

ANALYSIS OF BIOECONOMY DEVELOPMENT IN FINLAND

Thi Quynh Nhi TRAN, Vytautas Magnus University, Agriculture Academy, Faculty of Bioeconomy Development, email: thi.quynh.nhi.tran@vdu.lt

Abstract

As countries strive to address global challenges, the concept of bioeconomy has become one of the central themes as an alternative to the traditional fossil-based economy. This article provides an overview of the bioeconomy, focusing mainly on three main sectors: primary production, fully-biobased manufacturing, and partly-biobased manufacturing. By using the quantitative method, EUROSTAT statistical data synthesis and policy analysis, the structure of the bioeconomy in Finland is analysed based on the gross value added (GVA) indicators of each sector. The result shows that forestry and bio-based industries play a dominant role in the value added of Finland's bioeconomy. The analysis indicates that Finland's bioeconomy has transitioned from higher volume to higher value added in alignment with Finland's carbon-neutrality goal by determining four main strategic pillars. The conclusions emphasize the importance of multi-ministry cooperation and regional plans for the long-term bioeconomic goals of Finland.

Keywords: bioeconomy, Finland, gross value added, primary production, biobased manufacturing, policy.

Introduction

The rising concern of environmental issues has brought the concept of bioeconomy to be an important part of policy frameworks across European countries. As countries invest in innovative solutions and projects to reduce the reliance on fossil-based resources and minimize the impact of climate change, the bioeconomy paves the way for renewable biological resources, and advanced biological technology to pursue sustainable economic growth. Finland is one of the most evident examples of a developed bioeconomy, combining the effective utilization of biological resources to create high-quality products, and the investigation in advanced bio-based industries with a strong commitment to sustainability. With the continuing progress of bioeconomy development, there is a need for a deeper understanding of the contributions of bioeconomy sectors to the GVA indicators and the effectiveness of the national policy frameworks.

The aim of this paper is to identify the sectoral contributions within Finland's bioeconomy with the focus on the interaction between main bioeconomy sectors, the impact of biological resources, and the strategy mechanisms. The following objectives have been set to achieve the aim:

1. To assess the performance and trends of the main bioeconomy sectors in Finland;
2. To evaluate the effect of policy frameworks in the context of Finland's bioeconomy development.

Research object and methods

The object of this research is the structure and development of the bioeconomy in Finland based on a strong emphasis on the main sector's contributions. To achieve the research objectives, the quantitative method is applied by analysing the synthesis of statistical data obtained from EUROSTAT, which focuses on the GVA indicators for each sector in Finland's bioeconomy. In addition, policy review is used to figure out the main strategy within Finland's broader strategic framework for bioeconomy development.

Research results and discussion

Contemporary economic systems are continually shaped by the need to lessen environmental impact without cutting down the economic outputs, hence limiting the economic growth. Within the context of European countries, the bioeconomy has emerged as a strategic development model that make efficient use of biological resources, research and industrial foundation to "decarbonize" European economy and "replace fossil-based materials and products" (European Commission, 2025).

According to recent research, the bioeconomy is understood as a concept that rests on environmental, economic, social and governance dimensions, integrating biological resources, knowledge, technologies and practices to deliver sustainable value across multiple sectors (Warchold, Jing Li & Prajal Pradhan, 2025). The bioeconomy comprises activities that deliver sustainable solutions based on biological resources to create added value in products, services and technologies across sectors from agriculture to biomanufacturing (2025 EU Bioeconomy Strategy). The bioeconomy can be understood

as a component of sustainable development, interpreted through its environmental, economic, social and governance dimensions (Faulkner, Murphy, Scott, 2024).

Another comprehensive typology of bioeconomy concepts proposed by Birner (2018) defines bioeconomy as an “integrated economic system” based on the integration of three strands, namely biotechnology, bio-resources, and bio-ecology. In other words, bioeconomy is an economic system that makes use of renewable biological resources “from land and sea” to replace “fossil-based inputs” by the application of modern biotechnology. Within a strategic management perspective, Ahenkora (2025) describes bioeconomy as a combination between traditional sectors and “related processing and service industries”, and also emphasizes that sustainability is not inherent in the bioeconomy, but the bioeconomy itself has to prioritise sustainability to “contribute to sustainable development”.

The bioeconomy encompasses the economic activities that make use of biological materials to “create added value” by delivering sustainable solutions (European Commission, 2025). The bioeconomy sectors are classified into three types of economic activities: “biomass production sectors”, “fully (100 percent) bio-based manufacturing sectors, processing biomass to higher added value products”, and “partly (less than 100 percent) bio-based manufacturing sectors, where biomass is used as a part of materials” (Ministry of Economy and Innovation of the Republic of Lithuania, 2020).

Table 1. Classification of bioeconomy sectors

Sectors	Description
Biomass production (Primary production)	Agriculture
	Forestry
	Fisheries
Fully bio-based manufacturing	Manufacture of food, beverages, and tobacco
	Manufacture of wood, cork, and their products, except for furniture
	Manufacture of paper and its products
	Manufacture of leather and related products
Partly bio-based manufacturing	Manufacture of textiles and apparel
	Manufacture of chemicals and chemical products
	Manufacture of pharmaceuticals
	Manufacture of rubber and plastic products
	Manufacture of furniture and other bio-based manufacturing

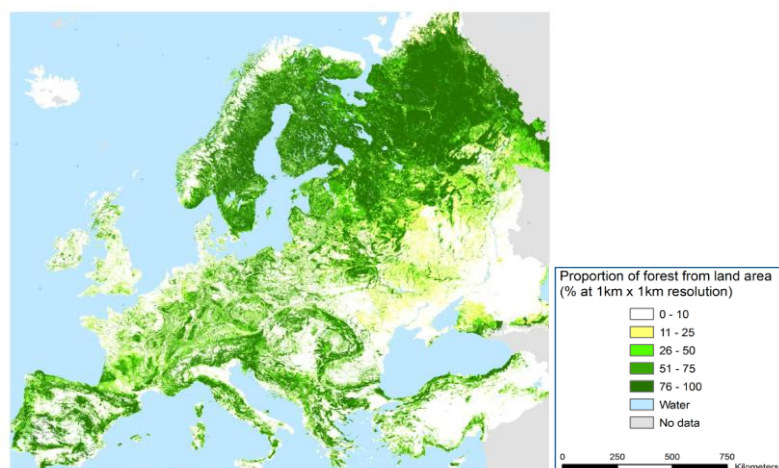
The ability to adapt and develop of each country is reflected in the diverse sectors of bioeconomy based on the abundance of natural resources and the specific policy frameworks. Among European countries, Finland stands out by utilizing effectively its rich forest resources, and commitment to sustainable development so as to establish a distinctive and advanced bioeconomy system.

To have a clearer understanding of the symbolic significance of Finland’s bioeconomy, it is necessary to examine the contribution of the mentioned three sectors in terms of GVA by analysing data from EUROSTAT. The contribution of biomass production (primary production) sectors is shown in table 2.

Table 2. GVA of primary production sectors in Finland by million euros

Production sector	2015	2016	2017	2018	2019	2020	2021	2022	Share of 2022	Dynamics 2022 with 2015
Agriculture	73	72	70	69	68	66	65	64	2	88
Forestry & logging	3069	3155	3238	3516	3541	3474	3577	3880	94	126
Fishing & aquaculture	111	117	130	119	115	126	135	163	4	147
Primary production totally	3253	3344	3438	3704	3724	3666	3777	4107	100	126

The primary production sectors added from 3.2 billion to 4.1 billion euros, increasing significantly at 26% within 8 years. It can be seen that forestry and logging nearly dominate the GVA of primary production sectors, representing 94% of total primary production in 2022. Although fishing and aquaculture only contributes 4%, it experiences the greatest growth at 147% compared to its level in 2015. Agriculture represents only 2% of total primary production in 2022, with a slight decrease over time. These numbers show that Finland’s bioeconomy is clearly forestry-based. Fishing and aquaculture show expanding potential, whereas agriculture is just a small-scale industry. The reason why forestry and logging reach the highest proportion among these three production sectors is mainly explained by the role of geographical features in shaping Finland’s bioeconomy. According to Finland’s Ministry of Agriculture and Forestry (2023), forests cover more than 75% of Finland’s land area. This feature directs Finland’s bioeconomy toward forest-based industries. The potential of forestry-based production through the advantage of geographical features is shown in the map proposed by Kempeneers et al. (2011) indicates the high forest density in Finland, especially northern Finland.



Source: According to Kempeneers et al. (2011)

Fig. 1. Map showing the proportion of forest from land area in Europe

In addition, the role of agriculture in Finland's bioeconomy is limited because of the cold temperatures and night frost in both early and late summer, which shorten the growing season (Food and Agriculture Organization of the United Nations, n.d.). Another reason is the low precipitation during the growing period, around 370 mm in southern Finland and around 260 mm in northern Finland (United Nations Framework Convention on Climate Change, 2017). The contribution of bio-based (both fully and partly) manufacturing sectors is shown in table 3.

Table 3. GVA of bio-based manufacturing sectors in Finland in million euros

Manufacturing sector	2015	2016	2017	2018	2019	2020	2021	2022	Dynamics 2022 with 2015
Food products; beverages & tobacco products	2.630	2.592	2.728	2.751	2.868	2.959	2.925	2.793	106
Textiles, wearing apparel, leather & related products	391	415	419	415	402	424	451	448	115
Paper and paper products	3.131	3.117	3.290	3.633	3.362	2.613	3.276	3.377	108
Rubber & plastic products	1.023	1.062	1.071	1.078	1.073	1.054	1.117	1.063	104
Bio-based manufacturing totally	7.175	7.186	7.508	7.877	7.705	7.050	7.769	7.681	107

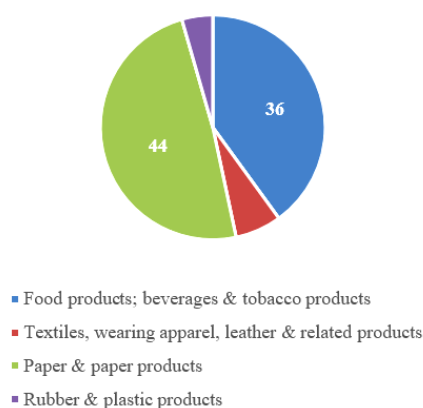
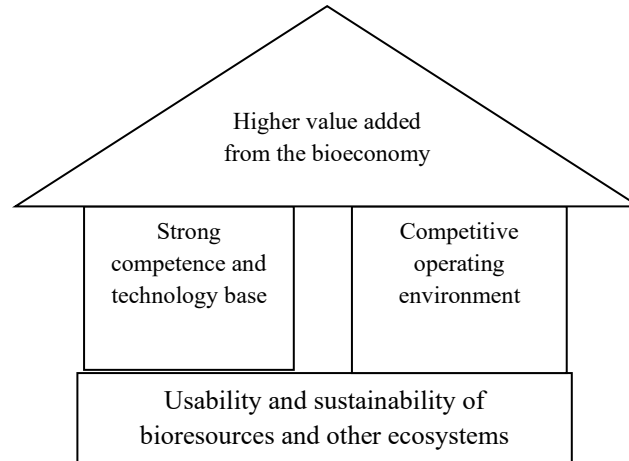


Fig. 2. Share of GVA of bio-based manufacturing sectors in Finland in 2022 by %

The data show that the GVA of Finland's bio-based manufacturing sector remained stable between 7.1 and 7.8 billion euros from 2015 to 2022. Paper and paper products gain the highest percentage of GVA contribution regarding bio-based manufacturing sectors in 2022 at 44%, reflecting Finland's strength in forestry and wood processing. Food, beverages, and tobacco products account for 36% and show a stable contribution. Rubber and plastic products contribute 14% of the total GVA percentage in 2022, leaving Textiles, leather, and apparel with only 6% of GVA contribution. These numbers show that the GVA of fully bio-based manufacturing sectors in Finland outweighs that of partly bio-based manufacturing sectors. Finland's bio-based manufacturing relies mainly on forestry-based industries, followed by food processing ones, whereas plastic-related industries provide complementary contributions.

Main bioeconomy strategy

The statistical result of GVA contribution not only indicates the current well-developed bioeconomy of Finland but also shows the effectiveness of the country's strategic significance. It is expected to reach a 50 billion euro value added by 2035 and align with Finland's carbon-neutrality goal (Finnish Government, 2022). The strategic vision has been decided to be "sustainably towards higher value added", which, in other words, means that Finland's bioeconomy has changed from expanding the volume of products to improving their value based on four main strategic pillars (Finnish Government, 2022).



Source: Finnish Government (2022)

Fig. 3. Strategic pillars of Finland's National Bioeconomy Strategy.

Finland has identified that the foundation of its bioeconomy is to make an efficient and sustainable use of biological resources. As mentioned, Finland has great potential in forest-based industries thanks to its abundant forestry resources. If Finland fails to use these resources wisely, there will be significant risks regarding the loss of biodiversity, and forestry over-exploitation. Therefore, to maintain this advantage, the most important task is to ensure sustainable harvesting and biodiversity protection, along with applying circular economy principles.

When it is enabled to balance between exploitation and preservation, Finland will make their way to enhance the value of products by "strong competence and technology base". This strategy emphasizes the great investment and priorities in not only research and development (R&D) by developing the educational programs to "train bioeconomy experts" and "creating preconditions for bioeconomy through research" (Finnish Ministry of Employment and Economy, 2014), but also advanced technology ability, such as biorefinery, and new biomaterials. If it is a success, these technologies will allow Finland to maintain its global competitive advantage in luxury bio-based products. Needless to say, it is also necessary to have effective risk and business model management, along with international cooperation, since this technology campaign also comes along with the risk of high cost or low speed of transformation.

Another main pillar is to provide a "competitive operating environment" by "ecosystem services commercialization", supporting small and medium enterprises (SMEs), strengthening regional bioeconomy action plans, as well as reducing regulatory barriers (Finnish Government, 2022). Building from the insights, encouraging regional bioeconomy actions is especially reasonable because each region has different biomass potential, hence the regional motif helps each region to make the best use of what they have to build sustainability. In addition, prioritizing SMEs promotes the diversification of the products' value chain by creating new biomaterials or products. The concern over this pillar is whether the implementation mechanisms are enough to manage the regional equality if richer regions are facilitated to develop faster, whereas poorer regions are left behind. To handle this concern, the strategy is implemented through a national steering group where multi-ministry cooperation ensures coherence and cross-sector alignment, thereby continuously updating the regional equality to avoid overlaps or policy conflicts.

Conclusions

1. The analysis confirms that the primary production and bio-based manufacturing sectors, particularly forestry and forestry-based industries, are the main contributors to the GVA of Finland's bioeconomy. This result reflects the advantages of natural resources and the industrial capacity of Finland.

2. It is clearly witnessed that there is a significant transition from high-volume and low value-added production to that of higher value-added within Finland's bioeconomy. This transition aligns with the goals of national carbon neutrality and the strategic pillars listed in the main bioeconomy strategy of Finland.

3. The paper indicates that the effectiveness of policy frameworks in Finland's bioeconomy depends on the main implementation mechanisms, such as strong coordination among ministries and the integration of regional plans. These mechanisms are crucial to achieving sustainable development and competitiveness in bioeconomy sectors.

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