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Forest Bioeconomy from the Perspectives of Different EU Countries and Its Potential for Measuring Sustainability

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Abstract: The globally accepted concept of a bioeconomy includes the field of forestry; however, the concept of a forest bioeconomy (FBE) does not appear to be defined uniformly. The concepts of bioeconomy and sustainable development are interlinked. In many countries, the bioeconomy is often the subject of efforts to quantify it from the state level, and therefore, the question arises as to whether the data regarding the financial support of an FBE in individual countries can be considered mutually comparable, with the aim of including them, for example, among the criteria for measuring sustainability (e.g., indicators of sustainable development—SDI). This option has political implications for political representation, taking the form of a comparable indicator in the approaches of individual states. This article analytically compares FBEs and our understanding of them in selected countries: Czechia, Slovakia, Finland, Italy, and Germany. Czechia financially supports various areas of forestry through European funds (Rural Development Programme, RDP CZ). In this article, we assess this support from the point of view of the perceptions of the FBE in the studied states, with an emphasis on the view of Czechia. First, an FBE analysis of the selected official and supporting documents of the studied countries was performed. The total financial data from the supported projects from the RDP CZ were subsequently assigned to these areas. Thus, the idea of financial support for the FBE through the RDP CZ from the perspectives of the selected countries was born. The differences in the perception of the FBE according to the description derived from the analysis were also confirmed by the different financial quantifications (hypothetical) of these different views. The obtained results demonstrate an incomparable state of perception of the FBE among the selected countries. For these reasons, it is currently inappropriate to use the level of FBE financial support to measure sustainability.

Keywords: bioeconomy; financial subsidies; forest policy; forestry; Rural Development Programme



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1. Introduction

The concept of a bioeconomy is currently being widely discussed and assessed at the national and regional levels in individual countries and not only at the level of the European Union (EU) [1–7]. However, the definition of a bioeconomy is not entirely uniform (due to regional, political, and other differences) [8]. The concept of a bioeconomy represents an opportunity to solve current natural and social challenges, such as climate change, the lack of natural resources, dysfunctional patterns of consumer–supplier relations [9] and, in essence, the crisis caused by the high degree of globalisation. According to Bugge et al. [10], the bioeconomy represents a new trend representing a view of economic relationships from a broader perspective, including several sectors (from the chemical industry and healthcare to bioenergy, agriculture, and forestry). With the growing importance and financial support of the bioeconomy, it is becoming a guiding concept for a large proportion of economic and social development worldwide. In this way, the ethical, political, and sociological dimensions of this issue are also gaining emphasis [11,12].

The use of renewable resources creates opportunities for many industries to replace fossil resources and foster changes in economic production [13]. The bioeconomy involves the transition from the use of fossil resources to the production of renewable biomass and the conversion of this biomass into food, feed, energy, biofuels, and downstream products [14,15]. The European Union (EU) has adopted a relatively clear approach to the bioeconomy. Since 2012, the EU Bioeconomy Strategy has been an official part of EU policy [16]. The key pillars of this policy are the support for research and development through the EU financial framework, research, and innovation programmes (FP7, Horizon 2020, and Horizon Europe) and the establishment of institutions and bodies for the discussion and funding of the bioeconomy in Europe, e.g., the Knowledge Centre for Bioeconomy [17]. An updated bioeconomy strategy was presented in 2018, and the European Commission (EC) outlined the direction that this policy area should adopt in the future [18].

There are large differences in approaches to the bioeconomy between EU countries [19]. As of 30 April 2022, a total of 12 EU countries had adopted a separate strategic document on the bioeconomy, developing a clearly defined approach to the bioeconomy concept. Finland was among the first countries to do this (2014, replaced by a new one in 2022), followed by Spain (2016), Lithuania (2017), Latvia (2017), France (2017), Italy (2019), Germany (2020), and others [20]. However, not every country has adopted a separate strategic document describing the goals and ambitions for the country's bioeconomy, including Czechia and Slovakia. These countries have mentioned the topic of a bioeconomy in several documents of various degrees of strategic importance [21]. In any case, despite the individual views and definitional approaches to the bioeconomy, they agree that the forestry sector is an important part of it. The forest bioeconomy (FBE) has no commonly agreed-upon definition and plays different roles in different EU countries [17]. National discourses, in general, indicate a re-approach to the bioeconomy [22]. Some traditional forestry discourses were reformulated in the context of the bioeconomy [23]. Today, there is a significantly greater focus on innovation in forestry technologies (without a single goal of profit) and the creation of a wood biomass in the context of climate change (i.e., with a decline in the use of wood as a fuel). Although forestry is an integral part of the bioeconomy, the forestry sector is still not a major player in national bioeconomy strategies, and the topic of forest functions does not appear in the prevailing public discourses [24]. However, it is supposed that the forest sector should play a stronger role in national bioeconomy concepts, because pressure influencing forest policy is increasing at the EU level.

Taking the bioeconomy as a whole, the FBE context can be understood as the use of forests to achieve economic transition, i.e., the creation of products and services that help economies to replace fossil-fuel-based raw materials, products, and services [25]. Specific examples of the transition from traditional forestry to an FBE include the use of biomass fuel to replace oil or coal and wood-based materials to replace oil-based plastics, concrete, and steel in products and structures [26], together with an increasing emphasis on other forest ecosystem services (tourism, recreation, biodiversity, etc.). The FBE is reflected in the entire forestry value chain from the management and use of natural resources to the supply of forestry products and services.

Thus, the bioeconomy (as in the case of the FBE) has significant political overlap. According to [27], in addition to being a science and technology project responding to global climate change, food security, and health, the bioeconomy is also a neoliberal political project serving to improve national competitiveness. This concept is applied in practice in different ways. It serves political players in the preparation of strategies and the resulting public support financial programmes (subsidy policies), and it is also a concept addressed in the field of research. Everything can apply to the FBE. An analysis by Lovrić et al. [28] showed that the overall level of finance flowing into the FBE is increasing, but the rate of growth does not match the potential suggested by bioeconomy research. The centralisation of the topic of the bioeconomy in selected European regions is also evident from the results of the review article in [29].

The mutual relationship between the concept of sustainability and the transition to the bioeconomy has already been investigated in the scientific literature. The current literature repeatedly emphasises the great potential of the bioeconomy to fulfil the principles of sustainability but, at the same time, points out that its implementation is impeded by significant obstacles. Some researchers claim that the main cause of the problem is the dependence on economic and political development, which arose even before the discovery of the concept of a bioeconomy [30]. An overview of the opportunities, driving factors, challenges, and barriers is presented in the articles of D'Adamo et al. [31], Salvador et al. [32], and others.

Interest in sustainability in regard to both production and consumption has prompted the need for regulation in the transition to a sustainable economy based on the use of renewable biological resources. For example, an approach that takes technological aspects into account was investigated by Moktadir et al. [33]. Sanz-Hernández et al. [34], on the contrary, emphasised the social aspect. The transition towards sustainable bioeconomic models is impossible without the inclusion of a social perspective, the involvement of stakeholders, and the social acceptance of the socio-technical changes that accompany the transition to a bioeconomy.

The concept of sustainable development corresponds to the complex character of the (forest) bioeconomy, with its national and regional diversity, and provides opportunities to achieve and sustain economic growth [35]. For example, the view on sustainability and the bioeconomy from a regional perspective was studied by Ayrapetyan et al. [36], who demonstrated the role of regional-level bio-clusters in the transition to bioeconomy principles. According to their findings, the question of sustainability is understood as part of this path towards transition rather than as a goal in itself. Moreover, the role of forestry has already been explored. Some of the forestry products have undergone significant changes in recent years. At the same time, new materials and technologies are emerging that aim to add value to wood products, reduce the carbon and water footprints of products and processes, reduce pollution and waste generation, and improve circulation. This approach, applying the principles of the bioeconomy, yields positive results, helping us to achieve sustainability [37–39].

However, the combination of these two concepts is a complex challenge that still raises many questions, even at the EU level [40]. Moreover, Ramcilovic-Suominen and Pülzl [41] mentioned that because they are broadly defined, these concepts allow different actors to fulfil their related obligations without necessarily making significant changes to their existing documents on policy making. The achievement of sustainable development goals (SDGs) [42] is most often assessed using a set of indicators. Calicioglu and Bogdanski [43] argued that it may be possible to report on SDGs and use them for bioeconomy reports at the same time, especially in the case of SDGs related to economic development, biodiversity conservation, waste reuse, etc. Although there are several sets of indicators (e.g., the World Bank's indicator set, which contains 358 items), direct indicators related to the (forest) bioeconomy exist neither among the principal indicators [44] nor in the complete set. Even though the EU Bioeconomy Strategy refers to the SDGs several times, the same applies to the forest indicator set in that the linkages between the FBE and SDGs are not clear [45,46]. However, there are indicators based on the amount or share of investments (from public budgets) and their relationship with environmental protection. One of the policy measures that, among others, is increasingly used to motivate sustainable behaviour is subsidies, which are financial contributions provided to individuals and businesses under pre-defined conditions [47].

Traditional economic theory and political analysis assume that subsidies in agriculture (and forestry) distort the market, reduce productivity, and are not effective. However, theoretical and empirical studies have shown that this is not always the case. Financial subsidies can increase the productivity in this sector in the event of market imperfections [48,49]. Subsidies are effective if they influence the behaviour of entities (individuals and businesses) according to the conditions of the subsidy. On the contrary, subsidies

are ineffective if they are provided to entities that would act in the same way without the subsidy, i.e., the subsidies do not motivate them to change their behaviour [50]. In addition, the study performed by Zilberman et al. [51] showed that measures leading to the correction of market failure could be used to achieve sustainable development precisely due to the emphasis on the bioeconomy (the enhancement of conservation, recycling, and use of renewable resources), which relies on biological processes and raw materials used for production processes. The financial aspects of the bioeconomy and their possible forms of measurement are also the subject of some studies [52–54].

Practical support for forestry within the EU is diversified at the national level and includes support from European funds. Moreover, one of the priority areas of the EU's rural development policy is forestry. Sustainable forest management is key to several national and regional rural development programmes. The co-financing of forestry measures under the Rural Development Regulation represents the main means of EU-level funding for sustainable forest management, forest protection, and the delivery of ecosystem services [55]. The main source of funding for the forestry sector is the European Agricultural Fund for Rural Development (EAFRD). Its funds have been distributed at the national level through the National Rural Development Programmes (RDP).

The logical question, therefore, arises as to whether the amount of support from public budgets aiming to support the forest bioeconomy is comparable between countries and whether the subsequently provided data could be used, for example, as one of the indicators for measuring sustainability (e.g., one of the indicators of sustainable development (SDIs)). The aim of this article is to answer this question with the help of the following research sub-questions:

- RQ1: Is the forest bioeconomy defined in the same way in the studied countries?
- RQ2: Is it possible to consider the support provided through the Rural Development Programme (RDP CZ 2014–2020) as supporting the forest bioeconomy in Czechia?
- RQ3: Will the amount of support change after considering the specific national definitions of the forest bioeconomy?

The analysis was performed using the example of Czechia (and its RDP CZ 2014–2020), and the actual situation was compared with those of the other selected EU countries.

The main goal of the present article is to examine whether the declared financial support of the forest bioeconomy on the level of the individual states is mutually comparable. Another goal is to determine whether the presented data can be used, for example, to measure sustainability. The practical application of our findings is that they could be used to provide possible guidance for political representation, i.e., representatives of the public sector, and to address the question of whether the financial support of the FBE can be used across states, e.g., as an indicator measuring sustainability. It should be noted that, in the private sector, the topic of sustainability has also been discussed [56,57].

2. Materials and Methods

Several methodological approaches are used in this article. In the first phase, an analysis of the strategic and other documents of the selected EU countries that are related to the (forest) bioeconomy was performed. Based on their factual analysis, we evaluated whether the FBE is understood in the same way in the studied countries, or whether there are national specifics. All factors were reflected in the subsequent comparison of the FBE support. The studied documents (official national-level documents) and articles were selected based on their relationships with the topic of the (forest) bioeconomy.

Secondly, the level of support for the FBE in Czechia, based on the analysis of the comprehensive data regarding the projects supported by the RDP CZ 2014–2020, was evaluated. The data on the projects were obtained from the provider of financial support from the RDP CZ 2014–2020, i.e., from the Ministry of Agriculture (MoA), and studied. These are internal project data that the MoA provides upon request.

The level of financial support was then compared with the specific understanding of the FBE and its support in the selected countries, and we evaluated whether the level of

support would change. The results of the RDP CZ 2014–2020 analysis were finally presented in the form of an in-depth interview with an official representative of the managing authority of the RDP CZ, the Ministry of Agriculture of Czechia (MoA).

2.1. Forest Bioeconomy in Selected EU Countries

The following countries were selected for comparison with the situation in Czechia: Finland, Germany, Italy, and Slovakia. These countries were chosen for several different reasons. Slovakia is a country with a historical development and approach to forestry similar to Czechia (they formed a common state until 31 December 1992). The other countries were selected based on the search presented in the Introduction, which were identified as leaders within the EU in terms of the sophistication of their respective bioeconomy strategies. Finland and Italy were chosen due to their totally different forestry situations and, simultaneously, because the concept of a bioeconomy of both countries is often perceived as the best practice. Additionally, the two countries were among the first in the EU to adopt their own bioeconomic strategies. The search showed that Germany is a leader in forestry and forestry policy in Central Europe. Contemporary Czech forestry has common historical roots with German forestry. For the countries in which a (forest) bioeconomy strategy is being developed, these documents were considered essential. For the countries in which such a strategy has not been developed, the documents being closest to this issue were evaluated. In addition, in many cases, important scientific publications addressing this issue were considered. Specifically, the analysis was based on the following documents:

- Czechia: The concept of the bioeconomy in Czechia from the perspective of the MoA for 2019–2024 [58]; Strategic framework of the circular economy of Czechia 2040 [59]; The concept of state forest policy until 2035 [60]; The concept of the MoA for the economic policy of the Forests of Czechia, State Enterprise [61]; and the publication BIO HUB CZ [62].
- Italy: BIT II—Bioeconomy in Italy [63] and Falcone et al. [64].
- Finland: Finnish Bioeconomy Strategy for 2022–2035 [65] and Korhonen et al. [66].
- Germany: National Bioeconomy Strategy [67], Purwestri et al. [8], and Giurca and Späth [68].
- Slovakia: Low-carbon development strategy of Slovakia until 2030 with an outlook to 2050 [69]; Draft of integrated national energy and climate plan for 2021–2030 [70]; Bioeconomy case study: The wood biomass sustainability criteria in Slovakia [71]; Strategy for bioeconomy in Slovakia—The contribution of the Slovak bioeconomy to the strategic plan SPP 2021–2027 report [72]; and Navrátilová et al. [73,74].

The above-mentioned documents were selected according to their degree of relevance to the topic of the bioeconomy [75,76]. For the countries that have their own strategy, the main source was the relevant official strategy. For the countries without a specific strategy, documents closely related to the field of the bioeconomy, the use of natural resources (both explicitly and implicitly), etc., were used for the analysis [77]. For the given countries, scientific publications focusing on the bioeconomy in the given country were also used.

A qualitative content analysis was performed based on the above-mentioned documents. During the analysis, we identified and searched for topics and concepts related to the FBE. Subsequently, the topics we identified were subjected to a detailed content assessment. The assessed documents were analysed in English and, in some cases, in Czech (in the case of the Czech documents) and Slovak (in the case of the Slovak documents). These were always the official versions of the documents.

To compare the FBEs in the studied countries, the basic areas that are essential for the FBEs in these countries were defined (Table 1). These categories were selected according to whether or not they are at least partially reflected in the supported forestry activities of the RDP CZ 2014–2020. Simultaneously, the category that can be perceived as at least on the borderline of the FBE and other related timber sectors (production and wood products) was considered. This category was accepted due to its partial support through the RDP CZ. The basic categories were subsequently diversified into subcategories (listed

in the Results chapter). Some categories may theoretically overlap. This is how they were defined, according to their explicit listing in the examined documents. The comparison was conducted only based on the presence or absence of the area in the analysed documents.

Table 1. Categories including the concept of the FBE.

Wood (forest biomass) as a forest product
Non-productive (ecosystem) forest functions
Mitigation of climate change impacts
Utilisation of forest production waste
Research and education in forestry
New technologies (digitisation, information, and communication technology (ICT), etc.)
Sustainable development (closer-to-nature forestry) with an emphasis on biodiversity
Economic aspect of forestry
Production of wood/wood-based products

2.2. Rural Development Programme 2014–2020 Analysis

The basic source for the information used for the factual (e.g., content) analysis was the programme document RDP CZ 2014–2020 [78], available on the MoA website, issued in 2015 in Prague in the form of the 9th updated version, dated 28 June 2021. Data on the applications of the support from the RDP CZ obtained from the MoA through an official request were used for the financial analysis. The received data were current as of 30 April 2022 and provide complete information on each of the funded projects. In total, there were 2462 unique projects across all types of operations and programme calls (from the period of 2015–30 April 2022). All the projects for which at least one application for payment was reimbursed by the national intermediate body (the State Agricultural and Intervention Fund) were evaluated. Two types of data were considered for each project: text and numerical. The text data included:

- (a) The project name;
- (b) The project description;
- (c) The project results.

In light of this, it was possible to categorise the projects according to their focus, i.e., the topic for which the support was intended. The numerical data included information on the financial requirements and demands of the individual projects. These were:

- (a) The total expenditure of the project;
- (b) The subsidy amount approved—EU;
- (c) The subsidy amount approved—national resources;
- (d) The subsidy amount approved—total.

2.3. Summary Analysis

Using the synthesis of the outputs of the above-mentioned steps, a final evaluation was performed. We compared the substantive focuses of the individual FBE categories of the supported projects with the characteristics of the FBE from the selected countries' points of view. This means that the support from the RDP CZ was alternatively evaluated from the points of view of the various analysed national understandings of the FBE. The purpose of this comparison was to show whether the reports on FBE funding are universal and comparable between countries or whether these national reports are incompatible with each other.

The obtained results were then personally discussed with the official representative of the MoA. The qualitative interview was conducted with the expert who had the opportunity to influence the focus of the financial support. It took place on 13 June 2022 and lasted for approximately one hour. The outputs of this interview were processed in the form of

notes by the authors of the article. The aim was to determine whether the MoA considers the provided financial support as support of the FBE. The questions asked focused on two areas. The aim of the first area was to verify and supplement the information derived from the analysis of the Czech approach to the FBE, and the second aim was to describe the focus of the RDP CZ forestry support in the context of the FBE.

3. Results

3.1. Forest Bioeconomy Analysis of the Studied Countries

An overview of the basic FBE categories, which are listed in the individual analysed background materials, is shown in the methodology depicted in Table 1. Next, Table 2 shows a more detailed breakdown of the categories into individual subcategories. If the table shows YES, this means that the support of the given subcategory as part of the FBE is evident from the bioeconomy strategy or another document. If “×” is used, this means that the given parameter was not mentioned in the studied documents as part of the FBE.

Table 2. Categories and subcategories of the FBE in the selected countries.

	Italy	Finland	Czechia	Slovakia	Germany
Wood (forest biomass) as a forest product	YES	YES	YES	YES	NO
Wood—the main renewable resource (renewable forest biomass) and its availability	yes	yes	yes	yes	×
Support of bioenergy, efficient use of forest biomass for energy production	yes	yes	yes	yes	×
Support of high demands for solid fuels from biomass, bioenergy, and other innovations (e.g., in construction)	yes	×	×	×	×
Support of fast-growing crops	×	×	yes	×	×
Classification of wood as a strategic commodity of the state	×	×	yes	×	×
Non-productive (ecosystem) forest functions	YES	YES	YES	NO	YES
Support and development of non-productive (ecosystem) forest functions	yes	yes	yes	×	yes
Higher use of non-wood production forest functions (mushrooms, berries, cork, etc.)	yes	×	×	×	×
Supporting the emergence of new opportunities and new business models based on the valuation of ecosystem services	×	×	yes	×	×
Mitigation of climate change impacts	YES	YES	YES	YES	YES
Climate smart forestry	yes	×	×	×	×
Reducing greenhouse gas emissions	yes	yes	yes	yes	yes
Reducing the impact of expected global climate change and extreme weather events	×	×	yes	×	×
Utilisation of forest production waste	YES	NO	NO	NO	YES
Circular bioeconomy—e.g., the use of waste and residue in forestry	yes	×	×	×	yes
Diversification of farms and forests within a circular bioeconomy	yes	×	×	×	×
Research and education in forestry	YES	NO	YES	NO	NO
Support of educational programmes in forestry	yes	×	yes	×	×
Passing on good, traditional practices to young foresters and forestry entrepreneurs	yes	×	×	×	×
Creation of strategic materials in the field with a higher use of wood mass, wood research, and bioeconomy	×	×	yes	×	×
Strengthening the importance of research and innovation in forestry	×	×	yes	×	×

Table 2. Cont.

	Italy	Finland	Czechia	Slovakia	Germany
Support of research and technological development in order to increase the competitiveness of the forestry sector	×	×	yes	×	×
Greater use of a growing number of EU programmes and growing scientific and technological interest in forestry	yes	×	×	×	×
New technologies (digitisation, ICT, etc.) in forestry	NO	YES	YES	NO	YES
Use of ICT in logging	×	yes	×	×	×
Use of digital innovations (e.g., in breeding)	×	×	×	×	yes
Use of biotechnologies in forestry	×	×	yes	×	×
Sustainable development (closer-to-nature forestry) with an emphasis on biodiversity	YES	YES	YES	YES	YES
Establishment of mixed forests, semi-natural management of commercial forests, increasing the stability and vitality of forests	×	yes	yes	yes	yes
Sustainable water management in the forestry sector	×	yes	×	×	×
Preserve and increase biodiversity in forest ecosystems, their integrity and ecological stability, dead wood	×	×	yes	yes	×
Expanding the area of forest land	×	×	yes	×	×
Increasing emphasis on the achievement of the goals of sustainable development	yes	×	×	×	×
Economic aspect of forestry	YES	YES	YES	NO	NO
Maintaining and increasing the contribution of forestry and forests to rural development	yes	×	yes	×	×
Reduction in wood imports, increase in self-sufficiency	yes	×	×	×	×
Creating functional value chains and supply networks	yes	yes	yes	×	×
Certification support (PEFC, FSC)	yes	×	yes	×	×
Increase in the primary wood processing capacity, including other related fields	×	×	yes	×	×
Construction of infrastructure for access to remote forests	yes	×	×	×	×
Increasing the economic viability and competitiveness of sustainable forest management	×	×	yes	×	×
Production of wood/wood-based products	YES	YES	YES	NO	NO
Sustainable construction (use of wood), wooden buildings	yes	yes	×	×	×
Nanocellulose support	×	yes	×	×	×
Support of wood fibre packaging	×	yes	×	×	×
Support of biorefineries processing forest biomass	×	yes	×	×	×
A widespread culture of wood-related crafts	yes	×	×	×	×
Export of finished wood products (i.e., furniture, window frames, special paper)	yes	×	×	×	×
Development of innovative wood-based production, management, and services	yes	×	×	×	×
Development of new certified products, wood composite materials	yes	yes	yes	×	×

The documents that served as an information source for this table are presented in the Methodology Section 2 and are listed in the References.

From the above overview, it is clear that it is easier to identify a specific view of the FBE in countries that have their own strategies. There is one relevant strategy and, subsequently, there are the possible scientific outputs that expand and complement it.

Conversely, for countries that do not have a strategy, it is necessary to proceed with an analysis of several supporting documents, which mutually shape the image of the FBE in each country. The Czech example illustrates this effectively. Due to the fragmentation of the strategic documents, it is possible to include many steps and activities in the FBE, while it is not 100% certain whether they truly represent the FBE. Countries with an adopted bioeconomy strategy (Italy, Germany, Finland) have a clear definition of the measures aimed toward the FBE. In the case of Czechia and Slovakia, we can observe two different views. In Czechia, due to the fragmentation of the documents and their ambivalence, it is possible to perceive a wide range of activities (including research and education) among the FBE. On the contrary, in the case of Slovakia, it is difficult to identify intersections in most of the monitored subcategories based on the official documents. The concept of the FBE can be seen in the support of non-productive forest functions and sustainable forestry.

3.2. Factual Analysis of the Rural Development Programme 2014–2020

The entire RDP CZ 2014–2020 is divided into several categories, namely operations. These represent individual substantive areas to which financial support flows (agriculture, forestry, etc.). The operations relevant to this article, which are related to the support of forestry and offer the possibility of obtaining funds from the EU and national resources in the RDP CZ, are the following:

- 4.3.2 Forest infrastructure;
- 8.3.1 Introduction of preventive measures for forests;
- 8.4.1 Restoration of forest stands after calamities;
- 8.4.2 Elimination of damage caused by floods;
- 8.5.1 Investments in the protection of amelioration/strengthening trees;
- 8.5.2 Non-productive investments in forests;
- 8.5.3 Conversion of substitute tree stands;
- 8.6.1 Machinery and technology for forestry;
- 8.6.2 Technical equipment of wood processing plants;

The first seven items come from Regulation 1305/2013. Due to the possible inclusion of national priorities, support in the context of the RDP CZ also includes the opportunity to acquire investment in tangible assets and infrastructure. Through this, the support of competitiveness and environmental protection are linked at the state level. This is an area focused on forestry enterprises (specifically 8.6.1 and 8.6.2). As part of the above-mentioned operations, individual applicants submit their applications for financial support (projects).

3.3. Financial Analysis of the Rural Development Programme 2014–2020

Based on the text portion of the individual projects, it was possible to categorise the projects according to their focus, i.e., according to the topic for which the support was intended.

These were:

- The reconstruction and renewal of forest roads;
- Construction of new forest roads;
- Flood protection measures (includes projects on building and repairing retention reservoirs and water areas in the forest, watercourse repair, the stabilisation of ravines, remediation of slopes, biotechnical anti-erosion measures in the forests, the reconstruction of water structures and riverbeds, restoration and repair of stone dams, restoration of bridges, etc.);
- Restoration, reconstruction, and transformation of vegetation;
- Construction of fences (in order to protect amelioration/strengthening trees);
- Support of recreational forest functions (includes projects introducing barriers to direct forest visitors, the reconstruction and creation of sports trails and infrastructure, construction and reconstruction of hiking and nature trails, rest areas, and other visitor infrastructure, the construction and renovation of forest parks, etc.);
- Acquisition of machinery and technology for forestry;

- Acquisition of machinery and technology for the timber industry.

After the analysis of the text categories supported within the RDP CZ, the individual levels of the financial categories were determined for each category.

To facilitate the comparison, a conversion from CZK to EUR took place, and the exchange rate was that on 30 May 2022, according to the Czech National Bank (EUR 1 = CZK 24.710).

Table 3 shows the different categories of areas supported by the forestry parts of the RDP CZ. The column denoting the Total project expenditure includes support from the MoA and, at the same time, the amount of co-financing on the part of the subsidy recipient. The column Subsidy amount approved—EU contains the financial contribution from EU sources, while the column Subsidy amount approved—national sources contains the part that the state budget of Czechia will supplement for each project through the MoA. The column Subsidy amount approved—total contains the sum of the previous two values, and it is basically the part that is paid directly by the RDP CZ to the beneficiaries. Therefore, we perceive these values as essential for this article. The ratios of the reimbursed sources from the RDP CZ are shown in Figure 1.

From Figure 1, it is clear that the largest part of the RDP CZ “forestry budget” was intended for the reconstruction and renewal of forest roads and, subsequently, for the acquisition of machinery and technology designed for forestry. A significant part (almost one fifth) is also occupied by the restoration, reconstruction, and transformation of vegetation. The other categories are rather comparable (5% or less from the budget).

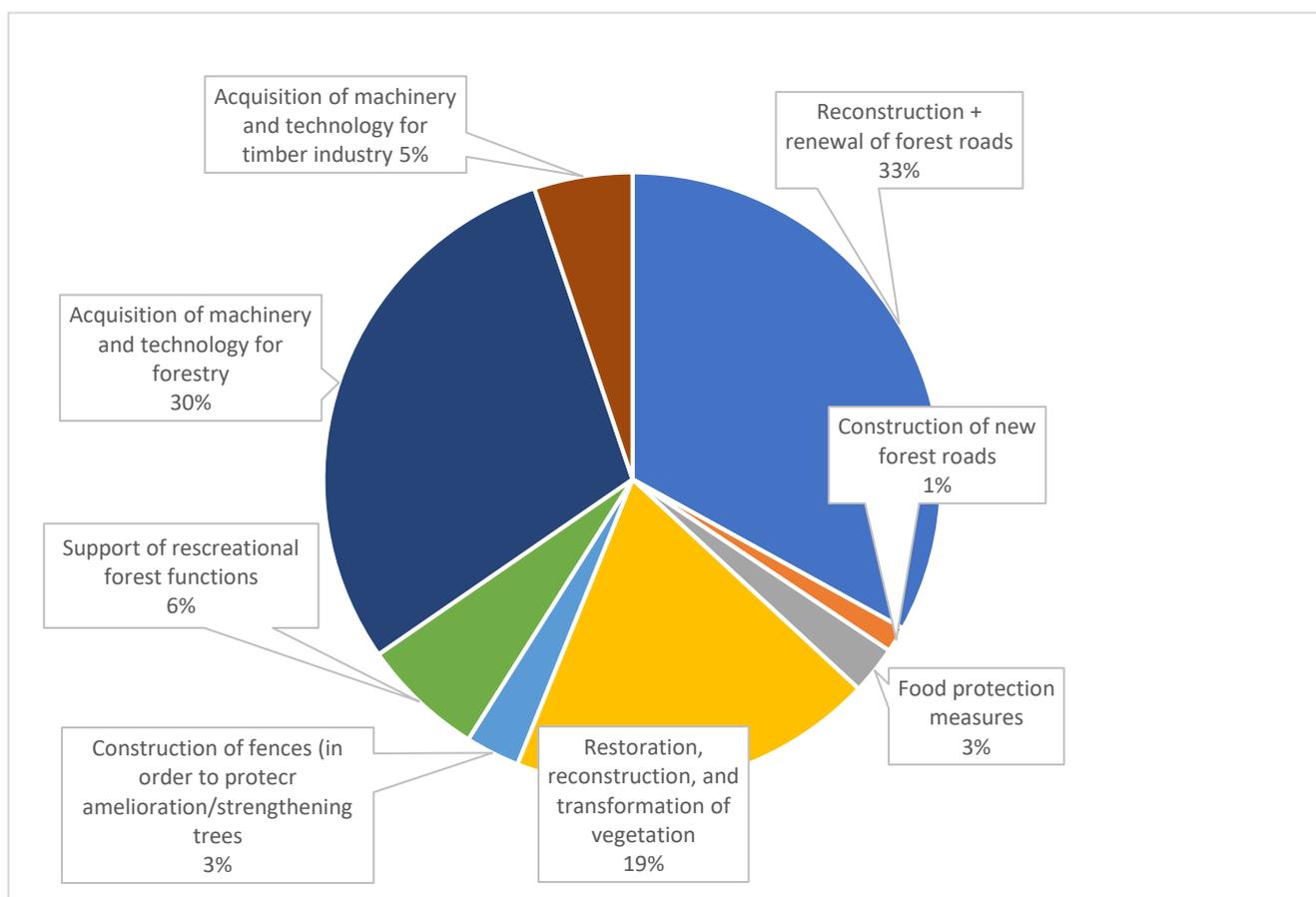


Figure 1. Subsidy amount approved in total for the individual categories.

Table 3. Financial support of the selected measures from the RDP CZ 2014–2020 in EUR.

Categories—Supported Areas	Total Project Expenditure	Subsidy Amount Approved—EU	Subsidy Amount Approved—National Sources	Subsidy Amount Approved—Total
Reconstruction + renewal of forest roads	47,448,773	15,481,743	16,281,980	31,763,722.58
Construction of new forest roads	1,786,503	644,401	657,420	1,301,821.21
Flood protection measures	3,280,932	1,201,811	1,226,091	2,427,902.67
Restoration, reconstruction, and transformation of vegetation	71,997,141	8,978,709	9,383,827	18,362,535.49
Construction of fences (in order to protect amelioration/strengthening trees)	4,234,023	1,352,725	1,380,063	2,732,788.43
Support of recreational forest functions	7,855,546	3,055,127	3,116,853	6,171,980.37
Acquisition of machinery and technology for forestry	71,045,607	14,030,646	14,314,129 ER	28,344,775.07
Acquisition of machinery and technology for the timber industry	13,205,789	2,446,948	2,496,384	4,943,331.81
Total	220,854,315	47,192,110	48,856,747	96,048,857.63

3.4. Summary Analysis

The summary analysis compared the support for forestry provided by the RDP CZ with an understanding of the concept of, and approach to, the FBE in the analysed documents of the selected countries and their reflection in the categories supported by the RDP CZ. The details are shown in Table 4. From this, it is clear which countries perceive the individual categories supported through the RDP CZ, based on the studied documents (strategic documents or other supporting documents), as supporting the FBE.

Table 4. Intersection of the individual RDP categories with perceptions of the FBEs of the selected countries.

Categories—Supported Areas	Concurrence with				
	Italy	Finland	Czechia	Slovakia	Germany
Reconstruction + renewal of forest roads	YES	×	×	×	×
Construction of new forest roads	YES	×	×	×	×
Flood protection measures	YES	YES	YES	YES	×
Restoration, reconstruction, and transformation of vegetation	YES	YES	YES	×	YES
Construction of fences (in order to protect amelioration/strengthening trees)	YES	YES	YES	YES	×
Support of recreational forest functions	YES	YES	YES	×	YES
Acquisition of machinery and technology for forestry	×	YES	YES	×	YES
Acquisition of machinery and technology for the timber industry	YES	YES	YES	×	×

In this regard, it is possible to draw attention, for example, to the view of Czechia. According to the analysis of the official documents, not all the categories can be perceived as supportive of the FBE. For example, the category of the reconstruction + renewal and construction of new forest roads does not fall within the support of the FBE. However, during an interview with a representative of the MoA with the aim of determining the view of FBE support from the perspective of the RDP CZ, the representative of the MoA expressed her opinion that “the MoA considers all the supported activities, i.e., all the financed projects in forestry, as FBE support”. The interview showed that the MoA perceives all their forestry activities as supporting the FBE. This view contradicts the findings based on the qualitative analysis of the official documents.

In contrast, the Italian view explicitly supports all the activities except for the acquisition of forestry machinery and technology. From the point of view of the support of the RDP

CZ, the conformity of the Czech and Finnish points of view is interesting. This certainly does not tell us that Czechia and Finland perceive the FBE in the same way, but in the context of the RDP CZ, the view is the same. For the final analysis, the above concurrences were converted into financial values. As a relevant numerical expression, we still consider the amount of the subsidy approved as a whole, i.e., the sum of the support from the EU sources and from the Czech national budget (without co-financing by the beneficiary). The financial support for the FBE in the studied countries in connection with the analysed documents defining this part of the bioeconomy is shown in Table 5.

Table 5. Financial expression of the support of the FBE based on the individual RDP categories in the selected countries in EUR.

Categories—Supported Areas	Italy	Finland	Czechia	Slovakia	Germany
Reconstruction + renewal of forest roads	31,763,723	×	×	×	×
Construction of new forest roads	1,301,821	×	×	×	×
Flood protection measures	2,427,903	2,427,903	2,427,903	2,427,903	×
Restoration, reconstruction, and transformation of vegetation	18,362,535	18,362,535	18,362,535	×	18,362,535
Construction of fences (in order to protect amelioration/strengthening trees)	2,732,788	2,732,788	2,732,788	2,732,788	×
Support of recreational forest functions	6,171,980	6,171,980	6,171,980	×	6,171,980
Acquisition of machinery and technology for forestry	×	28,344,775	28,344,775	×	28,344,775
Acquisition of machinery and technology for the timber industry	4,943,332	4,943,332	4,943,332	×	×
Total	67,704,083	62,983,314	62,983,314	5,160,691	52,879,291

From Table 5 and Figure 2, it is clear that if we consider the support from the RDP CZ from the perspective of the Italian FBE, it is possible to identify the highest level of support. The Finnish and Czech views are the same in the context of the RDP CZ. The German view follows, which includes only a few categories, but these have a significant financial budget. From this point of view, the lowest level FBE support is identified in Slovakia.

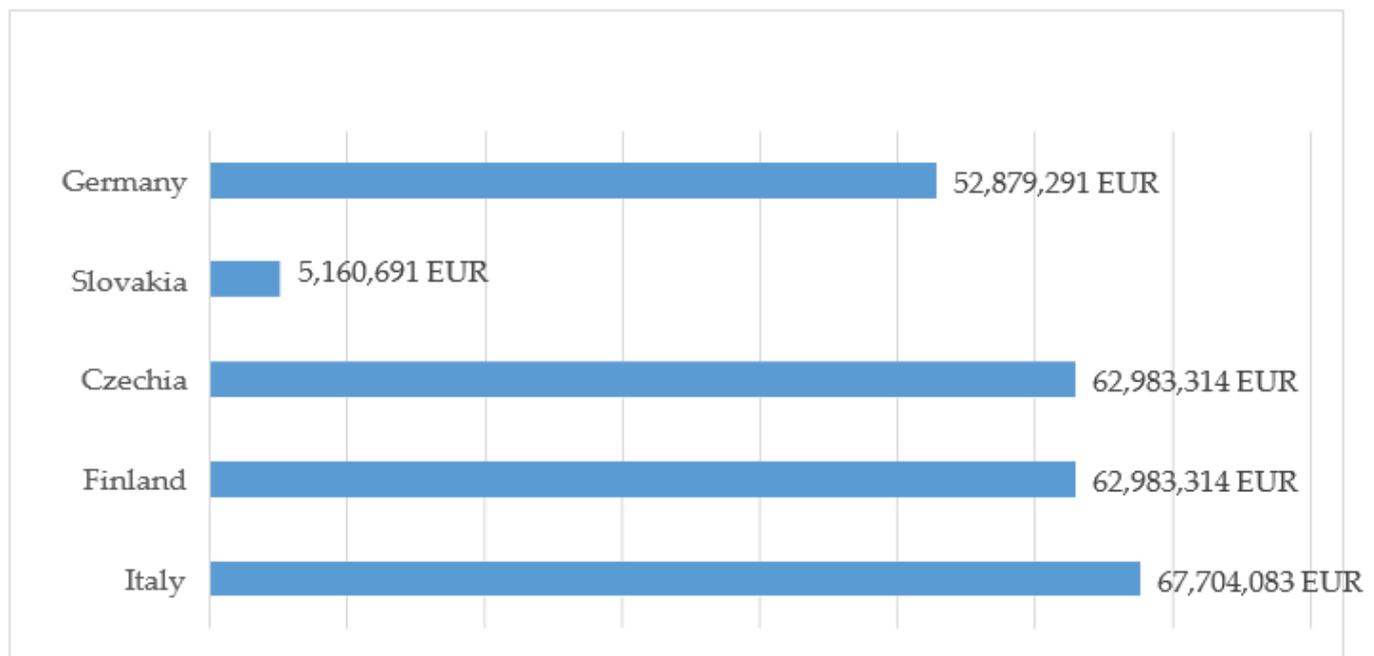


Figure 2. Financial support for the FBE in the RDP CZ from the point of view of the approaches of the researched countries.

4. Discussion

An important (critical) factor that influenced the results is the actual analysis of the FBE concept data of the selected countries. This was a qualitative analysis of the documents, which were selected on the basis of their connection to the topic of the bioeconomy [75,76]. The first step mainly involved the analysis of the official strategic documents, similar to the concept of De Besi and McCormick [9]. This step was applied to Italy, Finland, and Germany and included the explicit mention of FBE activities in the respective strategies. In the second step (Czechia and Slovakia), the bioeconomy-related documents were analysed (similarly to Lovrić et al. [77]). These are official policy documents in which the topic of the FBE can be identified (both explicitly and implicitly). The information obtained was subsequently (where necessary) supplemented by results from the selected current scientific publications that describe and evaluate the FBE in the countries concerned. Because the main document to which the results of the content analysis were related was the RDP CZ, a controlled interview was held with a representative of the main stakeholder, namely the RDP CZ managing authority, the Ministry of Agriculture. The MoA's view, as the forestry guarantor, was important for this research. However, the respondent's view differed from the view of the document analysis. If similar interviews, possibly through the Delphi methodology (such as that of D'Amato et al. [79]), were included among the views on the FBE of the other selected countries, or if other experts from Czechia were interviewed (as described in Bálíková et al. [80]), the research would be enriched by the actual perception of the policy makers. This view would probably be most beneficial for Slovakia, which does not have a separate bioeconomy strategy, and whose other bioeconomy-related documents do not contain sufficient information (based on our findings). At the same time, it would be possible to obtain more precise results in terms of the implicit perceptions of the FBE of all the studied countries. It would also be possible to use the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), working through the search for specific words (e.g., bioeconomy and forest), similar to the method used by Sanz-Hernández et al. [81]. However, this would not sufficiently affect the implicit statements of the FBE in the Czech and Slovak documents. Barañano et al. [82] used articles from the ScienceDirect database in their analysis, using the word search engine. This could also be a method for conducting a more extensive analysis of the given outputs; however, again, the implicit statements from the strategic documents would not be covered. The method of bibliometric analysis can also be used to examine the content of the already published outputs, as used in the work of Paletto et al. [29], to cite one example. Their results confirm that Finland is one of the leaders in the FBE.

The presented results and their interpretations are, in fact, influenced by several other factors, especially the volatility and discrepancy between the Czech crown and the euro in terms of financial expression. This is because Czechia is the only country included in the analysis that does not use the euro as its currency. The MoA reports individual project amounts in Czech crowns, with the subsequent process of the certification of the expenditure (recognition of the expenditure by the EC) taking place at regular intervals by the Czech Ministry of Finance. These dates are different for each operational programme in Czechia. The transfer between CZK and EUR, therefore, takes place on the date of the certification. In the period from May 2015 to April 2022, there were several changes. and the average exchange rate for the period (26 May 2015–29 April 2022) was, according to the kurzy.cz internet portal [83], CZK/EUR 26.141 (varying from CZK/EUR 24.15 to 27.81). Using this value, the data in Table 4 would be lowered by approximately 5.79%. In the case of the above-mentioned margin, this is a change increased by up to 2.27% and decreased by a maximum of 12.54%. We would obtain completely accurate information if we were to classify the individual applications for payment for the entire period according to the terms of the RDP certification and recalculate them at the then valid exchange rate. However, for the purposes of this article, it is not the exact financial statements in EUR that are relevant, but rather the trends and evidence of the different FBE concepts. The total reported RDP CZ numbers may be different at the end of the programme. The certification

and approval of individual payment claims will take place up to the end of 2023, i.e., the approved financial amounts will include payment claims approved in the period from 1 May 2022 to 31 December 2023. At this time, it is not possible to estimate exactly how many projects will be approved and, in particular, what they will amount to financially. However, significant proportional changes in the results cannot be expected. For illustrative purposes, we can quantify the amount drawn as of 30 June 2021, when the total drawn financial support of the RDP CZ, as of that date, amounted to EUR 3,117,940,428, which represents 65.6% of the total allocation for the RDP CZ. Compared to 31 December 2020, the funds paid out increased by about 13% [84]. Simultaneously, it should be mentioned that a new programme aiming to support agriculture and forestry is already being finalised under the new EU financial framework (2021–2027) [85]. Support for selected forestry activities is expected to be part of this new programme.

A shift in terms of the clarification of the definition of the bioeconomy in Czechia should take place in 2025, by which point the country should already have its own conceptual document, which will also include the issue of the FBE. For this reason, it is clear that it will be appropriate to continue examining this topic and monitor the shift in the concept of the FBE CZ (also in other countries) over time.

Given the defined agenda of the MoA in the Competence Act of Czechia (Act No. 2/1969 Coll.), it is possible to assume a different focus of the financial support from the RDP CZ. Specifically, we refer to the area of the Acquisition of machinery and technology for the timber industry. The reason for this is that the division of the agendas in the Czech state administration strictly separates the forestry activities (forest protection, legislation such as the Forest Act, etc.) under the responsibility of the MoA and related industries under the responsibility of the Ministry of Industry and Trade of Czechia (wood processing, etc.). The reasons for including this operation among the activities of the FBE are: (i) the fact that, according to literature, the general perception of the forestry sector [86,87] often includes not only forestry activities but also the subsequent industrial processing of the dendromass, i.e., wood processing, paper industry, etc.; (ii) according to the analysis of the documents of Czechia, wood is classified as a strategic raw material; and, (iii) this operation was included in the RDP CZ as an activity beyond the scope of the original regulation of the European Parliament and Council (with the consent of the European Council (EC)). This third reason also demonstrates the strategic plan of Czechia that aims to support the processing of forest biomass in its territory. However, if we were to exclude this category from the analysis, the results would include purely forestry categories that fully reflect the responsibility of the MoA. It should be emphasised again that the values depicted in Table 5 and Figure 2 do not represent the amount of support or implemented FBE projects in the individual countries but compare the projects supported in the framework of the RDP CZ 2014–2020 with the different views on the FBE (support) in the studied countries. Thus, they document differences in the potential reports regarding FBE support (e.g., considering the Czech view of the FBE, an amount of EUR 63 million can be reported, while using the German view, an amount of EUR 53 million can be reported—see Table 5).

Ronzon and Sanjuán [88] showed that the European Bioeconomy Strategy is aligned with at least 12 SDGs. Basic documents related to sustainable development (SD) [89] or the relationship between a green economy and the SD [90] address the issue of the possibility of measuring the SD, which they see as a way of creating new types of indicators. Many authors [44,91,92] have focused on the criteria that such indicators should meet and what risks are involved in their use. Regular reports on the implementation of the bioeconomy (BE) principle in the EU are also based on the selected indicators. For example, the 2016 report presents EU funding for bioeconomy research, innovation, and investment [93]. However, these are only the total amounts for the two main chapters: H2020 and the European Structural and Investment Fund (ESIF). The last report published in June 2022 [46] again emphasises the importance of H2020 in the framework of research and innovation investments for the development of substitutes for fossil-based materials that are bio-based, recyclable, and marine biodegradable. The key publication, in this respect, is

the report of 2020 on the Bioeconomy Monitoring System dashboards, which evaluates the implementation of BE using a set of approximately 170 indicators [94]. Several of these indicators are also concerned with the relationship between the BE and forests and forestry. For example, indicators such as the Forest fragmentation and connectivity index, Deadwood, or Share of the forest area are relatively easy to identify and report on at the national level. However, the problem may occur in the case of the sectoral indicators, such as the Turnover in bioeconomy per sector, Gross value added per person employed in the bioeconomy, Value-added per sector, and Investment in research and innovation indicators. As our analysis shows, the views on a sector that we may call FBE-related vary considerably across Europe. Until a precise methodology (or definition) is established defining what can be included in the FBE, it is necessary to approach such data with some reservations, as they are prone to errors related to the individual national approach. The same applies to information on public aid aimed toward FBE support. Additionally, some other authors have addressed connections with the forest bioeconomy, such as Linser and Lier [95], who stated that 13 out of 17 SDGs are related to the forest bioeconomy. Baumgartner [96] addressed the question of how forest management could help in efforts to reach the SDGs, and the impacts of bioeconomy activities on the SDGs is the subject of the paper by Heimann [97].

5. Conclusions

Every EU country emphasises the importance of the bioeconomy in a number of their annual reports, including, for example, the reports on the state of the forests and forest management. Moreover, they show this importance through the amount of the financial resources they use in order to support the BE. However, our analysis proved that the perception and definition of the FBE vary across countries. Therefore, at this stage, it is not possible to compare the level of FBE financial support between countries. It is also not possible to use it as a uniform and comparable indicator for measuring sustainability. The link between the bioeconomy and sustainability is obvious and has been proven by many authors. Due to the unclear definition, however, it is not possible to compare the financial quantification of the support (and also the benefits) of the bioeconomy between the individual countries with different perceptions. Such a procedure would not yield relevant information or results. However, if there is a political consensus and a unified anchoring of the term, this conclusion will have to be re-evaluated, as there are clear connections between the FBE and sustainability issues.

Based on the analysis of the official documents supplemented with the relevant scientific publications, the views on the FBE of the selected countries were compared. The results were then compared with the supported areas of the RDP CZ. This analysis made it clear that:

- RA1 (research answer): The concept of the FBE is not defined and perceived in the same way in the official documents of the studied countries. The difference also emerges because not all the studied countries have their own bioeconomy strategies. This strategy enables a better grasp and definition of the topic. For countries such as Czechia and Slovakia, it is necessary to use other supporting documents to determine a definition and to proceed from the implicit statement of the FBE. For a more precise statement, further research should, if possible, include focused interviews with representatives of the state administration of the studied countries.
- RA2: Funds provided for forestry operations through the RDP CZ can only partially be perceived as supporting the bioeconomy from the perspective of Czechia. There are doubts as to which operations (see Table 5) of the RDP CZ can be included in the FBE. Above, we described the difference between our analysis versus the perception of the MoA representative (interview). This was caused by the lack of a unified Czech strategy.
- RA3: The amount of FBE support certainly varies according to national specificities. This difference is due to the inconsistent concept of the FBE across all the studied

countries. Thus far, there is no single concept that allows for a comparison of the financial support at the country level.

From the above analysis, with regard to the concept and limits of the SDIs [44,91,92], it follows that it is currently inappropriate to use state support for the FBE as a uniform and comparable indicator (e.g., one of the indicators of the SDIs). However, clear links between some indicators and the FBE can be identified with. Moreover, according to Issa et al. [98], it is essential to monitor the development and shifts in the bioeconomy in line with the SDGs with the goal of sustainable development, which is necessary for the shift in the economy and society.

In the case of a political consensus, it will be possible to continue working scientifically to bring national perspectives closer together in order to take advantage of the approach to the FBE in the future. Further analyses could be performed on the definitional concept of the FBE in other countries.

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References

1. Stark, S.; Biber-Freudenberger, L.; Dietz, T.; Escobar, N.; Janosch Förster, J.; Henderson, J.; Laibach, N.; Börner, J. Sustainability implications of transformation pathways for the bioeconomy. *Sustain. Prod. Consum.* **2022**, *29*, 215–227. [[CrossRef](#)]
2. Pyka, A.; Cardellini, G.; van Meijl, H.; Verkerk, P.J. Modelling the bioeconomy: Emerging approaches to address policy needs. *J. Clean. Prod.* **2022**, *330*, 129801. [[CrossRef](#)]
3. Bröring, S.; Vanacker, A. Designing Business Models for the Bioeconomy: What are the major challenges? *EFB Bioeconomy J.* **2022**, *2*, 100032. [[CrossRef](#)]
4. Bergamo, D.; Zerbini, O.; Pinho, P.; Moutinho, P. The Amazon bioeconomy: Beyond the use of forest products. *Ecol. Econ.* **2022**, *199*, 107448. [[CrossRef](#)]
5. Ncube, A.; Sadondo, P.; Makhanda, R.; Mabika, C.; Beinisch, N.; Cocker, J.; Gwenzi, W.; Ulgiati, S. Circular bioeconomy potential and challenges within an African context: From theory to practice. *J. Clean. Prod.* **2022**, *367*, 133068. [[CrossRef](#)]
6. Bastos Lima, M.G. Just transition towards a bioeconomy: Four dimensions in Brazil, India and Indonesia. *For. Policy Econ.* **2022**, *136*, 102684. [[CrossRef](#)]
7. Frisvold, G.B.; Moss, S.M.; Hodgson, A.; Maxon, M.E. Understanding the U.S. Bioeconomy: A New Definition and Landscape. *Sustainability* **2021**, *13*, 1627. [[CrossRef](#)]
8. Purwestri, R.C.; Hájek, M.; Šodková, M.; Sane, M.; Kašpar, J. Bioeconomy in the National Forest Strategy: A Comparison Study in Germany and the Czech Republic. *Forests* **2020**, *11*, 608. [[CrossRef](#)]
9. De Besi, M.; McCormick, K. Towards a bioeconomy in Europe: National, regional and industrial strategies. *Sustainability* **2015**, *7*, 10461–10478. [[CrossRef](#)]
10. Bugge, M.M.; Hansen, T.; Klitkou, A. What is the bioeconomy? A review of the literature. *Sustainability* **2020**, *8*, 691. [[CrossRef](#)]
11. Vogt, M.; Frankenreiter, I. Bioeconomy: The Innovative Twin of Sustainability. *Sustainability* **2022**, *14*, 14924. [[CrossRef](#)]

12. Lanzerath, D.; Schurr, U.; Pinsdorf, C.; Stake, M. (Eds.) *Bioeconomy and Sustainability. Perspectives from Natural and Social Sciences, Economics and Ethics*; Springer: Cham, Switzerland, 2022.
13. Böcher, M.; Töller, A.E.; Perbandt, D.; Beer, K.; Vogelpohl, T. Research trends: Bioeconomy politics and governance. *For. Policy Econ.* **2020**, *118*, 102219. [[CrossRef](#)]
14. European Commission. *Innovating for Sustainable Growth: A Bioeconomy for Europe*; European Commission: Brussels, Belgium, 2012; pp. 2–9. Available online: https://www.ecsite.eu/sites/default/files/201202_innovating_sustainable_growth_en.pdf (accessed on 1 April 2022).
15. Ronzon, T.; Santini, F.; M'Barek, R. *The Bioeconomy in the European Union in Numbers—Facts and Figures on Biomass, Turnover and Employment*; Joint Research Centre, Institute for Prospective Technological Studies: Seville, Spain, 2015; pp. 1–4. Available online: https://joint-research-centre.ec.europa.eu/publications/bioeconomy-european-union-numbers-facts-and-figures-biomass-turnover-and-employment_en (accessed on 15 July 2022).
16. Patemann, C.; Aguilar, A. The origins of the bioeconomy in the European Union. *New Biotechnol.* **2018**, *40*, 20–24. [[CrossRef](#)]
17. Ludvig, A.; Zivojinovic, I.; Hujala, T. Social Innovation as a Prospect for the Forest Bioeconomy: Selected Examples from Europe. *Forests* **2019**, *10*, 878. [[CrossRef](#)]
18. European Commission. *A Sustainable Bioeconomy for Europe: Strengthening the Connection between Economy, Society and the Environment*; European Commission: Brussels, Belgium, 2018; p. 107. Available online: <https://op.europa.eu/en/publication-detail/-/publication/edace3e3-e189-11e8-b690-01aa75ed71a1/language-en> (accessed on 13 May 2022).
19. Wydra, S.; Hüsing, B.; Köhler, J.; Schwarz, A.; Schirrmeister, E.; Voglhuber-Slavinsky, A. Transition to the bioeconomy—Analysis and scenarios for selected niches. *J. Clean. Prod.* **2021**, *294*, 126092. [[CrossRef](#)]
20. European Commission. Available online: https://knowledge4policy.ec.europa.eu/visualisation/bioeconomy-different-countries_en#survey (accessed on 7 June 2022).
21. Hájek, M.; Holecová, M.; Smolová, H.; Jeřábek, L.; Frébort, I. Current state and future directions of bioeconomy in the Czech Republic. *New Biotechnol.* **2021**, *61*, 1–8. [[CrossRef](#)]
22. Edwards, P.; Brukas, V.; Brukas, A.; Hoogstra-Klein, M.; Secco, L.; Kleinschmit, D. Development of forest discourses across Europe: A longitudinal perspective. *For. Policy Econ.* **2022**, *135*, 102641. [[CrossRef](#)]
23. Pülzl, H.; Kleinschmit, D.; Arts, B. Bioeconomy—An emerging meta-discourse affecting forest discourses? *Scand. J. For. Res.* **2014**, *29*, 386–393. [[CrossRef](#)]
24. Pülzl, H.; Giurca, A.; Kleinschmit, D.; Arts, B.; Mustalahti, I.; Sergent, A.; Secco, L.; Pettenella, D.; Brukas, V. *Towards a Sustainable European Forest-Based Bioeconomy—Assessment and the Way Forward*; European Forest Institute: Joensuu, Finland, 2017; pp. 36–51.
25. Wolfslehner, B.; Linser, S.; Pülzl, H.; Bastrup-Birk, A.; Camia, A.; Marchetti, M. *Forest Bioeconomy—A New Scope for Sustainability Indicators*; European Forest Institute: Joensuu, Finland, 2016; pp. 5–9. Available online: https://efi.int/sites/default/files/files/publication-bank/2018/efi_fstp_4_2016.pdf (accessed on 20 June 2022).
26. Hannerz, M.; Nohrstedt, H.Ö.; Roos, A. Research for a bio-based economy in the forest sector—A Nordic example. *Scand. J. For. Res.* **2014**, *29*, 299–300. [[CrossRef](#)]
27. Mitra, J.; Zoukas, G. Unpacking the Concept of Bioeconomy: Problems of Definition, Measurement, and Value. *Sci. Technol. Stud.* **2020**, *33*, 2–21. [[CrossRef](#)]
28. Lovrić, M.; Lovrić, N.; Mavsar, R. Mapping forest-based bioeconomy research in Europe. *For. Policy Econ.* **2020**, *110*, 101874. [[CrossRef](#)]
29. Paletto, A.; Biancolillo, I.; Bersier, J.; Keller, M.; Romagnoli, M. A literature review on forest bioeconomy with a bibliometric network analysis. *J. For. Sci.* **2020**, *66*, 265–279. [[CrossRef](#)]
30. Dietz, T.; Börner, J.; Förster, J.J.; Von Braun, J. Governance of the Bioeconomy: A Global Comparative Study of National Bioeconomy Strategies. *Sustainability* **2018**, *10*, 3190. [[CrossRef](#)]
31. D'Adamo, I.; Gastaldi, M.; Morone, P.; Rosa, P.; Sassanelli, C.; Settembre-Blundo, D.; Shen, Y. Bioeconomy of Sustainability: Drivers, Opportunities and Policy Implications. *Sustainability* **2022**, *14*, 200. [[CrossRef](#)]
32. Salvador, R.; Vetroni Barros, M.; Donner, M.; Brito, P.; Halog, A.; De Francisco, A.C. How to advance regional circular bioeconomy systems? Identifying barriers, challenges, drivers, and opportunities. *Sustain. Prod. Consum.* **2022**, *32*, 248–269. [[CrossRef](#)]
33. Moktadir, M.A.; Dwivedi, A.; Rahman, T. Antecedents for circular bioeconomy practices towards sustainability of supply chain. *J. Clean. Prod.* **2022**, *348*, 131329. [[CrossRef](#)]
34. Sanz-Hernández, A.; Esteban, E.; Garrido, P. Transition to a bioeconomy: Perspectives from social sciences. *J. Clean. Prod.* **2019**, *224*, 107–119. [[CrossRef](#)]
35. Czyżewski, A.; Grzyb, A.; Matuszczak, A.; Michałowska, M. Factors for Bioeconomy Development in EU Countries with Different Overall Levels of Economic Development. *Energies* **2021**, *14*, 3182. [[CrossRef](#)]
36. Ayrapetyan, D.; Befort, N.; Hermans, F. The role of sustainability in the emergence and evolution of bioeconomy clusters: An application of a multiscale framework. *J. Clean. Prod.* **2022**, *376*, 134306. [[CrossRef](#)]
37. Hasegawa, M.; Van Brusselen, J.; Cramm, M.; Verkerk, P.J. Wood-Based Products in the Circular Bioeconomy: Status and Opportunities towards Environmental Sustainability. *Land* **2022**, *11*, 2131. [[CrossRef](#)]
38. Aggestam, F.; Giurca, A. Implementing Circular-Bioeconomy Principles across Two Value Chains of the Wood-Based Sector: A Conceptual Approach. *Land* **2022**, *11*, 2037. [[CrossRef](#)]

39. Egenolf, V.; Distelkamp, M.; Morland, C.; Beck-O'Brien, M.; Bringezu, S. The timber footprint of German bioeconomy scenarios compared to the planetary boundaries for sustainable roundwood supply. *Sustain. Prod. Consum.* **2022**, *33*, 686–699. [CrossRef]
40. Moosmann, D.; Majer, S.; Ugarte, S.; Ladu, L.; Wurster, S.; Thrän, D. Strengths and gaps of the EU frameworks for the sustainability assessment of bio-based products and bioenergy. *Energy Sustain. Soc.* **2020**, *10*, 22. [CrossRef]
41. Ramcilovic-Suominen, S.; Pulzl, H. Sustainable development—A 'selling point' of the emerging EU bioeconomy policy framework? *J. Clean. Prod.* **2018**, *172*, 4170–4180. [CrossRef]
42. United Nations. Available online: <https://unstats.un.org/sdgs/dataportal> (accessed on 4 June 2022).
43. Calicioglu, O.; Bogdanski, A. Linking the bioeconomy to the 2030 sustainable development agenda: Can SDG indicators be used to monitor progress towards a sustainable bioeconomy? *New Biotechnol.* **2021**, *61*, 40–49. [CrossRef]
44. Shuai, C.; Yu, L.; Chen, X.; Zhao, B.; Qu, S.; Zhu, J.; Liu, J.G.; Miller, S.A.; Xu, M. Principal indicators to monitor sustainable development goals. *Environ. Res. Lett.* **2021**, *16*, 124015. [CrossRef]
45. Fritsche, U.; Brunori, G.; Chiaramonti, D.; Galanakis, C.; Hellweg, S.; Matthews, R.; Panoutsou, C. *Future Transitions for the Bioeconomy Towards Sustainable Development and a Climate-Neutral Economy—Knowledge Synthesis Final Report*; Publications Office of the European Union: Luxembourg, 2020; pp. 12–29. Available online: <https://publications.jrc.ec.europa.eu/repository/handle/JRC121212> (accessed on 18 July 2022).
46. European Commission. *EU Bioeconomy Strategy Progress Report*; European Commission: Brussels, Belgium, 2022; pp. 4–26. Available online: https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/ec_rtd_eu-bioeconomy-strategy-progress.pdf (accessed on 18 June 2022).
47. Henstra, D. The tools of climate adaptation policy: Analysing instruments and instrument selection. *Clim. Policy* **2016**, *16*, 496–521. [CrossRef]
48. Garrone, M.; Emmers, D.; Lee, H.; Olper, A.; Swinnen, J. Subsidies and agricultural productivity in the EU. *Agric. Econ.* **2019**, *50*, 803–817. [CrossRef]
49. Minviel, J.J.; Latruffe, L. Effect of public subsidies on farm technical efficiency: A meta-analysis of empirical results. *Appl. Econ.* **2017**, *49*, 213–226. [CrossRef]
50. van Valkengoed, A.M.; van der Werff, E. Are subsidies for climate action effective? Two case studies in The Netherlands. *Environ. Sci. Policy* **2022**, *127*, 137–145. [CrossRef]
51. Zilberman, D.; Gordon, B.; Hochman, G.; Wesseler, J. Economics of Sustainable Development and the Bioeconomy. *Appl. Econ. Perspect. Policy* **2018**, *40*, 22–37. [CrossRef]
52. Jukka, L.; Miika, M.; Lauri, L.; Mirja, M.; Ville, U.; Lassi, L. A financial and environmental sustainability of circular bioeconomy: A case study of short rotation coppice, biochar and greenhouse production in southern Finland. *Biomass Bioenergy* **2022**, *163*, 106524. [CrossRef]
53. Wesseler, J.; von Braun, J. Measuring the Bioeconomy: Economics and Policies. *Annu. Rev. Resour. Econ.* **2017**, *9*, 275–298. [CrossRef]
54. Palátová, P.; Purwestri, R.C.; Marcineková, L. Forest bioeconomy in three European countries: Finland, the Czech Republic and the Slovak Republic. *Int. For. Rev.* **2022**, *24*, 594–606. [CrossRef]
55. Quiroga, S.; Suarez, C.; Ficko, A.; Feliciano, D.; Bouriaud, L.; Brahic, E.; Deuffic, P.; Dobsinska, Z.; Jarsky, V.; Lawrence, A.; et al. What influences European private forest owners' affinity for subsidies? *For. Policy Econ.* **2019**, *99*, 136–144. [CrossRef]
56. Qing, L.; Chun, D.; Dagestani, A.A.; Li, P. Does Proactive Green Technology Innovation Improve Financial Performance? Evidence from Listed Companies with Semiconductor Concepts Stock in China. *Sustainability* **2022**, *14*, 4600. [CrossRef]
57. Qing, L.; Chun, D.; Ock, Y.-S.; Dagestani, A.A.; Ma, X. What Myths about Green Technology Innovation and Financial Performance's Relationship? A Bibliometric Analysis Review. *Economies* **2022**, *10*, 92. [CrossRef]
58. Ministry of Agriculture. *Koncepce Biohospodářství v České Republice Z Pohledu Resortu Ministerstva Zemědělství Na Léta 2019–2024*; Ministry of Agriculture: Prague, Czech Republic, 2019; pp. 3–33. Available online: https://eagri.cz/public/web/file/630927/Koncepce_biohospodarstvi_v_CR_z_pohledu_MZe_na_leta_2019_24.pdf (accessed on 15 March 2022).
59. Ministry of Environment. *Strategický Rámec Cirkulární Ekonomiky ČR 2040*; Ministry of Environment: Prague, Czech Republic, 2021; pp. 41–120. Available online: https://www.cbcsd.cz/wp-content/uploads/2021/04/Strategicky_ramec_CC_2040_duben_2021.pdf (accessed on 15 March 2022).
60. Vláda České Republiky. *Koncepce Státní Lesnické Politiky do Roku 2035*; Vláda České Republiky: Prague, Czech Republic, 2020; pp. 4–31. Available online: https://eagri.cz/public/web/file/646382/Koncepce_statni_lesnicke_politiky_do_roku_2035.pdf (accessed on 16 March 2022).
61. Lesy České Republiky. *Koncepce Ministerstva Zemědělství k Hospodářské Politice Podniku Lesy ČR; s.p.* 2014, pp. 10–45. Available online: <https://lesy.cz/wp-content/uploads/2016/12/koncepce-lcr-2015-2019.pdf> (accessed on 2 March 2022).
62. Bio Hub, C.Z. *Bioekonomika Ve Strategických Dokumentech ČR*; Bio Hub CZ/Zemědělský výzkum. Zemědělský výzkum, s.r.o.: Troubsko, Czech Republic, 2020; pp. 5–11. Available online: http://www.bio-hub.cz/images/doc/Bioekonomika_na_nrodn_rovni_CZ_final.pdf (accessed on 25 March 2022).
63. BIT, I.I. *A New Bioeconomy Strategy for a Sustainable Italy*; Presidency of Council of Ministers, Italy. 2019, pp. 7–60. Available online: https://cnbbsv.palazzochigi.it/media/1774/bit_en_2019_02.pdf (accessed on 25 March 2022).
64. Falcone, P.M.; Tani, A.; Tartiu, V.E.; Imbriani, C. Towards a sustainable forest-based bioeconomy in Italy: Findings from a SWOT analysis. *For. Policy Econ.* **2020**, *110*, 101910. [CrossRef]

65. Finnish Government. *The Finnish Bioeconomy Strategy*; Finnish Government: Helsinki, Finland, 2022; pp. 9–35. Available online: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/163969/VN_2022_5.pdf?sequence=4&isAllowed=y (accessed on 5 May 2022).
66. Korhonen, J.; Miettinen, J.; Kylkilahti, E.; Tuppur, A.; Autio, M.; Lähtinen, K.; Pätäri, S.; Pekkanen, T.-L.; Luhas, J.; Mikkilä, M.; et al. Development of a forest-based bioeconomy in Finland: Insights on three value networks through expert views. *J. Clean. Prod.* **2021**, *299*, 126867. [[CrossRef](#)]
67. The Federal Government. *National Bioeconomy Strategy*; Federal Ministry of Education and Research: Berlin, Germany, 2020; pp. 15–48. Available online: https://www.bmel.de/SharedDocs/Downloads/EN/Publications/national-bioeconomy-strategy.pdf?__blob=publicationFile&v=2 (accessed on 15 March 2022).
68. Giurca, A.; Späth, P. A forest-based bioeconomy for Germany? Strengths, weaknesses and policy options for lignocellulosic biorefineries. *J. Clean. Prod.* **2017**, *153*, 51–62. [[CrossRef](#)]
69. Enviroportál. Available online: <https://www.enviroportal.sk/sk/eia/detail/nizkoughlikova-strategia-rozvoja-sr-do-roku-2030-s-vyhladom-do-roku-2050> (accessed on 15 March 2022).
70. Úrad Vlády Slovenskej Republiky. Available online: <https://rokovania.gov.sk/RVL/Material/24390/1> (accessed on 15 March 2022).
71. European Network for Rural Development. *The Wood Biomass Sustainability Criteria in Slovakia*; European Commission: Brussels, Belgium, 2020; pp. 1–4. Available online: https://enrd.ec.europa.eu/sites/default/files/enrd_publications/bioeconomy_case_study-the_wood_biomass_sustainability_criteria_in_slovakia-v03.pdf (accessed on 28 April 2022).
72. The Ministry of Agriculture and Rural Development of the Slovak Republic. *Správa Stratégia Pre Biohospodárstvo Na Slovensku*; Bioeconomy Cluster: Nitra, Slovakia, 2020; pp. 10–15. Available online: <https://bioeconomy.sk/wp-content/uploads/2020/01/Pr%C3%ADspevok-slovensk%C3%A9ho-biohospod%C3%A1rstva-k-SP-SPP-2021-2027-1.pdf> (accessed on 16 March 2022).
73. Navrátilová, L.; Výbošťok, J.; Dobšínská, Z.; Šálka, J.; Pichlerová, M.; Pichler, V. Assessing the potential of bioeconomy in Slovakia based on public perception of renewable materials in contrast to non-renewable materials. *Ambio* **2020**, *49*, 1912–1924. [[CrossRef](#)] [[PubMed](#)]
74. Navrátilová, L.; Giertliová, B.; Hajdúchová, I.; Šálka, J. Acceptance of bioeconomy principles in strategic documents on European and Slovak level. *SHS Web Conf.* **2021**, *92*, 02044. [[CrossRef](#)]
75. Babbie, E.R. *The Practice of Social Research*, 15th ed.; Cengage Learning: Belmont, CA, USA, 2020; pp. 15–16.
76. Kleinschmit, D.; Böcher, M.; Giessen, L. Forest Policy Analysis: Advancing the analytical approach. *For. Policy Econ.* **2016**, *68*, 1–6. [[CrossRef](#)]
77. Lovrić, N.; Krajter Ostoić, S.; Vuletić, D.; Stevanov, M.; Đorđević, I.; Stojanovski, V.; Curman, M. The future of the forest-based bioeconomy in selected southeast European countries. *Futures* **2021**, *128*, 102725. [[CrossRef](#)]
78. Ministry of Agriculture. *Program Rozvoje Venkova Na Období 2014–2020*; Ministry of Agriculture: Prague, Czech Republic, 2021; pp. 288–696. Available online: https://eagri.cz/public/web/file/680981/Program_rozvoje_venkova___schvalene_zneni.pdf (accessed on 1 April 2022).
79. D’Amato, D.; Veijonaho, S.; Toppinen, A. Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. *For. Policy Econ.* **2020**, *110*, 101848. [[CrossRef](#)]
80. Bálíková, K.; Dobšínská, Z.; Balážová, E.; Valent, P.; Šálka, J. Forest land tax reductions—An effective payment for forest ecosystem services in Slovakia? *Cent. Eur. For. J.* **2021**, *67*, 167–176. [[CrossRef](#)]
81. Sanz-Hernández, A.; Jiménez-Caballero, P.; Zarauz, I. Gender and women in scientific literature on bioeconomy: A systematic review. *For. Policy Econ.* **2022**, *141*, 102762. [[CrossRef](#)]
82. Barañano, L.; Unamunzaga, O.; Garbisu, N.; Briers, S.; Orfanidou, T.; Schmid, B.; Martínez de Arano, I.; Araujo, A.; Garbisu, C. Assessment of the Development of Forest-Based Bioeconomy in European Regions. *Sustainability* **2022**, *14*, 4747. [[CrossRef](#)]
83. Kurzy. Available online: <https://www.kurzy.cz/kurzymen/kurzy.asp?A=G&V=3&m1=CZK&m2=EUR&od=26.05.2015&do=29.04.2022&T=0> (accessed on 1 June 2022).
84. Hodnocení Programu rozvoje venkova na období 2014–2020. *Průběžná Podzimní Hodnotící Zpráva 2021*; Naviga Advisory and Evaluation: Brno, Czech Republic, 2021; pp. 15–30. Available online: <https://www.dotaceeu.cz/cs/evropske-fondy-v-cr/narodni-organ-pro-koordinaci/evaluace/knihovna-evaluaci/desata-prubezna-zprava-o-hodnoceni-zari-2021> (accessed on 28 May 2022).
85. eAgri. Available online: <https://eagri.cz/public/web/mze/dotace/szp-pro-obdobi-2021-2027/> (accessed on 28 May 2022).
86. Lipiäinen, S.; Sermiyagina, E.; Kuparinen, K.; Vakkilainen, E. Future of forest industry in carbon-neutral reality: Finnish and Swedish visions. *Energy Rep.* **2021**, *8*, 2588–2600. [[CrossRef](#)]
87. Heiskanen, A.; Hurmekoski, E.; Toppinen, A.; Näyhä, A. Exploring the unknowns—State of the art in qualitative forest-based sector foresight research. *For. Policy Econ.* **2022**, *135*, 102643. [[CrossRef](#)]
88. Ronzon, T.; Sanjuán, A.I. Friends or foes? A compatibility assessment of bioeconomy-related Sustainable Development Goals for European policy coherence. *J. Clean. Prod.* **2020**, *254*, 119832. [[CrossRef](#)] [[PubMed](#)]
89. United Nations. *Agenda 21*; United Nations Conference: Rio de Janeiro, Brazil, 1992. Available online: <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf> (accessed on 25 June 2022).

90. United Nations Environment Programme. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*; United Nations Environment Programme: Nairobi, Kenya, 2011; pp. 2–23. Available online: https://sustainabledevelopment.un.org/content/documents/126GER_synthesis_en.pdf (accessed on 25 June 2022).
91. Wilson, J.; Tyedmers, P.; Pelot, R. Contrasting and comparing sustainable development Indicator metrics. *Ecol. Indic.* **2007**, *7*, 299–314. [[CrossRef](#)]
92. Hák, T.; Janoušková, S.; Moldan, B. Sustainable Development Goals: A need for relevant indicators. *Ecol. Indic.* **2016**, *60*, 565–573. [[CrossRef](#)]
93. Ronzon, T.; Lusser, M.; Klinkenberg, M.; Landa, L.; Sanchez Lopez, J.; M'Barek, R.; Hadjamu, G.; Belward, A.; Camia, A.; Giuntoli, J.; et al. *Bioeconomy Report 2016. JRC Scientific and Policy Report*; European Commission: Brussels, Belgium, 2017; pp. 20–40. Available online: <https://publications.jrc.ec.europa.eu/repository/handle/JRC103138> (accessed on 20 June 2022).
94. Kilsedar, C.E.; Wertz, S.; Robert, N.; Mubareka, S. *Implementation of the EU Bioeconomy Monitoring System Dashboards: Status and Technical Description as of December*; Publications Office of the European Union: Luxembourg, 2020; pp. 26–28. Available online: <https://publications.jrc.ec.europa.eu/repository/handle/JRC127762> (accessed on 15 June 2022).
95. Linser, S.; Lier, M. The Contribution of Sustainable Development Goals and Forest-Related Indicators to National Bioeconomy Progress Monitoring. *Sustainability* **2020**, *12*, 2898. [[CrossRef](#)]
96. Baumgartner, R.J. Sustainable Development Goals and the Forest Sector—A Complex Relationship. *Forests* **2019**, *10*, 152. [[CrossRef](#)]
97. Heimann, T. Bioeconomy and SDGs: Does the bioeconomy support the achievement of the SDGs? *Earth's Future* **2019**, *7*, 43–57. [[CrossRef](#)]
98. Issa, I.; Delbrück, S.; Hamm, U. Bioeconomy from experts' perspectives—Results of a global expert survey. *PLoS ONE* **2019**, *14*, e0215917. [[CrossRef](#)]

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