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DIVERSE ECOSYSTEM SERVICES AS A SOURCE OF INCOME IN FORESTRY – A COMPARISON OF SELECTED EUROPEAN STATE FOREST ENTERPRISES

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ABSTRACT: Current environmental and climate policies and societal expectations, which may lead to restrictions on timber harvesting in forests, may affect the sustainable forest management model, which is primarily based on revenue from timber sales. This problem could also affect the State Forest Holding (PGLLP) in Poland, which derives almost 90% of its income from timber sales. The paper discusses the possibilities of diversifying income sources in selected European state forest enterprises (Poland vs Bavaria and Lower Saxony in Germany and Austria) based on the concept of ecosystem services and their sale. The analysis is based on financial data from the annual reports of the analysed enterprises. The solutions applied in some countries show that revenues from the sale of ecosystem services other than timber can constitute an important part of the income of forest enterprises, and their experience could be utilised for the development of future strategies in State Forests.

KEYWORDS: sustainable forest management, diversification, revenues, ecosystem services

Introduction

The main product and the main source of income in forestry has traditionally been timber. The increasing social demand for other ecosystem services, most of which are not marketable, is leading to an increase in the costs of forest management on the one hand and may also lead to a decline in timber harvesting and thus to a decrease in forestry companies' income from timber sales on the other (Klocek, 2005).

The European Green Deal, a new growth strategy adopted by the European Commission in 2019, aims to transform the European Union into a society living in a modern, resource-efficient and competitive economy. One of its objectives is to protect, conserve and enhance the EU's natural capital and protect the health and well-being of citizens from environmental risks and negative impacts (Communication, 2019). One of the measures is the protection of 30% of the EU's land area, including forests (of which 10% are to be strictly protected), through the mandatory protection of all primary and old-growth forests (Communication, 2020; Communication, 2021). This proposal, which is controversial in forestry circles, could lead to a significant reduction in the volume of timber harvested (Wolicka-Posiadała & Kaliszewski, 2024). The growing demand for timber in EU countries would have to be covered by increased timber imports from outside the EU. It should be noted that this would presumably entail the risk of intensifying less sustainable or even devastating timber production in other regions of the world (Schier et al., 2022).

Increasing restrictions on timber harvesting and increasing risks to forest management due to negative environmental changes may lead to the need to change the current operating model of a forest enterprise, which relies primarily on revenue from timber sales, and may necessitate the search for additional sources of revenue. This problem may also affect the State Forests National Forest Holding (the State Forests, PGLLP), almost 90% of whose revenue comes from timber sales. The aim of this paper is to show the possibilities of revenue diversification in selected state forest enterprises in Europe (in Germany – Bavaria and Lower Saxony, as well as in Austria) and to contrast with the State Forests in Poland in order to show the direction for possible future changes in this respect in Poland.

An overview of the literature

The framework for the implementation of forest management in Poland is laid down in the Forest Act of 1991. It is defined in Article 6 of the Act as "activities aimed at shaping the structure of forests and their utilisation in such a way as to maintain their biological diversity, high productivity and regeneration capacity, vitality and ability to fulfil all relevant protective, economic and social functions at local, national and global levels now and in the future, without damaging other ecosystems" (Act, 1991). The concept of "multifunctionality" was introduced by the National Policy on Forests (Ministry of Environmental Protection, Natural Resources and Forestry, 1997), which recognises that forests perform "a variety of functions either naturally or as a result of forest management activities", with "many types of forest functions being simultaneously complementary or derived from each other and variable in time and space".

The principle of sustainability, first of timber supply and then of timber production, was formulated in the 18th century (Klocek, 2005). The term "forest functions", as it is understood today, was introduced and popularised by Dieterich in 1953. In formulating forest function theory as the basis of multifunctional forestry based on the principle of sustainability, he assumed that "benefits" are natural interactions of the forest that become "welfare benefits" when they satisfy societal needs and societal needs are referred to as 'forest functions' (Bader & Riegert, 2011). Dieterich's concept was expanded in the following years and formed the basis for today's definition of sustainable forest management, which takes equal account of ecological, economic and social aspects and is in line with the concept of sustainability defined at the Earth Summit in Rio in 1992 (Volz, 2006) and is also supported by the Forest Europe Process (MCPFE, 1993).

Forest function theory is to be understood as a political and socio-functional approach to systematising the possibilities of forest use, but also as an explanation of the social significance of forestry. The use of the term "forest functions" implies the idea of the "unity of forest and forestry". According

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to this idea, the principle of multifunctional forestry implemented by forest enterprises secures and guarantees all forest functions for society (Oesten & Roeder, 2012). According to this view, maximising the benefits for society is possible when the various functions of the forest are in balance, for which the state, represented by the forest service, is responsible. Foresters are able to harmonise the different functions by harvesting and selling timber on the one hand and carrying out long-term and sustainable forest management on the other (Pistorius et al., 2012). An extension of the forest function theory is the "wake theory", which is based on the assumption that the subordination of forest management exclusively to timber production promotes the fulfilment of other forest functions. The fulfilment of the social and natural functions of the forest, therefore, does not have a negative effect on the economic situation of the forest enterprise (Klocek, 1999; Oesten & Roeder, 2012).

Despite the strong establishment of forest function theory and its widespread use in European countries, it is often criticised (Ripken, 2004; Pistorius et al., 2012). Its main weakness is the assumption that all forest functions are provided and delivered as a consequence of timber production and that the different forest services are treated equally, although they have different characteristics from a socio-economic perspective. The lack of distinction between "forest benefits" and "forest management services" consequently leads to additional financial burdens and lower returns for forest enterprises that are supposed to provide forest functions for society as a whole (Klocek, 2003; Volz, 2006). In the 1980s and 1990s, this approach led to an economic crisis in the state forests of Austria and many German federal states, which forced reforms in forest administration and management as well as the commercialisation of forest enterprises (Klocek, 2006; Oesten & Roeder, 2012). Examples of the solutions introduced in the 1990s and in the first decade of the 21st century are the public-law companies in several German federal states and the public limited company that manages the federal forests in Austria.

A relatively new approach to forests is the concept of ecosystem services, which complements the concept of forest functions and expands the possibilities for recognising and exploiting the potential of forest ecosystems in times of climate change and increasing societal needs (Kindler, 2016). In contrast to the concept of forest functions, its application offers the opportunity to consider forest ecosystem services at different spatial and temporal scales, to identify the relationships between them (e.g. synergies and trade-offs between ecosystem services) and to determine the demand and supply of these services (Bennett et al., 2009; Kaliszewski et al., 2024). The concept of ecosystem services is based on the assumption that ecosystems and society are two different domains. Ecosystems represent a fixed capital stock that can provide a variety of benefits to people with limitations (Costanza & Daly, 1992). Ecosystems provide services to society and thus contribute to social welfare. Ecosystem services are thus the link between ecosystems and society, and there is a dynamic relationship between the two spheres: humans cause – directly or indirectly – changes in ecosystems, and changes in ecosystems affect humans (Hassan et al., 2005; Danley & Wildmark, 2016).

The concept of ecosystem services formulated in the 1970s was further popularised by the Millennium Ecosystem Assessment – a United Nations assessment of human impact on the environment in the period 2001-2005 (Hassan et al., 2005). In it, ecosystem services are broadly defined as "the benefits that people derive from ecosystems". Despite the formulation of many other proposals, this definition is still one of the most commonly used (Bartkowski, 2017). Timber – the most important source of income and the economic basis for sustainability in forestry – is also a service understood in this way (Poturalska et al., 2024).

The use of ecosystem services by humans means that a benefit and a value can be attributed to them. It is important to point out that the valuation of ecosystem services is a much broader concept than determining their monetary value, as it also includes their non-use value (de Groot et al., 2012; Bartkowski, 2017). Determining the value of ecosystem services is done for a number of purposes, including:

- creating public awareness of the value of ecosystems and justifying public spending on their maintenance and protection,
- providing information on the importance of ecosystem services to various stakeholders,
- supporting decisions in assessing the environmental impacts of alternative activities,
- identifying the beneficiaries and those who bear the costs of activities related to the use of the natural environment,
- creating incentive schemes or markets for ecosystem services (Mavsar & Varela, 2014).

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The commercialisation of ecosystem services does not mean that they are sold directly to individual customers. The economic instruments used in practice include subsidies and grants, tax concessions and exemptions, tradable permits, certificates, the creation of markets for ecosystem services and contracts for the provision of certain services (Prokofieva & Wunder, 2014).

One way to improve the financial situation of forestry enterprises is to diversify their sources of income. Diversification is closely linked to portfolio theory and the "diversified investment portfolio" (Markowitz, 1952). It describes the selection of portfolio components that simultaneously reduce risk and maximise return (Pieniacka, 2016). Diversification can be achieved by a company expanding into areas where it can better utilise its existing capabilities or certain resources (e.g. market) or by a company becoming involved in areas unrelated to its existing business (e.g. finance) (Shapiro & Varian, 2007). In the context of forestry, one way to diversify revenues may be to sell ecosystem services provided by sustainable forest management or other areas of forest enterprises (Merlo et al., 2000; Ungerböck et al., 2015).

Research methods

Two economic entities from Germany were included in the study: the Bavarian State Forests (Bayerische Staatsforsten, BaySF) and the Lower Saxony State Forests (Niedersächsische Landesforsten, NLF). The Austrian Federal Forests (Österreichische Bundesforste, OeBF) were also analysed. The structure of their revenues and the changes in this structure over the last 9-13 years (2011-2023; for the NLF, the available data covers the period 2013-2021) were analysed. The data source for the revenue structure of these organisations was their annual economic reports. Revenue from timber sales was specified, and the areas that can be considered as revenue from the sale of non-timber ecosystem services – i.e. benefits derived from the ecosystems managed by the analysed companies – were identified, excluding revenue from administrative activities, consulting, financial operations, etc. The results of the three companies were compared with the information for the State Forests (PGLLP) published in the annual financial and economic reports.

The revenues from the sale of ecosystem services were assumed to be the revenue from the following activities of the analysed companies (which are listed in the economic reports of these companies):

- PGLLP: ancillary production (including hunting management, harvesting of Christmas trees, bark or undergrowth),
- BaySF: hunting and fishing management (including revenues from the sale of game, the sale of hunting licences, the lease of hunting districts on state-owned land), ancillary activities (e.g. maintenance of natural areas, recreation, extraction of raw materials), specific services of general interest (maintenance and improvement of protective forests, restoration of wetlands, creation of cycling and hiking trails in the forest and creation of biotope connections),
- NLF: non-timber forest products, hunting management, maintenance of the recreational function,
- OeBF: hunting and fishing management, property management (tourism, water management), management of natural areas.

As the percentage share of the individual revenue categories was analysed, there was generally no need to standardise the currency. Where necessary, revenue in PGLLP, expressed in Polish zloty, was converted into euro at the average euro exchange rate published by the National Bank of Poland on 29 December 2023 (€1 = PLN 4.3480) (National Bank of Poland, 2023).

The study analysed the share of revenue from timber sales, the share of revenue from hunting (and possibly fishing) and the share of revenue from the sale of other ecosystem services.

In formal terms, BaySF, NLF and OeBF are enterprises – the former in the form of a public limited company in which the Austrian federal government holds all shares, the other two in the form of public law institutions (originally Anstalt des öffentlichen Rechts). The State Forests Holding is not a company, as according to the State Enterprise Act of 1981 (Act, 1981), one of the characteristics of a state enterprise is the possession of a legal personality, which the PGLLP does not have and merely represents the state treasury with regard to the assets it manages (Act, 1991).

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Results of the research

The area managed by the German and Austrian companies analysed varies and is significantly smaller (9-22 times) than that of PGLLP. However, it should be noted that PGLLP is the largest public forestry company in the European Union (Eustafor, 2016) and that there is no other comparable public forest enterprise in the EU. At OeBF, the forest area accounts for about 60 % of the area managed by the company, which is the lowest proportion among the discussed business units. There are considerable differences in employment levels between the companies. NLF has the highest employment rate per unit area, while PGLLP has a slightly lower rate. NLF also has the highest income per hectare. The income of PGLLP is significantly lower, about 38% lower than that of NLF. Even lower incomes are recorded in OeBF, which also has the lowest yield per hectare of forest area – more than twice as low as NLF (Table 1).

Table 1. General characteristics of the state forest enterprises analysed (data for 2023, NLF – 2021)

Characteristics	State Forests (PGLLP)	Bavarian State Forests (BaySF)	Lower Saxony State Forests (NLF)	Austrian Federal Forests (OeBF)
Managed area [1000 ha]	7624	808	340	850
Forest area [1000 ha]	7339	757	323	510
Share of forests in the area [%]	96	94	95	60
Employment [1000 pers.]	25.8	2.2	1.2	1.0
Employment per land area [pers./1000 ha]	3.38	2.72	3.53	1.18
Annual revenues [mln €]	3 221.7	510.7	232.4	344.7
Annual revenues per land area [€/ha]	422.5	632.1	683.5	405.5
Timber harvest [million m^3]	40.07	5.39	2.47	1.87
Average timber harvest [m^3/ha of forest area]	5.46	7.12	7.64	3.67

Source: authors' work based on General Directorate of the State Forests (2024), Bavarian State Forests (2023), Lower Saxony State Forests (2022a) and Austrian Federal Forests (2024).

Revenue from timber sales accounts for between 84 and 91% of the BaySF's total income, with the proportion rising again in the last two years after several years of decline (to 84% in 2021). The NLF and OeBF have a significantly lower share of timber sales revenue at 56-67% and 46-53%, respectively. It is noteworthy that the share of revenue from timber sales in the OeBF has also increased by several percentage points in the last two years (Figure 1), which is due to the increase in average timber prices in Europe (Ekström, 2022).

At 86-89% of total income, revenue from timber sales in the PGLLP is similar to that of the BaySF (Figure 1). It is noteworthy that timber utilisation intensity is higher in the BaySF than in the PGLLP (Table 1), which could be influenced by the higher proportion of richer upland habitats in the BaySF.

At 7.7-10.7%, the proportion of income from hunting and fishing is significantly higher in the OeBF than in the other companies analysed. In the NLF, income from hunting accounts for 2.1-3.6% and in the BaySF for 1.6-2.3% of total income, while in the PGLLP, it only accounts for 0.6-0.8% of total income. The differences between OeBF and the other companies would be somewhat smaller, namely 0.8-1.1 percentage points, if fisheries management is excluded. At the same time, it must be added that the income reported for PGLLP also includes income from other ancillary production. On average, hunting management accounts for 96% of PGLLP's income from ancillary production.

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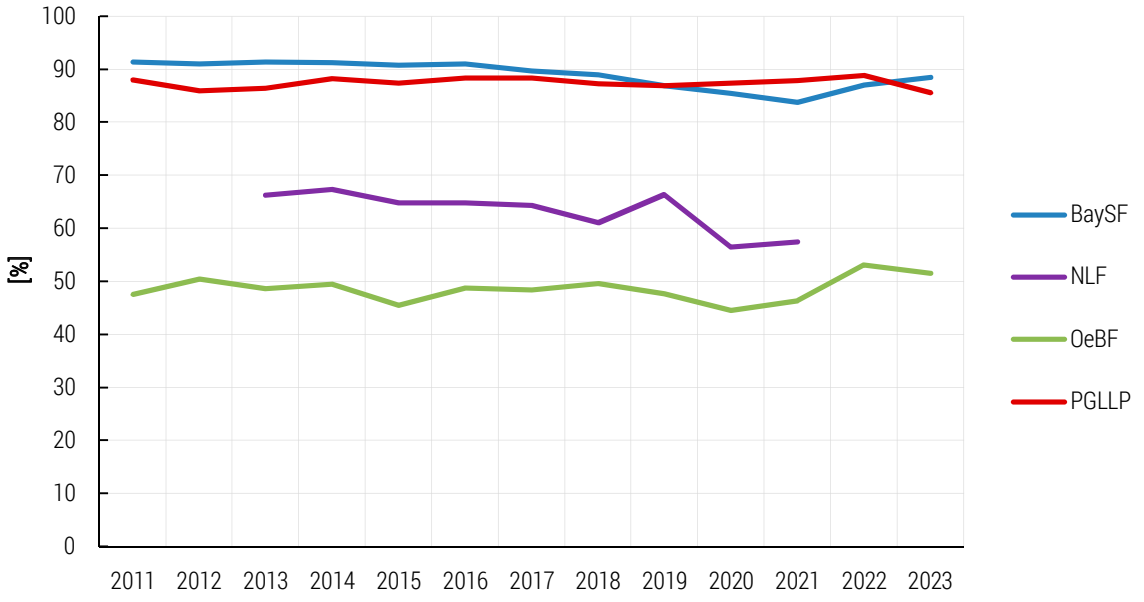

Figure 1. Share of revenue from timber sales in the total revenue of the forestry companies analysed from 2011 to 2023

Source: authors' work based on General Directorate of the State Forests (2012-2024), Bavarian State Forests (2011-2023), Lower Saxony State Forests (2015-2022a) and Austrian Federal Forests (2012-2024).

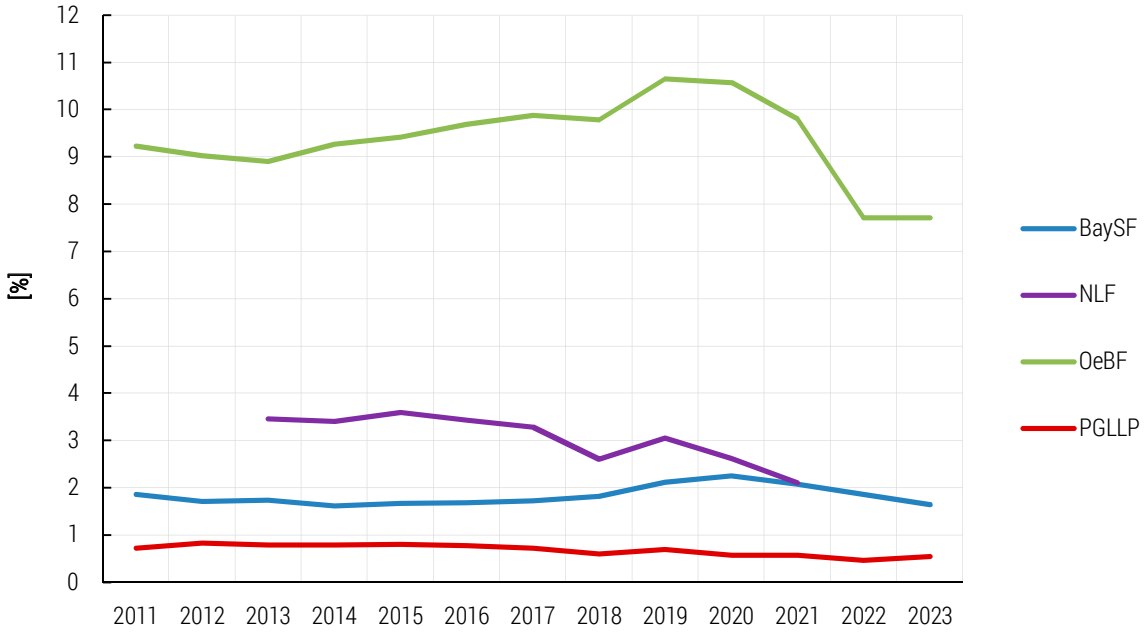

Figure 2. Share of income from hunting and fishing (BaySF, OeBF) and ancillary production (PGLLP) in the total income of the forest companies analysed from 2011 to 2023

Source: authors' work based on General Directorate of the State Forests (2012-2024), Bavarian State Forests (2011-2023), Lower Saxony State Forests (2015-2022a) and Austrian Federal Forests (2012-2024).

The share of other income identified with income from the sale of ecosystem services is many times higher in the OeBF than in the NLF and BaySF (Figure 3). It is noteworthy that this income group fluctuates significantly over time in all the enterprises analysed.

In addition to the data for the OeBF, Figure 4 shows the information broken down by the various income groups included in the analysis. Tourism activities account for between 5.5% (2012) and

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8.5% (2020) of total income in OeBF. Also noteworthy is the income from natural area management, which accounts for between 2.4 and 4.4% of total income (3.3% on average). The amount of these revenues is strongly influenced by the fact that the OeBF manages two national parks, for which it receives funding from the federal states, as it does for the management of other valuable natural areas.

In the financial and economic reports of the PGLLP, the income cannot be shown in the above-mentioned categories, but selected points are nevertheless included in the discussion.

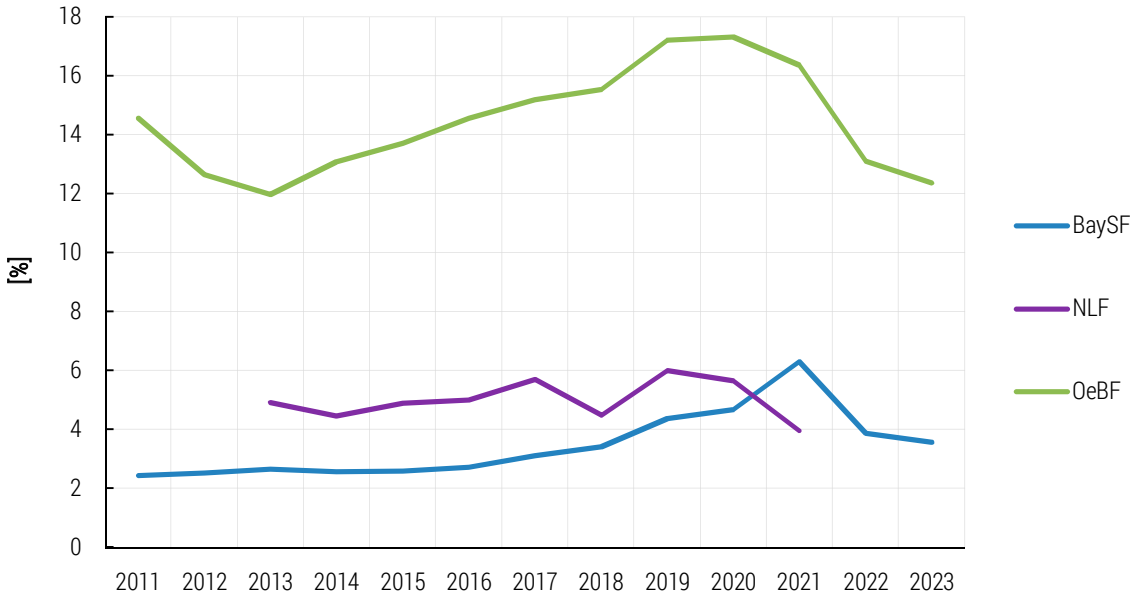

Figure 3. Share of revenues from other activities (except hunting and fishing) identified with the sale of ecosystem services in the total revenues of the analysed forest enterprises between 2011 and 2023

Source: authors' work based on Bavarian State Forests (2011-2023), Lower Saxony State Forests (2015-2022a) and Austrian Federal Forests (2012-2024).

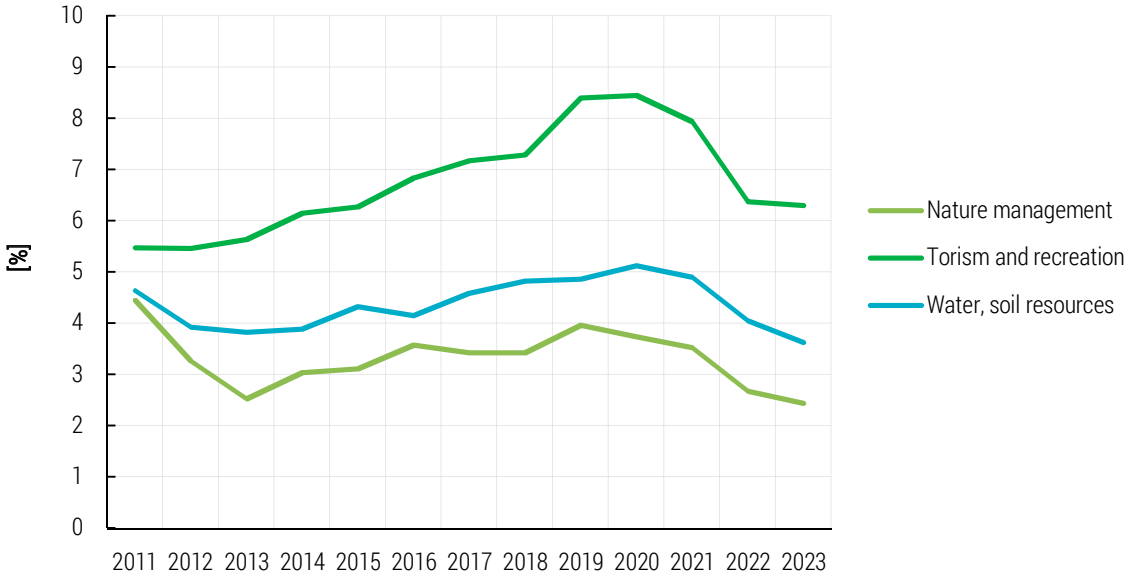

Figure 4. Share of revenue from other areas (excluding hunting) identified with ecosystem services in the OeBF from 2011 to 2023

Source: authors' work based on Austrian Federal Forests (2012-2024).

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The revenue from ecosystem services comes from various sources for the companies analysed. In the case of PGLLP, income from ancillary production comes from the sale of products and services on the market (Regulation, 1994). The ecosystem services listed in the NLF are financed through subsidies from the state (e.g. maintenance of the recreational function) or through the sale of products and services at market conditions, as in the case of the management of non-timber forest products from hunting management (Lower Saxony State Forests, 2022b). The BaySF derives its income from hunting and fishing from sales on the market, while a significant part of the remaining income consists of subsidies from the state budget (e.g. maintenance of natural areas or specific services in the public interest (Bavarian State Forests, 2020; Bavarian State Forests, 2023). The OBF sells services to private individuals and companies (hunting and fishing, real estate management) or generates revenue on the basis of contracts with the federal states and public organisations (development of natural areas) (Austrian Federal Forests, 2017, 2020, 2023).

Discussion

The study presented here shows that within the structure of forest enterprises, revenues from the sale of ecosystem services other than timber can be of significant importance. Two of the four business units investigated, PGLLP and BaySF, are characterised by a high proportion of income from the sale of timber, which was around 85-90% over the entire study period. However, the difference between the two companies should be noted – at PGLLP, revenues from non-timber products (ancillary production) account for only 0.5-0.8% of total revenues, while at BaySF, they range from 4.2% to over 8.4%. In the other two companies (NLF and OeBF), the share of revenue from timber sales is much lower, ranging from 56.5% to 67.4% at NLF and from 44.5% to 53.2% at OeBF. The strong increase in revenue from timber sales between 2022 and 2023 in the three companies for which data is available (PGLLP, NLF, OeBF) is mainly due to the strong rise in timber prices across Europe (Ekström, 2022).

An important area of revenue is hunting (and fishing in the case of OeBF and BaySF). The activities included in this category have different scopes in each company, so a clear comparison is not possible. Revenue in this category is 1.6-2.3% for BaySF, 2.1-3.6% for NLF and 7.7-10.7% for OeBF, with the latter accounting for between 0.6 and 1.2 percentage points of revenues from fisheries management). In the PGLLP, hunting revenues account for 93-95% of ancillary production revenues, but ancillary activities alone account for less than 1% of total PGLLP revenues. However, it should be noted that the PGLLP also receives income from fisheries management, but this is not counted as an ancillary activity but as a supplementary activities such as transport or repair services in workshops. All supplementary activities account for 0.1-0.2% of PGLLP income (General Directorate of State Forests, 2021, 2023).

The most diverse area is the companies' income from other activities (apart from timber sales, hunting and fishing). They are, therefore, difficult to compare. In addition, income in this group varies greatly from year to year. The broadest spectrum is found in the OeBF and includes real estate management (tourism and recreation, water management) and the management of natural areas, including nature and forest management tasks in two national parks (Austrian Federal Forests, 2021, 2023). The remaining three enterprises are not active in national parks. The share of revenue from the sale of ecosystem services in this group in the OeBF was between 12.0% and 17.3% (Figure 3), with revenue from tourism and recreation accounting for the highest share. In the NLF, the share of revenue in this category was between 4.0 and 6.0% and in the BaySF, it was between 2.4% and 6.3% with a clear upward trend (except in 2022-2023, when the share of revenue from timber sales increased).

It should be noted that due to the large differences between the companies concerned, both in terms of the extent of commercialisation of ecosystem services and the revenues generated from them, due to the large differences between the companies concerned, both in terms of the area of activity and the socio-economic environment in which they operate. Compared to the Austrian and German state forest enterprises, PGLLP's income from the sale of non-timber ecosystem services is negligible. According to the Forest Act (1991), PGLLP operates on a financially autonomous basis and covers its operating costs from its own revenues. In fact, since the beginning of its operation in its current organisational and legal form, i.e. since 1992, PGLLP's financial result has been positive every year, although it derives its income mainly from timber sales. However, it should be noted that the

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forestry service is also maintained nationwide within the framework of financial independence. In the absence of a separate public forest administration, the Forest Service in Poland *de facto* performs some of the tasks that in other countries are assigned to separate, publicly financed forest administrations.

PGLLP may receive subsidies from the state budget for certain tasks commissioned by the state administration on the basis of Article 54 of the Forestry Act. Some of these tasks can be defined as the provision of ecosystem services, including the purchase of forests and areas for afforestation and their restoration, the afforestation of former agricultural land, the management and protection of forests in the case of a threat to their sustainability, the protection of plant and animal species or the financing of forestry education for the public. In practice, subsidies in this area are of marginal importance: in 2023, they amounted to PLN 2.34 million, i.e. 0.015% of PGLLP's revenue (General Directorate of State Forests, 2024). In contrast, the funds from the state budget (grants, task agreements with the federal states) are of considerable importance for the other analysed companies and are used for the management and protection of nature (NLF, BaySF, OeBF) as well as for the development of recreational infrastructure and tourism (NLF, BaySF). In addition, there is a wider range of tourism and recreation development services that are sold to private and public organisations, particularly in the case of OeBF.

Forest management is currently under increasing pressure to expand forest areas with a dominant nature conservation function. It must also consider aspects related to the role and importance of forest resources in mitigating climate change and the impact of the increasing demand for wood as an energy source. Added to this is the growing demand for recreation and leisure activities in the forest (Paschalis-Jakubowicz, 2010; Gołos & Kaliszewski, 2016). All of these processes can lead to conflicts with timber production (Blatter et al., 2020).

At the same time, timber sales are and will probably always be the basis for the income of forest companies, as they enable the provision of numerous ecosystem services that are essential for human life and the smooth functioning of society (Pistorius et al., 2012). However, the demand for timber is subject to cyclical fluctuations (in the case of OeBF and BaySF, in particular, between 2022 and 2023). In addition, the ongoing environmental, social and – as a result – political changes, which may lead to a significant reduction in the economic use of forests, make it necessary to find alternative sources of income in order to reduce dependence on the sale of timber alone.

The revenue dependency of public forest administrations in Germany and Austria led to an economic crisis in the 1980s and 1990s and forced reforms in forest administration and management as well as the commercialisation of forest enterprises (Klocek, 2006; Oesten & Roeder, 2012). As a result, the enterprises established during the reforms generate much more income from the sale of diversified services, including ecosystem services. The current economic situation of PGLLP indicates that the diversification of income sources will not change fundamentally in the coming years. However, in the situation of increasing restrictions on forest management and timber harvesting, the introduction of legal regulations and instruments that enable PGLLP to diversify its sources of income will be necessary and should already be the subject of attention and discussion by the forestry community social organisations and decision-makers.

Conclusion

The restriction of public forest management in Germany and Austria, which was caused by the increasing demands of nature conservation and the fulfilment of social tasks, led to an economic crisis in the 1980s and 1990s and forced administrative and forestry reforms as well as the commercialisation of forestry enterprises. Today, the enterprises that emerged from the reforms generate significantly more income from the sale of various services, including ecosystem services. The current economic situation of the PGLLP indicates that no far-reaching change in the diversification of income sources is necessary or will take place in the coming years. However, in the situation of increasing restrictions on forest management and logging resulting from both social demand and climate and nature conservation policies, the development of legal regulations and instruments to diversify PGLLP's sources of income may become necessary and should already be the subject of attention and discussion by the forest community and social organisations and decision-makers.

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The contribution of the authors

Conceptualization, A.K. and M.J.; literature review, A.K. and W.M.; methodology, A.K. and M.J.; formal analysis, A.K., M.J. and W.M.; writing, A.K. and M.J.; conclusions and discussion, A.K., M.J. and W.M.

The authors have read and agreed to the published version of the manuscript.

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ZRÓŻNICOWANE USŁUGI EKOSYSTEMOWE JAKO ŹRÓDŁO DOCHODÓW W LEŚNICTWIE – PORÓWNANIE WYBRANYCH EUROPEJSKICH PAŃSTWOWYCH PRZEDSIĘBIORSTW LEŚNYCH

STRESZCZENIE: Obecna polityka środowiskowa i klimatyczna oraz oczekiwania społeczne, mogące prowadzić do ograniczenia pozyskania drewna w lasach, mogą wpłynąć na model zrównoważonej gospodarki leśnej, oparty przede wszystkim na przychodach ze sprzedaży drewna. Problem ten może również dotyczyć Państwowego Gospodarstwa Leśnego Lasy Państwowe (PGLLP) w Polsce, które prawie 90% swoich przychodów czerpie ze sprzedaży drewna. W artykule omówiono możliwości dywersyfikacji źródeł przychodów w wybranych państwowych przedsiębiorstwach leśnych w Europie (Polska na tle Bawarii i Dolnej Saksonii w Niemczech oraz Austrii) w oparciu o koncepcję usług ekosystemowych i ich sprzedaży. Analiza opiera się na danych finansowych pochodzących z raportów rocznych analizowanych przedsiębiorstw. Rozwiązania zastosowane w niektórych krajach pokazują, że przychody ze sprzedaży usług ekosystemowych innych niż drewno mogą stanowić istotną część dochodów przedsiębiorstw leśnych, a ich doświadczenia można wykorzystać przy opracowywaniu przyszłych strategii w Lasach Państwowych.

SŁOWA KLUCZOWE: zrównoważona gospodarka leśna, dywersyfikacja, przychody, usługi ekosystemowe

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