
Operating Profit in Non-Industrial Forestry in Finland: Analysis of Income, Expenses and Efficiency 2016-2023

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Abstract:

Purpose: The study aimed to analyze the structure of income, expenses, and financial efficiency of the private non-industrial forestry sector in Finland from 2016 to 2023. The main focus was on understanding how specific categories of expenses, such as forest regeneration and young stand management, affect the sector's operational performance, particularly in the context of reduced state subsidies.

Design/Methodology/Approach: The study employed a quantitative approach and utilized several methods. Secondary data analysis was conducted using data from the Finnish Statistical Office, which enabled the examination of the dynamics of income, subsidies, and expenses in relation to the sector's financial performance. Structural and comparative analysis was also performed to identify dominant cost categories and their changes over time, comparing results across different years and regions. Additionally, correlation analysis was used to investigate the relationship between expense categories and operating profit, employing Pearson's correlation coefficient.

Findings: The study revealed significant differences in financial performance across regions. The highest operating profits were achieved in 2022, when the sector's efficiency exceeded 800%, coinciding with a reduction in state subsidies. The lowest results were recorded in 2020, which was associated with higher subsidies and a challenging timber market situation caused by the COVID-19 pandemic. Correlation analysis indicated that costs related to forest improvement and subsidies showed a strong negative correlation with operating profits, suggesting that they did not yield the expected financial benefits. In contrast, administrative costs had a positive impact on financial results, highlighting the importance of effective management. The increase in administrative costs was correlated with higher operating profits, underscoring the significance of efficient management in improving the sector's profitability.

Practical Implications: The results of the study provide insights into optimizing expenditures and modifying subsidy policies. The development of modern technologies is crucial, as they can enhance management efficiency and improve the sector's resilience to changing market and climatic conditions.

Originality/Value: The study combines economic and ecological approaches to forest resource management, highlighting their impact on the sector's financial performance. It contributes to the development of forest economics, emphasizing the importance of sustainable management amid decreasing state support.

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1. Introduction

Forests are integral to both the economic and social well-being of Finland. Sixty percent of Finland's forest land is privately owned, with the state controlling 26 percent. Companies, including those in the forestry industry, own nine percent, and the remaining five percent is held by various other entities. These forests provide numerous opportunities for income generation, job creation, and business support through their material resources and recreational value.

As Finland's most crucial renewable natural resource, forests will become increasingly valuable as the demand for natural resources grows. The diverse roles of forests from supplying wood products and energy to offering recreational and well-being benefits highlight the need for their extensive yet sustainable use. Additionally, forests are vital in addressing and adapting to climate change challenges (Ministry of Agriculture and Forestry of Finland, 2024).

In this sector, both revenues and expenses related to forest management and regeneration significantly impact operating profits. This study aims to analyze the income, expenditure structure, and financial efficiency of private non-industrial forestry in Finland from 2016 to 2023. Understanding how specific expenditure categories, such as forest regeneration or management of young stands, affect operating profits is crucial.

The study is particularly relevant in the context of cost optimization and the reduction of state subsidies, which have historically supported the private non-industrial forestry sector. The reduction of these subsidies presents new challenges for financing investments and maintaining sustainable forest resource management.

The key research questions addressed in this study are:

- How did income (earnings and state subsidies) evolve during the analyzed period?

- Which expenditure categories dominated in the non-industrial forestry sector?
- How do individual cost categories impact the sector's operating profit?
- How did the decreasing level of state subsidies affect the financial results of the non-industrial forestry sector?

The results of this analysis aim to provide a clearer understanding of the sector's income and expenditure structure, leading to more effective financial management and better planning for future investments.

Additionally, this research can inform decision-makers in formulating public policies that support the sustainable development of Finland's non-industrial forestry sector, especially in light of decreasing state subsidies. The study also contributes to forest economics by exploring the financial aspects of non-industrial forestry activities, considering both ecological and economic perspectives. This comprehensive approach enhances understanding of the relationship between financial policy and efficient forest resource management.

However, one significant limitation is the small sample size of data, covering only eight periods (2016 to 2023). This limited timeframe may not fully capture long-term trends and variations, potentially affecting the generalizability of findings.

2. Literature Review

The literature was selected based on a basic bibliometric analysis. Particular emphasis was placed on two databases, Scopus and Web of Science. The choice of these databases was dictated by their versatility, prestige, and recognition in the scientific community.

Operating profit, often referred to as Earnings Before Interest and Taxes (EBIT), represents the profit a company makes from its operations, excluding any interest expenses and taxes. This measure provides insight into the company's core profitability by focusing solely on operational performance without the influence of financing and tax obligations (Jayathilaka, 2020).

There is extensive literature on operating profit, especially in the context of industrial enterprises, analyzing the relationships between income, expenses, and the financial efficiency of organizations. There are many studies on various economic sectors that examine the impact of cost structures on the profitability of enterprises, as well as the role of state subsidies in financing companies' operational activities.

However, in the context of forestry, especially private and non-industrial forestry, there is a lack of similar analyses that would thoroughly examine the impact of operational expenses on profit in this sector. Over the past two years, publications on forest management have emerged, but they mainly focus on ecological issues, forest

protection, sustainable forest management, and the role of forests in combating climate change in countries such as Sweden, Norway, and Canada.

There have also been studies on the attitudes, goals, and preferences of Finnish forest owners regarding forest protection and alternative climate change mitigation strategies in Finnish forests. A study conducted by Verónica Rodríguez-Vicente and Manuel F. Marey-Pérez in northern Spain analyzed the management of non-industrial private forests (NIPF) by their owners.

The focus was on forestry economics attributes such as farm investments, planting and forestry management expenses, public subsidies, and income from timber and other sources. Interviews were conducted with forest landowners to understand their engagement in land management between 1999 and 2003.

The study's results showed that attractive forest profits and favorable market conditions for timber production are key factors influencing forestry investments. Personal and family conditions also play a significant role in land management. The multiple regression model used in the study explained 84.5% of the variability in forest planting activities, indicating the importance of both investments and forestry income, as well as farm size (Rodríguez-Vicente and Marey-Pérez, 2010).

In a study by Ronald Raunikaar and Joseph Buongiorno, the willingness of non-industrial private forest (NIPF) owners in the south-central United States to forgo some timber profits in favor of non-timber values (NTV) was analyzed. The study found that many NIPF owners prefer to maintain a more diverse and natural forest structure, even at the expense of lower timber profits.

The average NIPF owner was willing to forgo 60% of timber profit to preserve the naturalness of their forests compared to more profitable but less diverse industrial plantations (Raunikaar, Buongiorno, 2006).

This study fills a significant gap in the literature on the financial aspects of managing private and non-industrial forests in Finland. Previous analyses have mainly focused on ecological, social, and general economic aspects of forest management but are limited in terms of both timeliness and geographical specificity. It also updates and adapts the approach to the contemporary realities of the forestry sector in Finland, analyzing the period from 2016 to 2023. Unlike previous works, it takes into account the specificity of Finnish conditions and the current economic and political context. The study focuses on the detailed structure of income and expenses in the non-industrial private forestry sector, as well as the impact of declining state support on financial results.

Thus, it addresses the need to update knowledge that is lacking in the existing literature. This study not only contributes new knowledge to the field of forestry economics but also provides practical insights for forest owners and policymakers, enabling a more informed approach to managing private forests in Finland.

3. Methodology

This study uses a quantitative approach to investigate the income, expenditure and financial performance of the non-industrial forestry sector in Finland in the period 2016-2023. The following methods were used:

- **Secondary data analysis:** The study is based on aggregated data from Statistics Finland, covering key categories of income (earnings and state subsidies) and expenditure (forest regeneration, management of young stands, etc.). These data were analysed over time to identify changes in the sector, which allowed the examination of the dynamics of income, subsidies and expenditure in the context of the sector's financial performance.
- **Structural and comparative analysis:** A detailed analysis of the expenditure structure identified the dominant cost categories and their changing shares over time. The results were compared with income data to assess their impact on operating profit. Comparative analysis allowed the comparison of results across years and regions, taking into account the specifics of a local market such as Lapland.
- **Correlation analysis:** This was carried out to investigate the relationship between expenditure categories and operating profit achieved in the non-industrial forestry sector. This method allowed us to determine which cost categories, such as forest regeneration, management of young stands or improvement of forest condition, have the strongest relationship with the level of operating profit. The Pearson linear correlation coefficient was used to examine the relationship, which determines the strength and direction of the linear relationship between two variables.

The results are presented using line, bar and pie charts, providing a clear picture of changes in income and expenditure structures and their impact on operating profit during the period under review. This approach identified key trends and phenomena in the sector. The analysis adopted a deductive approach, drawing conclusions based on available data and simple statistical analyses. The results of the study were contextualized within the framework of economic theories on natural resource management and financing of the forest sector.

4. Research Results and Discussion

In the following analysis, the results of calculations regarding revenues and expenses in private non-industrial forestry are presented. The focus was on determining which cost categories had the greatest impact on operating profits during the studied period. Due to the limited number of available data (only 8 periods), appropriate statistical analyses were conducted, including the normality test (Shapiro-Wilk) which allowed for the correlation analysis between operating profit and other variables. This section also presents charts, tables, and formulas that illustrate the

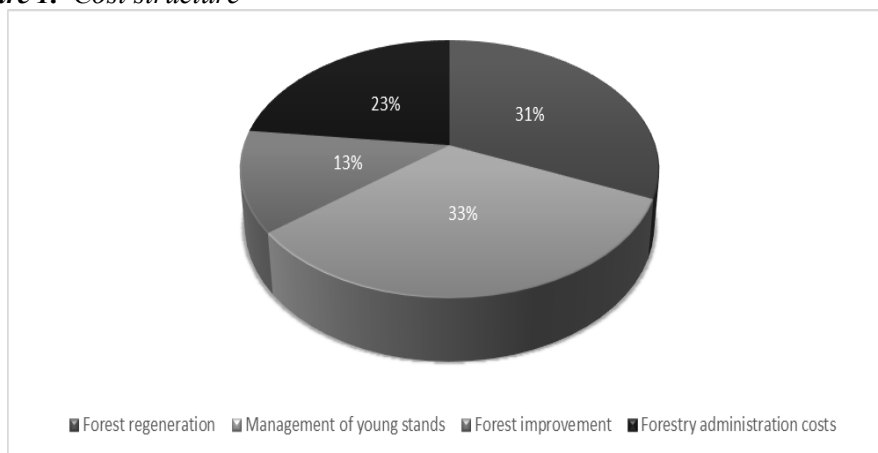
results of these analyses. The discussion focuses on interpreting the obtained results in the context of changing economic and political conditions in Finland.

5. Analysis of the Revenue and Cost Structure

Between 2016 and 2023, earnings in private non-industrial forestry in Finland significantly increased from 130.5 euros/ha in 2016 to 191.7 euros/ha in 2023. This increase occurred despite a significant decrease in subsidies, which fell from 3.8 euros/ha in 2016 to 3.1 euros/ha in 2023. At a critical point in 2022, the subsidy was only 2.7 euros/ha, but this did not significantly affect the earnings level, which amounted to 178.8 euros/ha.

Throughout the study period, investment costs in timber production remained relatively stable, ranging from 14.7 to 17.2 euros/ha. Since the variables related to forest regeneration costs, young stand management, forest condition improvement, and forestry administrative costs had a normal distribution (as confirmed by the Shapiro-Wilk test), the arithmetic mean for these costs was used during the study period. Additionally, a graphical presentation of the structure of these costs was conducted, as shown in Figure 1.

Figure 1. *Cost structure*



Source: *Author's calculations based on Statistics Finland 2023.*

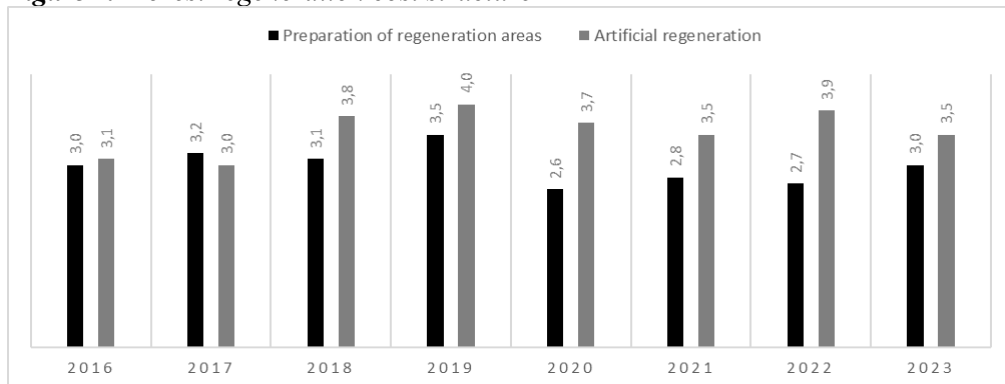
On average, the most costly aspect during the study period was the management of young stands, indicating that this phase of forest development requires special attention and financial resources to ensure the proper quality and condition of the stands in the future.

Additionally, this may suggest the need to increase investments in this part of forestry to minimize the risk of suboptimal growth of young trees, which could consequently lead to higher costs in later stages of timber production. The least costly among the presented group was forest condition improvement.

The costs of investments in wood production include forest regeneration costs, young stand management costs, and forest improvement costs. Forest regeneration costs are divided into the costs of preparing regeneration areas and artificial regeneration. Management of young stands costs are divided into the costs of tending seedling stands, improving young stands, and initial clearing of intermediate felling areas. Forest improvement costs are divided into forest fertilization costs, forest ditches, and the construction and basic improvement of forest roads.

The costs associated with investments in timber production encompass a wide range of activities that together form a comprehensive forest management process. Their diversity reflects the complexity of this sector and the multifaceted nature of the activities necessary to maintain healthy and productive stands. The structure of all cost groups is presented in Figure 2.

Figure 2. Forest regeneration cost structure



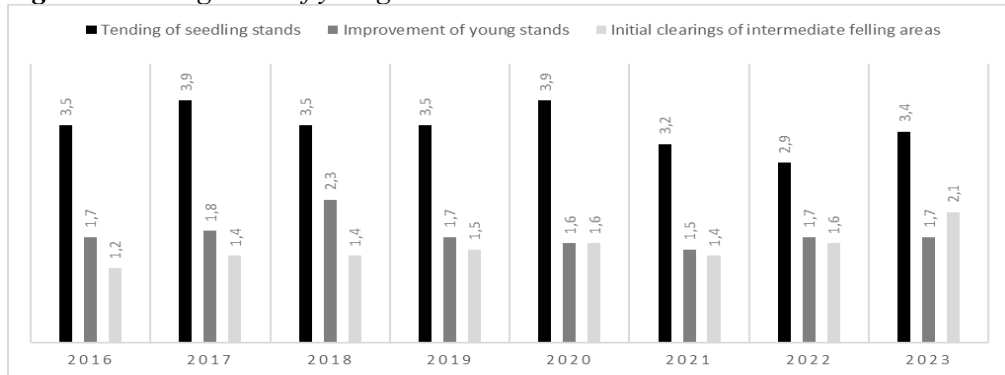
Source: Author's calculations based on: Statistics Finland 2023.

Figure 2 shows that during the analyzed period, the costs of artificial regeneration almost always exceeded the costs of preparing regeneration areas, except for the year 2017, which was an anomaly from the general trend. Artificial regeneration, being a more intensive and demanding process, generated significant financial expenditures compared to activities related to preparing the area for forest renewal.

Figure 3 shows that in the group of costs related to management of young stands, the most costly was the tending of seedling stands. This category maintained its dominance throughout the analyzed period, indicating its crucial importance in ensuring the optimal growth and development of young trees.

The costs associated with this category resulted from the need for regular maintenance activities, such as pruning, shaping trees, and eliminating competing vegetation, which allowed for achieving the appropriate density and quality of the stand. The second most costly category was the improvement of young stands.

Figure 3. Management of young stands cost structure

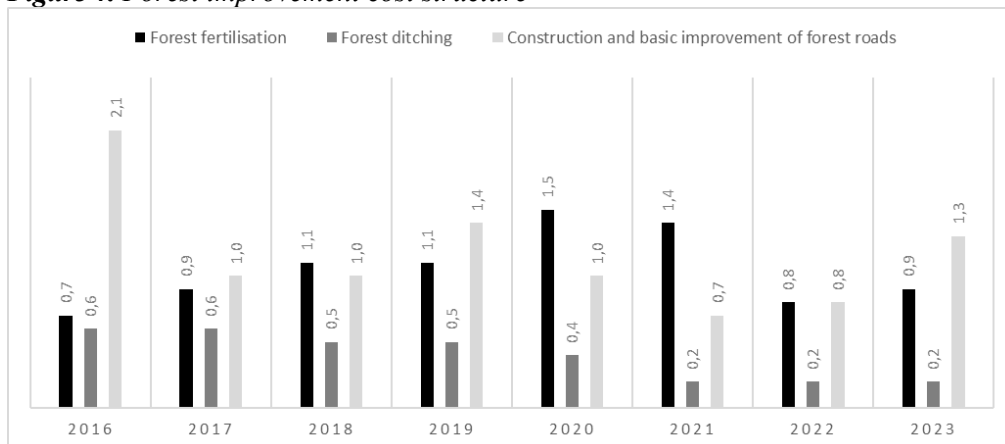


Source: Author's calculations based on: Statistics Finland 2023.

Although this category generated lower expenditures compared to the tending of seedling stands, its role in the management process was significant. The improvement of stands included activities such as selecting and removing less valuable trees to support the growth of those with greater commercial or ecological potential. The lowest costs in the analyzed group were generated by the initial clearing of intermediate felling areas.

Although this category involved significant preparation of areas for further activities, it required relatively fewer financial resources compared to more intensive maintenance processes. However, activities in this area were crucial for maintaining order in forest areas and enabling the effective conduct of subsequent stages of young stand management. The cost structure indicates that young stand management requires prioritizing maintenance activities, as they form the basis for obtaining high-quality stands in the future. Relatively lower expenditures on other categories show their more supportive nature in the context of the entire process.

Figure 4. Forest improvement cost structure



Source: Author's calculations based on: Statistics Finland 2023.

In the group of costs related to forest improvement, the costliness of these activities showed a variable trend from year to year. However, the costs of forest ditches remained at the lowest level in this group.

The largest portion of expenditures was for the construction and basic improvement of forest roads, which consistently reached the highest values during the analyzed period, particularly in the years 2016, 2017, and 2020. The costs associated with forest fertilization were moderate, ranging from 0.2 to 0.9 euro/ha, showing greater changes in the years 2020–2023.

The increase in earnings with relatively stable costs, even despite the reduction in subsidies, was associated with an increase in operating profit from 113.9 euros/ha in 2016 to 173.7 euros/ha in 2023. Therefore, operating profit appears to be independent of subsidies, which may indicate growing operational efficiency in private non-industrial forestry.

This may suggest that forest owners in Finland were able to optimize their operations, increasing efficiency and profitability despite decreasing government subsidies. The increase in profit may also result from higher timber prices. In Finland, timber prices showed an upward trend from 2016 to 2023. The real return on investment in timber production in non-industrial private forests was 10.4% in 2023.

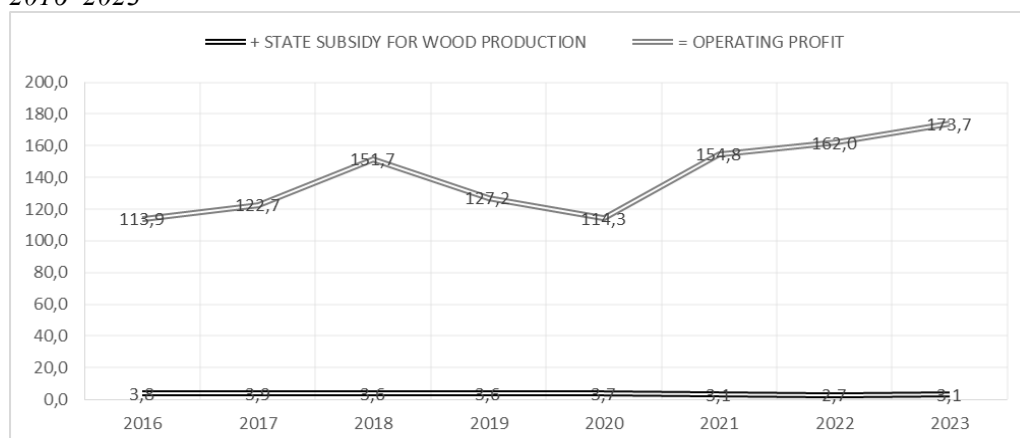
The increase in profitability was contributed to by the rise in timber prices, which has a significant impact on the return rate calculated by the Finnish Natural Resources Institute (Luke). The return rates excluding stumpage price changes were 4.1% (Statistics Finland, 2023). The increase in timber prices in Finland from 2016 to 2023 contributed to the increase in operating profit in private non-industrial forestry, despite the decline in subsidies.

Higher timber prices allowed for higher revenues from raw material sales, which positively affected the sector's profitability. However, despite the overall increase in price levels and labor, it is worth noting the aspect of maintaining a relatively stable level of costs.

The highest operating profit values were recorded in the regions of Päijät-Häme, Kanta-Häme, and South Karelia, while the lowest were in the regions of Lapland, Kainuu, and North Ostrobothnia. The structure of these values is presented in Figure 6 below.

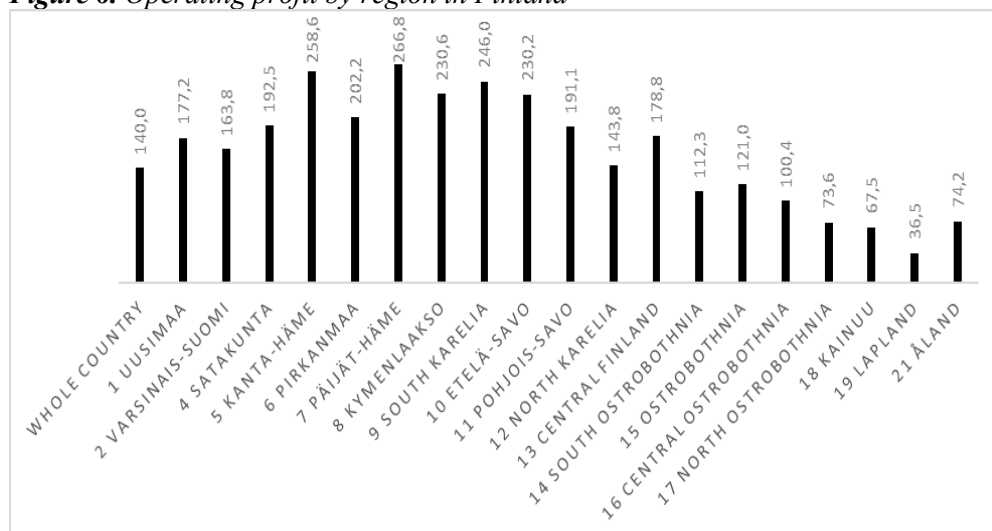
This variation is due to different geographical conditions, availability of raw materials, and management efficiency in individual regions. The most profitable regions are characterized by more intensive use of forest resources and better access to infrastructure, while the regions with the lowest profit values face more challenging climatic conditions and higher transportation costs.

Figure 5. Impact of state subsidies on timber production and operating profit in 2016–2023



Source: Author's calculations based on: Statistics Finland 2023.

Figure 6. Operating profit by region in Finland



Source: Author's calculations based on: Statistics Finland 2023.

6. Assessment of Financial Efficiency

In this part of the study, the focus was on assessing the financial efficiency of the non-industrial forestry sector in Finland from 2016 to 2023. Financial efficiency is one of the key indicators that allows for evaluating how well the forestry sector manages its financial resources in terms of generating income, controlling costs, and achieving operating profits.

This analysis includes an examination of operating profits (EBIT), which result from

the sector's operational activities. Based on calculations conducted on data from 2016 to 2023, the dynamics of financial results were assessed, identifying years of higher and lower efficiency, as well as analyzing changes in the cost and income structure. To calculate efficiency, the following formula was used:

$$\text{Efficiency} = \frac{\text{Operating profit}}{\text{Total wood production costs}} \times 100\%$$

The most efficient year for the Finnish non-industrial private forestry sector was 2022, when the subsidy was the lowest. Efficiency exceeded the 800% threshold at that time. Conversely, the least efficient year was 2020, when the subsidy remained at 3.7 euros/ha. Efficiency in that year was 547%. The year 2020 was less efficient primarily due to lower profit compared to costs.

The operating profit in 2020 was 114.3 euros/ha, the lowest in the entire period (although the differences were not drastic), and the costs of 20.9 were relatively high compared to other years. This may be due to poorer conditions in the timber market (e.g., reduced demand for timber, price changes). It is also possible that external factors such as the COVID-19 pandemic may have affected activity and production, which could have reduced total revenue and efficiency. The table below shows the efficiency of the non-industrial private forestry sector year by year. The average efficiency of the entire sector during the study period was 680%.

Table 1. Efficiency in the private non-industrial forest sector

2016	2017	2018	2019	2020	2021	2022	2023
558%	604%	706%	578%	547%	798%	827%	823%

Source: Author's calculations based on: Statistics Finland 2023.

7. Correlation Analysis

In order to accurately analyze the relationships between various cost categories and operating profit in the non-industrial forestry sector in Finland, a correlation analysis was conducted, based on a previously performed normality test. The Shapiro-Wilk test, applied to each of the selected variables, showed that the data distribution for all examined variables is normal.

This means that data such as forest regeneration costs, young stand management costs, forest improvement costs, forestry administrative costs, operating profit, and subsidies meet the normality assumptions, allowing for further correlation analysis using Pearson's linear correlation coefficient for 8 periods. The correlation analysis allowed for examining the extent to which individual expenditure categories affect the financial performance of the sector, measured by operating profit (EBIT).

The linear correlation between forest regeneration costs, young stand management

costs, forest improvement costs, forestry administrative costs, subsidies, and operating profit allows for assessing which of these variables have the strongest impact on the sector's profitability. The results of the correlation analysis are presented in the table, and the interpretation of the results takes into account both the strength and direction of these relationships.

This made it possible to determine which costs have the greatest impact on financial efficiency, and whether state subsidies play a significant role in improving the sector's financial performance. Ultimately, the conducted analysis provides valuable information on the financial structure of the non-industrial forestry sector, which can help in further improving financial management strategies and cost optimization in the future.

In the conducted Pearson linear correlation analysis, the operating profit (dependent variable) was correlated with five explanatory variables: forest regeneration costs (X1), management of young stands costs (X2), forest improvement costs (X3), administrative costs (X4), and subsidies (X5). The results of the correlation analysis are presented in Table 2:

Table 2. *Pearson linear correlation results*

X1	X2	X3	X4	X5
0.18	-0.04	-0.77	0.73	-0.83

Source: *Author's calculations based on: Statistics Finland 2023.*

Forest regeneration costs (X1): The correlation coefficient was 0.18, suggesting a very weak but positive correlation between forest regeneration costs and operating profit. This means that higher costs associated with forest regeneration do not have a significant impact on the increase in operating profit during the study period. The value of the coefficient indicates that this relationship is rather marginal and does not have a substantial impact on the sector's profitability.

Young stand management costs (X2): The correlation coefficient was -0.04, indicating a very weak, practically zero correlation, and thus no significant impact of these costs on operating profit. Costs associated with managing young stands have virtually no impact on the sector's profitability, suggesting that these expenditures are not crucial for the financial performance of the forestry sector during the study period.

Forest improvement costs (X3): The correlation coefficient was -0.77, indicating a strong negative correlation between forest improvement costs and operating profit. The higher the costs associated with forest improvement, the lower the operating profit. This relationship may suggest that expenditures on forest improvement during the analyzed period did not bring proportional financial benefits and actually reduced the profitability of the forestry sector.

Forestry administrative costs (X4): The correlation coefficient was 0.73, indicating a significant positive correlation between administrative costs and operating profit. Higher administrative costs have a positive impact on the sector's financial results, which may suggest that these expenditures are associated with better management and organization of forestry activities, leading to a higher level of operating profit.

Subsidies (X5): The correlation coefficient was -0.83, indicating a very strong negative correlation between subsidies and operating profit. The higher the subsidies, the lower the operating profit, which may suggest that the increase in subsidies during the analyzed period did not contribute to increasing the profitability of the forestry sector.

It is possible that higher subsidies were applied in years when the sector faced financial difficulties, which did not allow for higher profits. It is also possible that the increased financial support was not properly utilized to improve operational efficiency, and its allocation did not result in increased sector revenue. Such results may suggest that subsidies were not sufficient to balance operating costs, especially in the context of high expenditures on forest improvement, which had a negative impact on operating profit.

The results of the correlation analysis indicate a varied impact of different cost categories and subsidies on the operating profit of the non-industrial forestry sector in Finland. The strongest negative correlation with operating profit is shown by forest improvement costs and subsidies, suggesting that these variables had a negative impact on the sector's profitability.

On the other hand, administrative costs, although associated with a positive correlation, suggest that appropriate investments in management can help improve financial results. Forest regeneration costs and young stand management had minimal impact on operating profit, which may indicate their marginal significance in the context of the sector's overall profitability during the analyzed period.

8. Conclusions, Proposals, Recommendations

The conducted studies on the financial efficiency of the non-industrial forestry sector in Finland from 2016 to 2023 showed significant variation in financial results across different regions of the country. Regions with the highest operating profits, such as Päijät-Häme, Kanta-Häme, and South Karelia, are characterized by better access to forest resources and developed infrastructure.

In contrast, regions with lower financial results, such as Lapland, Kainuu, and North Ostrobothnia, face more challenging geographical conditions and higher transportation costs. The financial efficiency analysis, measured by the EBIT indicator, showed that the highest operating profits were achieved in 2022, when subsidies were the lowest, and the sector's efficiency exceeded 800%.

The least efficient year was 2020, when subsidies were higher, and operating profit was the lowest, which may suggest the negative impact of external factors such as the COVID-19 pandemic and a more challenging timber market situation. The correlation analysis indicated a varied impact of different costs on the sector's profitability.

The strongest negative correlation with operating profit was shown by costs related to forest improvement and subsidies, suggesting that the increase in these expenditures did not bring the expected financial benefits. On the other hand, administrative costs had a positive impact on financial results, indicating the importance of proper sector management. The studies provide valuable information on the financial structure of the non-industrial forestry sector in Finland.

These results can form the basis for developing more effective forestry policies aimed at improving the sector's financial efficiency. Despite the sector's high profitability, the studies indicate the possibility of further optimizing its operations.

It is worth focusing on even more efficient use of forest resources, adjusting subsidy policies, and further developing modern technologies that can enhance management efficiency. Investments in innovative solutions can help maintain this high profitability and increase the sector's resilience to market and climate changes.

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