFPs, Mexico, review • Ch 8: bush mango, rattan, bamboo, Cameroon, empirical	• Ch 9: ginseng, Korea, empirical • Ch 10: baobab, Malawi, review • Ch 11: medicinal plants, Nepal, review • Ch 12: all NTFPs, Argentina, empirical 	• Ch 13, a suite of NTFPs, general, review, managing for NTFPs • Ch 14: pine cones, Chile, empirical, production systems • Ch 15: berries, Finland, empirical, GIS technologies

Figure 1.2. Overview of bioeconomic themes, chapters, featured NTFPs, geographical coverage, and methods (photo: © Carsten Smith-Hall).

bioeconomy in the past two decades, paying particular attention to the potential for supporting the livelihoods of the First Nations. In Chapter 4, Jun He highlights the importance of indigenous institutions and knowledge in relation to the sustainable use of commercial NTFPs in promoting bioeconomy development in southwest China. In Chapter 5, Sandra Afonso and co-authors supply insights into the main NTFPs relevant to the Brazilian bioeconomy and identify activities that can integrate the two. Staying in South America in Chapter 6, Janaína Diniz and Nathalie Cialdella use the example of the conservation and trade of the açaí palm in French Guiana, Surinam, and northern Brazil to shed light on the importance of cultural aspects and market dynamics to facilitate the development of a bioeconomy that benefits marginalised local populations. In Chapter 7, María Teresa Pulido Silva and Daniela Ortega Meza review more than two decades of official NTFP statistics in Mexico and find that the official reporting system needs revision, as does the approach to the bioeconomy, needing to pay more attention to issues of poverty alleviation, resource sustainability, and secondary processing. Lastly, in Chapter 8, Jude Kimengsi and co-workers provide empirical insight into the forest-based bioeconomy of Cameroon, focusing on bush mango, rattan, and bamboo, identifying challenges linked to the NTFP-based bioeconomy transitioning.

Theme 2 contains four studies examining how to facilitate the transition to an NTFP inclusive bioeconomy. In Chapter 9, Mi Sun Park and Hansol Lee use the case of wild-simulated forest-grown ginseng in South Korea to

identify a three-phased activity-based pathway to revitalise the ginseng industry and transit to a forest-based bioeconomy, focusing on developing a stable production system, improving value chains and export conditions, and supporting the development of the ginseng biotechnology-based industry. In Chapter 10, Dietrich Darr and co-authors examine the production, processing, and commercialisation of baobab in East Africa, focusing on how innovative bio-based products, the principles of cascading use, renewable energy, and the circularity of nutrients constitute pathways to move toward the forest-based bioeconomy. In Chapter 11, Meenakshi Piplani and Carsten Smith-Hall present a framework for analysing the transitioning to the forest-based bioeconomy and apply it to the case of commercial medicinal plants in Nepal, identifying four bioeconomic transition pathways: cultivation, decentralised resource management, developing the domestic processing industry, and establishing regional collaboration. The theme ends with Chapter 12, where Sandra Sharry, Patricia Boeri, and Natalia Raffaelli provide a specific example of the process of integrating NTFPs into the Argentinean bioeconomy at the national and sub-national levels.

Theme 3 presents three examples of tools and technologies that can assist in a forest-based bioeconomy transition. In Chapter 13, Michelle Balasso and co-authors integrate the concepts and principles of forest management, NTFPs, and the bioeconomy, arguing that the transition can be facilitated through combining silvicultural management of non-timber and timber species with the use of governance mechanisms that consider socio-economic and legislative actions. In Chapter 14, Verónica Loewe-Muñoz and Claudia Delard investigate the economics of stone pine nut production under different management schemes in Chile, arguing that cultivation incentives and fostering stakeholder involvement to reach a critical production area and volumes, supported by science-based technological innovation, facilitate the transition to a bioeconomy. Lastly, in Chapter 15, Rainer Peltola and co-authors show how citizen science and GIS-based approaches and tools can be combined and applied to increase the production of wild berries and strengthen the integration of NTFPs into the Finnish bioeconomy.

Key messages for the bioeconomy and NTFPs

- Integrating NTFPs into the bioeconomy presents opportunities to make their values more visible, reinvent thinking and approaches in the forest sector, and increase forests' contributions to global challenges like biodiversity conservation and poverty eradication.
- These opportunities have not been realised. Characterising, defining, and developing the forest-based bioeconomy concept is still emerging, and there is almost no consideration of the bioeconomic role of NTFPs.
- The potential of a (forest-based) bioeconomy goes beyond the current dominant emphasis on biotechnology and the geographical limitation to northern and western Europe.

- This book provides the first global approach to thinking about and integrating NTFPs into a forest-based bioeconomy. Based on a diversity of studies, it covers and integrates the assessment of bioeconomy resources and strategies, identifies and describes bioeconomic transition pathways, and presents tools and technologies to assist transitions.

Note

The findings and conclusions in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

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