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Article

Economic Forest Sustainability: Comparison between Lithuania and Sweden

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Abstract: The study conceptualizes economic forest sustainability as "the forest-related income and economic well-being sustained over time" and then compares Lithuania and Sweden at different scales. Sweden adopts a holistic perspective of the forest sector, where forestry and forest industries are perceived as a well-integrated economic branch. Forestry is expected to deliver raw material to forest industries, at the same time creating good preconditions for profitable forest management. Forest owners are given large freedom to act according to market signals and their own household needs, while the resulting intensive forest management cumulatively leads to a significant contribution to the country's welfare. Lithuania, in contrast, lacks an integrated sector perspective, forestry and forest industries being regarded as two separate realms. Private forest property rights are severely constrained by numerous legislative stipulations, leading to a significant reduction of economic value in production forests. On top of that, thirty percent of private owners face additional restrictions through forestland zoning, leading to further substantial loss of economic value. We suggest several measures for improving the economic forest sustainability in Lithuania, where a genuine national forest program could serve as a suitable bearing medium.

Keywords: forest sector; forestry; private forest owner; net present value; social equity

1. Introduction

European regions and countries exert a high diversity in approaches to managing their forests [1]. This applies also to the Baltic Sea region, where the prevailing forest management paradigms range from intensive production-oriented forestry in Sweden to close-to-nature forestry in Germany [2]. Within the region, Lithuania and (Southern) Sweden constitute two interesting case countries for international comparison, as both share rather similar nature conditions and a rather high importance of forest sector in the national economy, but differ radically in terms of the trajectories of their socio-economic development. Sweden represents a stable and rich EU economy, where forestry is based on the long-standing tradition of private forest ownership, private family forests occupying roughly one half the total forest area. The remaining half is divided almost equally between private forest companies and public bodies. Lithuania has been going through a radical socio-economic transition, after breaking from the Soviet Union in 1990. As other sectors, forestry and forest industries had to cope with the complete remake of the polity and learn to operate under conditions of a market economy. A significant feature has been the restitution of ownership to the pre-World War II landowners and their heirs. As a result, roughly half of forest area is owned and managed by the State; 40% of the area is covered by private family forests; and the remaining 10% is still reserved for the restitution.

Several studies have seized the opportunity to compare various aspects of Lithuanian and Swedish forestry. The examination of priorities by forestry stakeholders and the actual forest management practices revealed that Lithuanian forestry is indecisive in terms of adhering more to the German or to the Scandinavian forestry school [2]. An analysis of forest management planning and policy instrumentation revealed that Lithuanian forest policy primarily relies on regulatory steering, while informational policy tools are most important in Sweden [3]. Of particular relevance to this study, it has been found that, compared with Sweden, the recorded forest condition in Lithuania is more favorable for biodiversity and that current policies and management are likely to increase this gap in coming years [4]. The authors [4] do however note that their study "only treated possible forest management impacts on biodiversity indicators, without examining the economic efficiency, social equity or other socio-economic implications. (…) while the socioeconomic implications are of great importance, they need to be left for future research".

Our study starts where Brukas *et al.* [4] had left. If they focused on the environmental forest sustainability, the current study spotlights its economic pillar, aiming to critically compare the economic forest sustainability in Lithuania and Sweden. We can hypothesize that Sweden may perform better in terms of economic forest sustainability due to its long-term tradition of production-oriented forestry and respect of owner rights [5]. On the other hand, superior performance could also be reasonably expected in Lithuania, due to increased attention to economic effectiveness when transitioning to the market economy [6], substantially lower costs of labor [2] and higher forest productivity than in Sweden, on average [7,8]. In our view, such a comparative study is highly suited

for operationalizing the economic dimension of the much-disputed concept of forest sustainability, through spotlighting its most important features and highlighting the strengths and weaknesses of the respective country. We start with defining the concept of economic forest sustainability and then conduct comparative analysis at different scales.

2. Concepts and Methods

2.1. Conceptualizing Economic Forest Sustainability

The origins of the term "sustainability" or "sustainable utilization" (*Nachhaltige Nutzung*) are found in German forestry. Responding to the timber famine in Central Europe, this concept was used already back in the 18th century to describe the fundamental tenet of the emerging scientifically-based forestry: to seek an even flow of timber [9]. Over the 20th century, the term was complemented by the concept of 'multiple forest use', highlighting the fact that forest delivers other important products and services in addition to timber [10]. The modern concept of 'sustainable development' was rooted in the so-called Bruntland report, accentuating that today's needs should be satisfied without compromising future generations' possibilities to satisfy their needs [11]. Since then, the number of meanings and interpretations has proliferated [12]. The term has been problematized due to its vagueness [13], the inherent contradiction between the aspirations to sustain *versus* to develop [14] and for the inevitable tensions between the interests representing the environmental, social and economic pillars of sustainability [15]. Others suggested de-emphasizing these contradictions and instead allowing the plurality of interpretations, while focusing on improving policies simultaneously concerned with wellbeing, equity and ecological integrity [16]. A recent qualitative review of forest management sustainability [17] did not find a conceptual convergence of the term. On the contrary, the reviewers found clear disciplinary biases and self-referential tendencies of research groups. This might be in part determined by researchers' conscious attempt to reinforce their own interpretations, while diminishing external influences [17]. Such findings indicate that a universally valid definition of (economic) forest sustainability cannot be synthesized from the scientific literature. Instead, there is a need for *ad hoc* conceptualizations, suiting the purpose and context of the particular study. With this background, we propose the following definition: "Economic forest sustainability refers to the forest-related income and economic well-being sustained over time and without compromising the environmental and social pillars of sustainability".

While this wide definition explicates the general focus, it does not capture the particularities of different contexts, scales and actors. For example, what is economically sustainable forest management for a private forest owner might be a much less sustainable forestry practice for society, and *vice versa*. Therefore, when examining (economic) sustainability, we need to be explicit about whose perspective we consider. In this study, we take the challenge to address two very different scales and perspectives: (i) at the macro (national) level, we critically compare the economic sustainability of the whole forest sector; this sheds light on the overall economic role of forest sectors in the analyzed countries and provides the contextual background for (ii) the micro scale, where we look at the differences in "optimizing" the economic sustainability for a private forest owner who is a primary direct user of forest resources in both countries.

2.2. Analysis at Macro Level

Widely differing approaches can be employed for examining (economic) sustainability. At one extreme, scholars may engage in a philosophical inquiry, as, e.g., [18] do, by problematizing relationships between sustainable development, distributional equity, optimal growth and pure time preference. Such fundamental studies are definitely important for testing the ethical ground for sustainable development. However, in its pure form, this mode is too abstract for a comparative analysis of forest sectors in two countries. At the other extreme, measurement of sustainability is often attempted by devising internationally acknowledged sets of criteria and indicators (C&I), such as the Pan-European C&I for sustainable forest management [19]. Contrary to the formally stated intentions, these are more frequently used for political negotiations or simply for structuring international reporting, rather than as functional instruments to measure and monitor sustainability [20]. Just a glimpse into the Pan-European C&I suffices to realize that they are too decontextualized to suit the purposes of our study.

We take a middle ground between the outlined extremes and combine different analytical approaches. Based on the syntheses of scientific sources and our cumulative insight, we firstly provide brief narratives [21] on key features of forest sectors. They purport to impart a system view of the sectors, encompassing forestry and forest industries in the case countries. Helped by sources from national statistics, we then complement the narratives with a set of quantitative indicators, enabling a meaningful comparison of economic sustainability at the macro level. The analysis is guided by the following question: how do, in comparative terms, Lithuanian and Swedish societies economically benefit from forest as an important form of land use?

2.3. Analysis at the Micro Level

If the macro level analysis estimates the societal economic impacts of forestry and forest industries as a whole, the micro level examines the economic gains that a private family owner can get from managing her forest. As a point of departure, we compare the current forest management "frameworks", consisting of the prevailing paradigms and forest management models. The forest management paradigm embraces the underlying tenets of forestry, the guiding forest management ideas shared by dominant forestry stakeholders in the analyzed country. At a more operational level, it is necessary to differentiate between landscape-level and stand-level forest management models, since some management activities could be regulated at the landscape (or forest) level, exceeding the boundaries of a single estate; while other management decisions pertain to particular forest stands within an estate. Thus, the landscape-level forest management model pertains to landscape-level decisions, such as sustained yield requirements based on area control, or forestland zoning. The stand-level forest management model is a forest management approach applied at the stand level, ranging from a specific forest operation (e.g., soil preparation for planting) to a silvicultural system extending over decades (thinning regimes).

We do not make an attempt to compare how all or selected owners actually align their decisions with the forest management frameworks in respective countries. Such an assessment is largely impossible at reasonable precision, given the large variety of estate and forest characteristics coupled

with highly individualized sets of goals by every owner [22,23]. Neither is it in the interest of this study to see how profitability is affected by the structural differences of ownership, such as the average estate size, or by contextual economic variables, such as different management costs and timber price structures. Instead, we are interested in what a hypothetical forest owner can gain from her forest given the "permissible" management regimes. For this purpose, we take a 1-ha forest stand of average characteristics in Lithuania and estimate its economic value, assuming the economically rational behavior of the owner when facing Swedish or Lithuanian silvicultural stipulations.

We start the economic analysis by estimating the cash flows for a stand of two of the economically most important tree species, Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*). Taken together, pine and spruce make up 58% of the total standing volume in Lithuania [7] and 82% in Sweden [8]. The chosen stands represent average productivity for the species, corresponding to the average height of dominant trees at a stand age of 100 years at 24 meters for pine and 28 meters for spruce. The timber growth models [24], assortment tables [25], observed timber prices [26] and actual costs of silvicultural activities served for estimating the cash flows throughout rotation.

Next, we estimate economic value for an average statistical stand in a private forest of Lithuania. The stand age is the crucial variable, averaging 61 years for pine and 53 years for spruce [7]. We estimate the net present value (NPV), which is widely recognized in the economic literature as the most appropriate criterion in forest capital analyses [27]. It accounts for the value of time by discounting the future costs and revenues back to the present. In our case, NPV equates the sum of the net revenue from the final felling at the end of the rotation and the soil expectation value (equivalent to the value of bare land for perpetual rotations), both discounted to the present value:

$$NPV = \left(\mathrm{R}_F + \frac{\sum_{t=0}^{n} R(1+r)^{n-t} - \sum_{t=0}^{n} C(1+r)^{n-t}}{(1+\mathrm{r})^n - 1} \right) \Big/ (1+r)^{n-t} \quad (1)$$

where: R_F, net revenue from the final felling; r, discount rate; n, length of forest rotation; t, stand age at which certain costs or revenues are incurred; R, revenue from a stand treatment; C, cost of a stand treatment.

Due to the long duration of forest rotations, the choice of discount rate has a major impact on the economic value. In this study, we use the discount rate of 3%, which is the recommended rate for private forestry in Lithuania [6] and is also the rate conventionally used in the Swedish forestry.

3. Results

3.1. Macro Level: Economic Sustainability for Society

3.1.1. Sweden: A Forest Sector Perspective

For centuries, Swedish forestry and forest industries have been essential contributors to building up the country's welfare [5]. Profitability from forest management and the evenness of revenues were stipulated already in the Forest Act of 1948 and remain important guiding principles to this day [2]. This has predetermined a widespread use of capital investment criteria, such as NPV, in establishing the silvicultural norms, as well as in routine decisions by forest owners and managers. Intensive forest management should secure a reliable supply of raw material for forest industries that traditionally have

a powerful position in the Swedish forest policy making [28]. Such a position is reinforced by the strong vertical integration, which, in turn, is safeguarded by: (i) the ownership structure, where one fourth of the Swedish forestland belongs to forest industries; and (ii) powerful forest owner associations that unify roughly one half of the Swedish family forest owners and run their own timber processing facilities. For example, the Southern Swedish forest owner association, Södra, today is the third largest producer of paper pulp in the world [29].

It is in this context that the Swedish non-industrial private forest owners and the Swedish forest industries form a strong production-oriented advocacy coalition [30]. During the last 2–3 decades, environmental actors have increasingly challenged this long-standing coalition, prompting ecological modernization of forestry. The effects of such modernization have, however, been modest in comparison to Lithuania [4], with the production-oriented coalition maintaining its dominant position. While the general environmental objectives have attained high status in the Swedish legislation, Swedish forestry was further deregulated during the revision of forest policy in the early 1990s. Forest owners are given great freedom for choosing a desired approach to forest management, and most owners tend to largely remain within the paradigm of intensive production forestry. These developments could have been stipulated by an intricate mix of factors, such as the adherence to proven long-standing forestry practices [31], the Swedish political culture of consensus-making among the well-established interest organizations [32] and the high sensitivity of an economically important sector to the world's markets [30]. Whatever the reasons, an important outcome in the context of our study is the highly integrated perspective of the forest sector (Figure 1). Forestry and forest industries are regarded jointly as an important branch of the Swedish bioeconomy, where the added value by forest industries constitutes the bulk of the monetary contribution from the sector (Table 1).

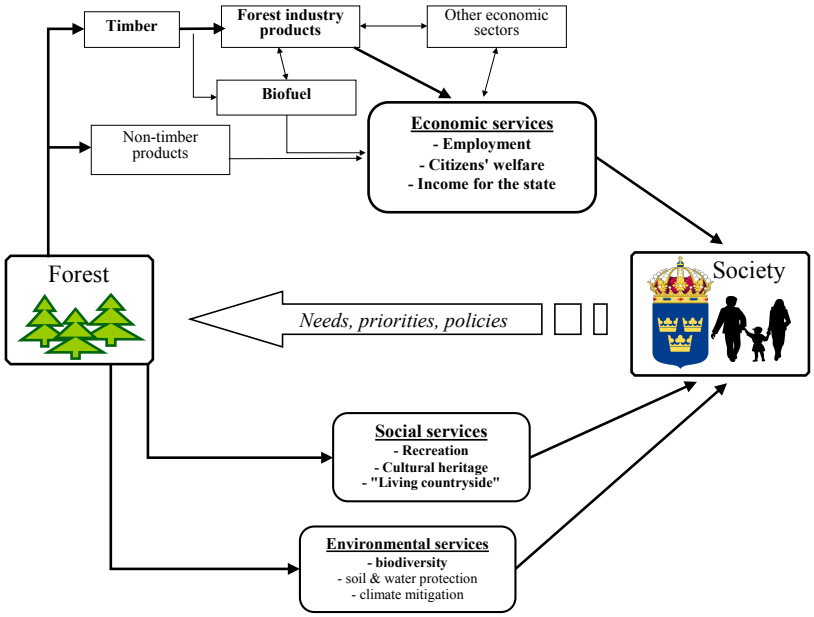

Figure 1. Macro perspective (forest sector) in Sweden.

3.1.2. Lithuania: A Forestry Perspective

Compared to Sweden, the Lithuanian forest sector operates against a radically different historical background [21]. The Soviet forestry administration (1944–1990) was characterized by a rigid hierarchical structure, with the Ministry of Forestry and Forest Industry on top of the hierarchy. The agendas of the ministerial and planning authorities were unquestioned by subordinates or outsiders and simply implemented by state forest enterprises and state-owned agricultural farms (*kolkhozes*). The top policy priority was the preservation of the domestic forestry resources, rather than maximizing revenues, either at an enterprise or at a national level [33]. Regaining of independence has brought radical changes in the external environment, including, but not limited to the transition to the market economy, a radical remake of the country's polity and the process of the restitution of land to the pre-World War II owners and their heirs, resulting almost in a quarter of a million "fresh" forest landowners.

Forestry and forest industry went on diverging paths of transition. The timber processing facilities were separated from the state forest enterprises, the whole timber industry being privatized. Though industrial forestland ownership is practically absent, timber industries have been featuring a rapid increase of the processing capacity, turning into a key branch of the Lithuanian processing industry [34]. Forest industry companies are fully exposed to the market forces in terms of both purchasing the raw materials and realizing their production. There are no national authorities specifically mandated with steering the development of forest industries.

The situation is entirely different in forestry. State forest managers and private forest owners are subjected to rigid regulation in the form of annual allowable cuts and numerous silvicultural stipulations. Several central bodies, including the Department of Forests under the Ministry of Environment, the State Forest Service and the Directorate General of State Forests, are involved in steering and supervision of private and state forestry. National forestry authorities strongly dominate the policy making, forest industries being effectively excluded from the respective arenas [35], while environmental interests gained strength in recent years through the powerful position of environmental authorities [16]. In sharp contrast to Sweden, national forestry actors primarily regard industries as harsh bargainers in timber purchases, and there are no attempts at designing an integrated strategy for the sector. Illustratively, the 15 page-long National Forestry Sector Development Program for 2012–2020 limits the role of forest industries to the statement that forestry and forestry industries together constitute an important branch of the Lithuanian economy. None of the program's 24 development criteria directly pertains to forest industries.

All in all, the Lithuanian macro perspective differs radically from Sweden (Figure 2). The economic performance is given a lesser priority, and most importantly, there is no integrated vision of the sector. Forestry and forest industries are rather viewed as two separate realms. This has formed the norm of seeing the forest management activity as an end in and of itself, without a targeted attempt at aligning the silvicultural systems with the industrial demands, be it through sectorial strategies or through an increased exposition to the market forces.

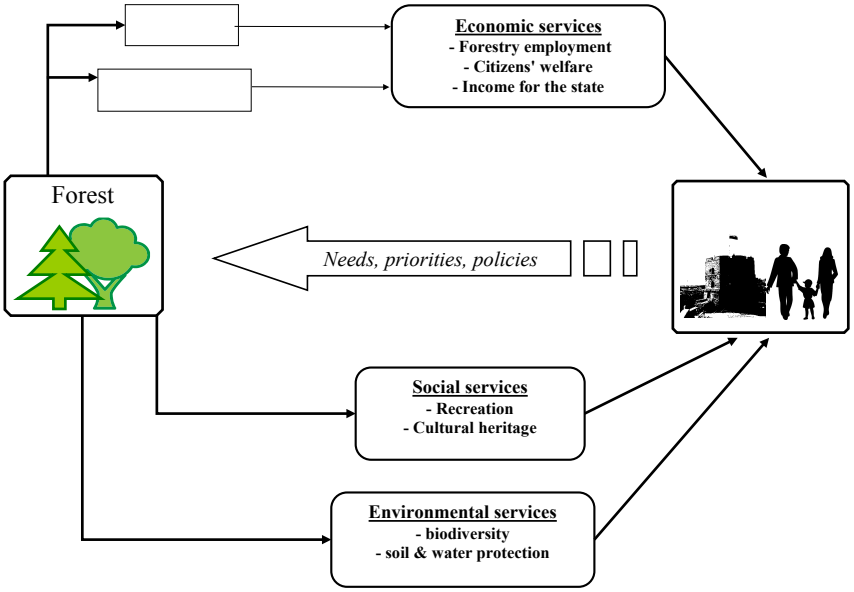

Figure 2. Macro perspective (forestry) in Lithuania.

3.1.3. Comparison of Macro Indicators

Table 1 juxtaposes selected key indicators of the Lithuanian and Swedish forest sectors, revealing some remarkable differences. The timber harvest-to-increment ratio represents a fundamental criterion, when regarding the potential for sustained timber flow and, in turn, the potential for sustained incomes from forest. The indicator values firstly demonstrate that decennial timber harvests are well below the increment, proving the accumulation rather than the depletion of resources. Secondly, the ratios clearly show more intensive forest utilization in Sweden, which harvests around two thirds of the total timber increment, compared to only around one half in Lithuania. The standing volume in Lithuania averages 244 m³/ha, which is considerably higher than in Southern Sweden (174 m³/ha) within comparable latitudes (Götaland region). The accumulation of volume in Lithuanian forests continues at a remarkable pace, showing a significant potential for increased utilization.

Table 1. Selected indicators of Lithuanian and Swedish forest sectors.

	Lithuania (LT)	*Sweden (SE)*	*% Difference*
Average annual harvest/increment ratio, % (2003–2012)	50	76	
Employment in forestry, people (2012)	10,900	15,700	
Employment in forestry, people/million ha forest (2012)	5450	680	701
Employment in the forest sector (excluding furniture) (2012)	35,300	74,700	
Employment in the forest sector, people/million ha forest (2012)	17,650	2554	591
Average nominal price of conifer sawn timber, Euro/m^3 (2010–2012)	46.8	57.1	

Table 1. *Cont.*

	Lithuania (LT)	*Sweden (SE)*	*% Difference*
Average nominal price of conifer pulpwood, Euro/m^3 (2010–2012)	30.1	35.3	
Total annual value of timber harvests, million Euros (2012 in LT, 2011 in SE)	292	3364	
Total annual value of industrial forest production, million Euros (2012 in LT, 2010 in SE) [1]	966	23,219	
Value of industrial forest production [1]/ value of timber harvests	3.3	6.9	
Total value of forest sector production [1]/ forest area, Euro/ha (2012 in LT, 2010 in SE)	629	1032	−64
Total forest industrial production [1]/ harvested timber, euro/m^3 (2010)	121	319	−164

[1] The estimates do not include furniture production.

Compared to Sweden, Lithuania records six-fold employment in the sector per normalized unit of forest area. On the one hand, the forest sector may be argued to play an important social role as a job provider, especially in the rural areas. One the other hand, the values of employment suggest a substantially lower level of technological advancement in the Lithuanian forest sector.

Though average prices for the main timber assortments are lower in Lithuania, the difference is relatively small compared to other indicators. This is in line with the proven integration of the regional timber markets [36] and is indicative of relatively similar market conditions that forest owners and industries face in the region. However, timber industries and the forest sector in Sweden perform remarkably stronger. Swedish timber industries add sevenfold value on the top of the value of timber harvests, while in Lithuania, the corresponding added value is three-fold. Furthermore, the total industrial production is considerable higher in Sweden, measured both per unit of forest area and per unit of harvested timber. Overall, the benchmarking of the key figures points to a significant potential to improve the economic performance of the Lithuanian forest sector or, in other words, to reinforce the economic pillar of sustainability at the societal level.

3.2. Micro Level: Forest Owner Perspective

When describing private family forestry, important keywords for Sweden and Lithuania are tradition and restitution, respectively. A statistical average owner in Sweden possesses 50 ha of forest [8] and has inherited her forestland from family or purchased it from other owners. A typical Lithuanian owner restored her ownership during the restitution process, an average forest estate only occupying 3.5 ha. Obviously, a typical Swedish owner is more prone to manage her forest following family traditions and has better forestry skills compared to the Lithuanian counterpart. In Lithuania, family traditions were broken due to the ban of private forest property in the Soviet era, while the current private forest owners are expected to comply with a rigid regulatory framework (Table 2).

Table 2. Current forest management (FM) models in Lithuania and Sweden. MARA, minimum allowable rotation age.

	Lithuania (LT)	***Sweden (SE)***
FM paradigm	The FM ideal: to obtain even, maximized timber flow of sawlog dimensions Forestry strongly regulated; similar regimes in state and private forests	Key aims: to support industries with pulpwood and timber; to secure preconditions for profitable forestry Large FM freedom, environmental consideration mainly through voluntary commitments
Landscape-level FM model	- Lithuanian FM is based on forestland zoning into functional forest groups, defining permissible FM regimes for each group - Annual allowable cuts based on age class control	- Regulation is minimal at the landscape level; some restrictions apply at property level, including the percentage of the area that can be clear-felled
Stand-level FM model	Prevailing model is even-aged FM with final clear or selective felling, often forming mixed semi natural stands: - Natural regeneration as common as artificial (~50%) - Thinning systems of rather low intensity, targeting maximum sawlog production at the end of rotation - MARAs fixed for species and forest groups - Environmental requirements include minimum quantities of deadwood and biodiversity trees	Prevailing model: even-aged management of conifer monocultures, prevalently spruce: - Artificial forest regeneration prevails (70%), with spruce as the dominant species (85%) (S. Sweden) - Rather intensive thinnings to "purify" species composition, improve stand structure and serve as a source of intermediate revenues - MARAs differentiated by site productivity, 60–90 years for pine and 45–90 years for spruce

Sources: [4,37,38].

In line with the described sectorial perspective (Section 3.1), Swedish forestry is expected to sustainably deliver important timber assortments to forest industries, while forest owners have good preconditions for managing their forest profitably. Owners are largely free from regulation at the landscape level. The most notable exception at the estate level is the requirement for estates exceeding 50 ha to avoid final felling to such an extent that more than a half of the productive estate area is covered by forest younger than 20 years [37]. At the stand level, Swedish forestry is based on an even-aged model of monocultures, where spruce is given preference due to its high profitability. Minimum allowable rotation ages (MARAs) are defined so as to prevent forest clearing at the young ages with a high current volume increment. For pine and spruce, MARAs are differentiated by site productivity, to account for the fact that the identical dimensions of timber assortments are reached earlier on more productive sites. To sum up, family forest owners in Sweden enjoy great decision freedom and, to a high extent, follow the established paradigm of economic forestry. They have considerable decision space to respond to market signals and to take into account the personal

household situation. Thus, the forest management framework enables the owner to conduct forestry that can be considered economically sustainable from a micro perspective.

Lithuanian forestry has its ideological roots in the classical theory of normal forest, purporting the even flow of timber from forests stands of maximum attainable productivity [2]. Adherence to the theory predisposes regulatory tendencies, e.g., in an attempt to attain an even forest age-class structure through area control. These tendencies were reinforced by the regulatory clout of the Soviet era, when the whole governance system was based on rigid steering and institutional hierarchies. Detailed stipulations of forest management plans constitute a good example in forestry. Such a heritage has obviously been important in shaping the forest policy of the independent Lithuania [21], which is meticulously steering private forestry and imposing largely the same stipulations as the state forestry.

Forest management at the landscape level is primarily accomplished through a system of so-called forest groups that are used to zone forestland to by the prevailing function: Group I or strictly protected forest reserves; Group II or protected forests with the primary function of environmental protection or to enhance recreational forest capacity; Group III or protective forests destined to protect soil and water; and Group IV or commercial forests with the primary function of timber production. Each forest stand (averaging 1.5 ha) in Lithuania is assigned to one of the groups. Certain base stipulations are prescribed for each forest group, including the types of permissible felling, the maximum allowed size of clearcut areas, if any, and MARAs (Table 3). The current system of zoning was hastily introduced in the mid-1990s, before the process of restitution gained impetus. Thus, private owners were returned their forests with already defined forest groups. It was a matter of luck if an owner happened to receive her forests zoned as Group II, III or IV. Only Group I is prohibited in private forests.

Table 3. Selected features of Lithuanian forest groups (forestland zones).

	Group I ***Forest reserves***	***Group II*** ***Protected forests***	***Group III*** ***Protective forests***	***Group IV*** ***Commercial forests***	***Total***
Silvicultural activity	Not allowed	Yes	Yes	Yes	
Clear felling	Not allowed	Not allowed	Up to 5 ha	Up to 8 ha	
MARA pine, years	-	171	111	101	
MARA spruce, years		121	81	71	
Area distribution of private forests, %	-	9	20	71	100

Sources: [7,37].

Numerous silvicultural prescriptions apply even if a stand is assigned the status of Group IV (commercial forests) [4]. In terms of economic value, the most crucial stand-level stipulation is MARA, as the length of rotation has a high impact on profitability, as well as on the owner's degrees of freedom in choosing a forest management regime. MARAs in Lithuania are defined according to the technical maturity, *i.e.*, the stand age at which the assortments of desired dimensions (sawlogs by the Lithuanian tradition) attain the highest mean annual increment. However, they are not differentiated by site productivity, e.g., the MARA for pine in forest Group IV is 101 years, irrespective of the site. This is odd, as following the technical maturity, MARAs can differ as much as 50 years between the most and the least productive sites [6].

Table 4 demonstrates cash flows for conifer stands assuming an economically rational forest owner that plants forest as prescribed by regulations and adopts thinning schedules aiming to form productive stands. Four options for final felling are provided, at stand ages corresponding to Swedish MARAs, as well as Lithuania MARAs for forest Groups II, III and IV. Cash flow is typical for a well-managed forest stand in the region. First, the owner incurs sizeable costs for forest regeneration, followed by the costs of tending and pre-commercial thinnings until the stand reaches 15–25 years. Some revenue is then received from commercial thinnings. Additionally, substantial net revenue comes from final felling at the end of rotation.

The resulting NPVs are presented in Table 5, revealing a very significant reduction of NPV due to high MARAs in Lithuania. The effects are especially severe for pine for which the gap between Lithuanian and Swedish MARAs ranges from 36 to 106 years. Even in commercial forests, the NPV is almost halved compared to Sweden. In forest Group II, a forest owner loses from around 75% to 90% of the economic value for an average statistical stand of both species.

Table 4. Cash flow for pine and spruce of average productivity in Lithuania.

Silvicultural measure	Scots pine		Norway spruce	
	Stand age	Cash flow, Euro/ha	Stand age	Cash flow, Euro/ha
Forest regeneration	0	−652	0	−941
Pre-commercial thinnings	5	−87	5	−87
	15	−72	15	−72
			25	−24
Commercial thinnings	25	211		
	45	487	45	685
	65	601		
Final felling, following ARAs				
- Sweden	65	6,283	60	7,848
- Lithuania, Group IV	101	9,557	71	9,493
- Lithuania, Group III	111	10,178	81	10,807
- Lithuania, Group II	171	11,178	121	13,419

Table 5. Net present values (NPVs), from average statistical conifer stands in Lithuania (LT) applying Swedish *versus* Lithuanian MARAs in forest Groups II–IV.

Tree species	*Southern Sweden*		*LT Group IV*		*LT Group III*		*LT Group II*	
	NPV, €/ha	*%* [a]	*NPV, €/ha*	*%*	*NPV, €/ha*	*%*	*NPV, €/ha*	*%*
Scots pine	5891	100	3147	53	2447	42	629	11
Norway spruce	6633	100	5887	89	4768	72	1727	26

[a] Percent values for each species are calculated by setting the Swedish NPVs to 100%, then estimating the percent share of Lithuanian NPVs for the species.

In addition to the loss of NPV, the Lithuanian forest owner is remarkably constrained in terms of possibilities to carry out the final felling, *i.e.*, the major income-bringing silvicultural treatment. As the statistical pine-dominated stand averages 61 years, one would need to wait 40 to 110 years until such stands reach the age of MARA, depending on the forest group. The corresponding waiting time for average spruce is from 18 to 68 years. Knowing that the average age of a Lithuanian forest owner is 53 years [39] and that the life expectancy is 74 years, it becomes obvious that most Lithuanian forest

owners would not have an opportunity to enjoy the revenues from clear felling during their lifespan. This creates an ethical dilemma. The restitution process has been carried out to restore justice by returning the property to pre-war owners and their heirs. However, due to the rigid regulatory framework, the inheritors cannot make real use of the timber stock accumulated on their property. If the average Lithuanian owner would instead face the Swedish MARAs, the average "waiting time" would only be four years for pine and seven years for spruce, giving a radically different range of economic options.

4. Discussion

4.1. Key Findings: Lithuania versus *Sweden*

After completing the challenge of multi-scale analysis, this study finds that Sweden performs better than Lithuania with regard to economic forest sustainability. At the macro level, the most salient difference is the prevalence of an integrated forest sector perspective in Sweden *versus* a much narrower forestry perspective in Lithuania, where forestry and forest industries are viewed as separate realms. In the case of Sweden, we identify a high consistency between micro and macro levels. Starting at the macro end, the integrated sector vision purports effective sector contribution to the country's welfare, seeking optimized raw material supply to timber industries, as well as reasonable profitability for forest owners. This is effectively achieved by letting the market mechanism steer the timber supplies, with little regulatory involvement by the state. At the micro end, a forest owner has a comparatively large freedom of choice, being able to decide on when to harvest according to the situation on the forest product markets, as well as the household situation. Having such freedom, many owners choose to manage their forest relatively intensively and to maximize revenues. This cumulatively leads to an increased contribution to the country's welfare due to both the demanded supplies to industries and owners' private spending.

In comparative terms, Lithuania lacks a sectorial vision, as well as micro-macro consistency. Combined with the regulatory institutional mentality, the lack of an integrated sector perspective leads to peculiar inefficiencies, such as the paradoxical MARAs. The criterion of technical maturity does implicate the aim to maximize supplies of certain chosen timber assortments. However, the MARAs were fixed once upon a time and stayed there unreflectively, partly failing to serve the intended aim and carrying numerous other deficiencies [6,35], including: (i) disregard for forest site productivity; (ii) ignorance of the structural changes in forest industries and the resulting sets of demanded assortments; (iii) inadequate use of the forest utilization potential; (iv) disregard of the economic logic in forestry, by not properly accounting for costs, revenues and the value of time; and (v) constraining the owners' ability to choose the silvicultural regimes according to their needs and priorities.

Social justice is an important aspect related to economic sustainability. Since the 1990s, environmental consideration in Sweden has been implemented in two major ways [4]. First, voluntary set-asides (roughly corresponding to Lithuanian forest Groups I and II) are implemented through forest certification, where owners are motivated through price premiums for certified timber. Second, the state may permanently withdraw forestland from timber production (habitat protection areas) or temporarily introduce forest management restrictions (nature conservation agreements). For the second

type of conservation measures, the state must both have the owner's consent and also compensate the ensuing economic losses according to the market prices. Such an approach does not violate the fundamental property rights and also makes the environmental authorities conscious about the costs, *i.e.*, they need to make well-weighed decisions to preserve the highest possible environmental value under the available budget.

In sharp contrast, the Lithuanian system of forestland zoning was implemented without economic assessment and without respect to property rights. Thus, there was no conscious approach to maximize the flow of ecosystem services given a certain "budget" that is the degree of acceptable economic loss. Alternatively, putting it in another way, there was no attempt to attain a targeted level of ecosystem services at the possibly lowest costs for the country. What is more important, no compensation for the economic losses was provided for individual forest owners. Some 70% of owners simply turned out to be lucky in getting the restituted property with the status of Group IV (Table 3), while around one tenth of the owners received property back with the Group II status and, thus, a manifold reduction of economic value. This obviously constitutes a severe violation of social equity.

4.2. Implications for Policy

No research can provide a neat answer of what is the "optimal" balance between environmental, social and economic objectives; this is a matter of different values and interests exercised in a democratic society. In terms of economic sustainability, we do not see a need for any radical enhancements in Sweden. The environmental pillar of sustainability is, on the other hand, more questionable. It is generally acknowledged that intensive forestry with a focus on spruce monocultures has degraded the biodiversity of Swedish forests [40]. Attempts at greening through the aforementioned measures have been already bringing some, though contestable, results [41]. More greening appears to be necessary; however, we would not advise a Lithuanian-type of hard steering.

Lithuania has, on the other hand, a large potential for improving economic forest sustainability. The fundamentals for change are institutional and ideological in nature [21], and major improvement cannot be achieved by some marginal fixes "here and there". It is also not possible to simply follow the Swedish path, as the solutions should be adapted to the social and ecological contexts of the given country. Taking into account the present state of forest resources, the economic potential of the sector, professional traditions and the cultural-institutional context, advisable policy measures can be grouped as follows: (i) devising a holistic sectorial strategy; (ii) relying more on markets, including substantially reduced regulation of the (private) forestry; (iii) promoting more adaptive strategies of forest management; (iv) including economic assessments in environmental conservation; and (v) introducing functional mechanism to justly compensate forest owners for environmental restrictions. All of these measures require a strong political will and breaching the vested interests of powerful authorities. The fundamental changes are hardly possible without altering the conservative mentality [21], which can require a lengthy, multi-decennial process of ideological maturation. It should be noted that many of the current restrictions, such as MARAs, are resting on silvicultural traditions rather than on environmental grounds. Tangible gains in economic sustainability and social justice are thus achievable without a considerable decline in environmental values [4].

National forest programs (NFPs) could be an interesting option for dialogue on sustainable forestry in both countries. The process of NFP has been recently commenced in Sweden, after a thorough analysis of international experiences [42]. The NFPs institutionalization at the Ministry of Rural Affairs and its initial focus on the bioeconomy [43] does hint at a bias towards economic interests and contains dangerous pitfalls characteristic of a "bureaucratic lead" of an NFP process. We believe that, in order to be successful, the Swedish NFP should avoid reinforcing the position of the production-oriented coalition. Instead, it should focus on promoting a transparent strategic dialogue on balancing timber production and environmental values in Swedish forestry on national, as well as local levels. Lithuania so far lacks an NFP when judged against the internationally acknowledged principles of broad stakeholder participation, holistic coordination, decentralization and iterative planning [44]. If conducted properly, such a genuine NFP could institutionalize a fairer and more transparent representation of different interests and be instrumental for creating a more holistic vision of the sector [45].

5. Conclusions

The analysis at multiple scales reveals that Sweden outperforms Lithuania in terms of economic forest sustainability. A more liberal regulation in Sweden creates more favourable preconditions for a forest owner to pursue profitable forestry. This, coupled with a holistic vision of the forest sector, fosters the sector's contribution to the country's economy. Lithuania possesses a clear potential for more effective pathways for profitable forestry, serving both a single landowner and the whole country. This potential can however only be realised given an adequate commitment by the highest forestry authorities. The vested sectorial interests need to be superseded by a genuine willingness to increase the sector's contribution to the country's welfare; and forest owners need to be increasingly perceived as stewards of their property needing proper incentives and advice, rather than potential "forestry criminals" to be steered by rigid regulation and control.

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Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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