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Sustainable Development Goals and the Forest Sector— a Complex Relationship

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Abstract: The United Nations adopted the Agenda 2030 with its core element, the 17 Sustainable Development Goals (SDGs), in September 2015. In order to achieve these goals within the coming years, intense efforts are required by all political and societal actors. Although the first definitions of sustainable development referred to the forest sector, the question remains: what contribution can forestry make to achieving the Sustainable Development Goals? Therefore, the direct positive and negative effects of forestry itself on sustainability are analyzed, and it is discussed how sustainable forest management could contribute to achieving other Sustainable Development Goals in addition to SDG 15. This analysis reveals that forestry plays a dual role, i.e., forestry can achieve positive sustainability effects but can also have negative impacts. It is thus recommended to use integrated assessment approaches to analyze whether a specific forest-related policy or strategy is contributing to sustainable development. Beside quantitative integrated assessments, the use of qualitative frameworks like the Framework for Strategic Sustainable Development is proposed. It is also suggested to operationalize the concept of second-order sustainability performance for the forest sector in future research.

Keywords: forestry; sustainable forest management; Sustainable Development Goals (SDG), Framework for Strategic Sustainable Development (FSSD), second-order sustainability performance; phycicity

1. Introduction

Forestry is particularly interesting from a sustainable development perspective: an early definition of sustainable development published in the 18th century was applied to forestry [1], and today this sector can play an important role in the transition to a sustainable society. The international debate on sustainable development was considerably intensified by the publication of the Sustainable Development Goals (SDGs). Additionally, the severe problem of climate change requires action from political and private actors on all levels. Thus, the goal of this paper is twofold: first, the positive and negative effects of the forestry sector itself on sustainable development will be analyzed. Second, it will be discussed how the forest sector is related to the SDGs. To reach this goal, a literature analysis of the addressed topics was performed followed by an analysis of the relations between SDGs and forest management. The paper is structured as follows: in the next section, an introduction to sustainable development and the SDGs is given. In section 3, the sustainability impacts of forestry itself as well as the relation between forestry and SDGs are discussed. Section 4 is devoted to the discussion and to final conclusions.

2. Sustainable Development Goals and Framework for Strategic Sustainable Development Goals

At the Rio+20 conference in 2012, the UN member states decided to develop global goals for sustainable development: the SDGs. These goals were developed to expand upon the previous Millennium Development Goals, where the social development dimension was very much in the foreground. The process to develop the SDGs was started by Colombia at the UN General Assembly in 2011; this Colombian proposal was endorsed by Guatemala, followed by Peru and the United Arab Emirates before gaining support from more countries. This proposal included a list of indicative thematic areas, covering poverty eradication, food security, water and sanitation, energy, sustainable and resilient cities, oceans, enhanced capacity of natural systems to support human welfare, sustainable consumption and production patterns, and enhanced employment and livelihood security [2] (p. 120).

Thus, the SDGs should place more emphasis on sustainability, including not only social but also economic and, in particular, ecological aspects in the development agenda, compared to the Millennium Development Goals. Additionally, these SDGs should be binding for all countries and not only be relevant for developing countries [3]. After the Rio+20 conference, a so-called open working group (OWG) with 30 members was founded by the United Nations general assembly by decision 67/555 [4]. The members of this OWG came from five country groups (African group, Asia-Pacific group, Latin American and Caribbean group, Western European and Others group, and Eastern European group). An innovative element was that several countries shared their membership in the OWG (for instance Canada, Israel and USA, or Colombia and Guatemala). On 19 July 2014, the OWG submitted a proposal for the SDGs. This comprised 17 overarching objectives, which are explained and concretized by 169 subgoals [5]. On 4 December 2014, the United Nations General Assembly approved the Secretary-General's proposal to build the post-2015 agenda on the OWG proposal [6]. On 25 September 2015, at the 2015 World Summit on Sustainable Development at the United Nations Headquarters in New York, the 17 "Sustainable Development Goals" were adopted accordingly by the United Nations General Assembly. This resolution is considered to be the most ambitious agenda "against poverty and for the planet" ever decided upon [7].

Among the SDGs, three broad groups coexist: first, articulating demand for further human resource appropriation; second, sustaining the resource base; and third, redistributing power and benefits [8]. The Agenda 2030 is a highly complex policy framework: the objectives linked therein are as ambitious as they are different, and they are challenging for all states who have to implement them. This is also reflected in the fact that the 17 objectives have been concretized, with a total of 169 objective-related targets [9]. Spangenberg analyzed the SDGs regarding their potential to drive progress towards sustainable development using the Driving Force-Pressure-State-Impact-Response (DPSIR) model [10], concluding that most targets address the state of a sustainability challenge (e.g., state of poverty, quality of water) or address an impact (e.g., climate change adaptation) [11]. Targets for pressures are missing; targets referring to driving forces are mentioned (like sustained growth or free trade and globalization) in the sense of "more of the same", instead of reversing these driving forces, which led to the current state of unsustainability [11]. A reason might be that according to the International Social Science Council (ICSU), only 29% of the 169 targets are well defined and based on the latest scientific evidence [12]. The observations from Spangenberg and the ICSSU are not surprising, given the SDGs are the outcome of a global political process, and the international development after 2015, which brought an intensified opposition against multi-national agreements. However, the SDGs are the best basis we have for policies to work for a sustainable future. It is thus in the hands of the UN member states and all societal, private, and corporate actors to focus, in addition to the 169 SDG targets, on pressures and impacts in their sustainability policies and strategies.

For doing so, actors need support to identify the mechanisms leading to unsustainability and principles describing how a certain system can be more sustainable. The Framework for Strategic Sustainable Development (FSSD) describes these mechanisms, these sustainability principles, and strategies to implement them, and is concrete enough to support decision-makers, helping them choose the most sustainable activities and formulate relevant questions [13–15]. The FSSD-

sustainability principles can improve our understanding of sustainability and the roots of unsustainability [16]. If these principles are considered, the outcome is a sustainable system [17,18] that leads to improved sustainability performance. The FSSD sustainability principles state that in a sustainable society, nature is not subject to systematically increasing

1. the concentrations of substances extracted from the Earth's crust (e.g., fossil carbon, metals);
2. the concentrations of substances produced by society (e.g., nitrogen compounds, endocrine disrupters);
3. the degradation by physical means (e.g., large-scale clear-cutting of forests, over-fishing); and, in such a society,
4. people are not subject to conditions that systematically undermine their capacity to meet their needs (e.g., decreasing trust through abuse of political and economic power) [19,20]. This fourth principle has been further developed to argue that, in a sustainable society, people are not subject to structural obstacles to health (e.g., dangerous working conditions, insufficient rest times), influence (e.g., by suppression of free speech, neglect of opinions), competence (e.g., by obstacles for education, insufficient development options), impartiality (e.g., by discrimination, unfair treatment), and meaning (e.g., by suppression of cultural expression) [21].

These FSSD-principles can be used by all actors who want to implement the SDGs in their area of responsibility, as these principles allow to address sustainability pressures and impacts missing in the SDGs.

Two essential characteristics must not be forgotten within the discussion about sustainable development: first, all human systems (e.g., societies, communities, economies, and markets) are part of the biosphere. The embedded nature of these systems in the natural environment is crucial and calls upon humans to respect the earth's ecological carrying capacity. The fundamental laws of thermodynamics show that all processes are irreversible and dependent on energy, which is provided by renewable or fossil energy sources available in nature. The embedded nature of this system can be called "*physicity*", a term that reveals the physical dependence of human beings and human systems on these energy sources. Second, sustainability is a system property and not attributable to the characteristics of a single object alone; instead, it is dependent on both the characteristics of this single object and its relations to other objects and systems.

3. Forest Sector and Sustainable Development

The first definition of sustainable development was related to forestry [1], and medieval sources had already stressed the importance of the long-term use of forests [22]. Sustainability topics are not new to the forest sector, but they cannot simply be reduced to the initial sustainability definition (not to use more wood than grows again). Before discussing these topics in detail, it is necessary to define "forest sector" for this discussion, as there is no commonly agreed definition [23]. According to ISIC (International Standard Industrial Classification of All Economic Activities used by the UN), the forest sector composed by forestry, logging, and related service activities is grouped to sector A while processing is grouped to the manufacturing sector (sector C) [24]. A similar distinction between forestry, logging, and related services and the further processing of wood and forest-made products is made within the EU's NACE classification [25]. While it is logical to distinguish between primary production, manufacturing, and service, this does not reflect the interconnections between these three macro-economic sectors and is thus less useful for the analysis of sustainability impacts of forest-related activities. Therefore, the FAO definition is used for this paper: "Ideally, the sector should be defined to include all economic activities that mostly depend on the production of goods and services from forests. This would include commercial activities that are dependent on the production of wood fiber (e.g., production of industrial roundwood, woodfuel, and charcoal; sawnwood and wood-based

panels; pulp and paper; and wooden furniture). It would also include activities such as the commercial production and processing of non-wood forest products and the subsistence use of forest products. It could even include economic activities related to production of forest services (although it would be difficult to determine exactly which activities are really dependent on forest services).” [23].

The analysis of sustainability impacts caused by the forest sector will be separated into first the discussion of sustainability impacts caused by the sector (section 3.1) and second the assignment of these impacts from forestry to the SDGs (section 3.2).

3.1. Sustainability Impacts of the Forest Sector

Using the FAO definition of forestry, the sustainability impacts of forest management itself and of commercial activities that are dependent on the production of wood fiber are considered. This means that activities like timber production; production of industrial roundwood, woodfuel, charcoal, or wood-based panels; the production of pulp and paper; or the production of wooden furniture have to be analyzed regarding their sustainability impacts. As forests are used widely for recreation, tourism also has to be considered.

All three areas of the forest sector (timber production, manufacturing of forest products, and tourism) cause sustainability impacts. These impacts are usually grouped into economic, environmental, and social impacts. Economic sustainability refers to the competitiveness of a company [26] or to the economic viability in case of non-for-profit organizations. This means that topics like innovation and technology management, collaboration, knowledge management, organizational processes, or reporting have to be considered for a measuring of economic sustainability impacts [27]. Environmental sustainability impacts refer to the use of renewable and non-renewable resources; emissions into air, water, or soil; the amount of waste and hazardous waste; the (over-) use of ecosystems; impacts on biodiversity; and environmental influence of the product over the life cycle [27]. The ISO 26000 standard about “social responsibility” [28] defines seven core subjects that have to be considered by any organization that aims to improve its sustainability performance; except for the subject environment, all others, i.e., organizational governance, human rights, labor practices, fair operating practices, consumer issues, and community involvement, belong to the social dimension of sustainable development. The role of indigenous people in forestry is of tremendous relevance from a social sustainability perspective.

Table 1 shows the relationship between the FSSD sustainability principles, specific sustainability topics, and the forest sector. Each activity within the forest sector has to be assessed concerning whether it is compliant with the FSSD sustainability principles. Additionally, Table 1 is useful to identify trade-offs between different sustainability aspects. Such trade-offs are likely, especially between economic goals on the one hand and environmental or social goals on the other hand. An example is an intensively managed forest that maximizes the output of wood with a minimum of emissions due to the efficient use of machinery, but this is usually on the cost of biodiversity and ecosystem quality and of a lower resilience of monocultures. Another trade-off can be identified between intensive forest management and the rights of indigenous people, or the role of smaller farmer-owned forests as a source of family income. However, there can be also trade-offs within one sustainability dimension: using more forest-based biomass from intensively managed forests to substitute non-renewable resources can be on the cost of loss of biodiversity. Vierikko et al. [29] show in their analysis of forest management practice in Finland that the relationship between components of sustainable forest management differs across spatial and temporal scales. For instance, socially active communities with a more diverse economic structure compete less intensively with ecological components of forests than communities where forestry plays a central economic role. This points to the problem of measuring sustainability impacts on different scales. Although different frameworks and indicator sets have been proposed and tested [30–32], sustainability assessments in the forest sectors remain challenging, and the use of general sustainability principles is recommended. Table 1 can be used in two different ways: as qualitative instrument to identify trade-offs where any forest-

based activity can be compared with the FSSD sustainability principles, or as quantitative instrument where the specific sustainability topics are measured with a respective indicator.

Table 1. Sustainability principles and sustainability topics related to the forest sector (see [19,20] for the Framework for Strategic Sustainable Development (FSSD) and [26,27] for sustainability topics).

Sustainability Principles (FSSD)	Sustainability Topics	Forest Sector	
Concentrations of substances extracted from the Earth’s crust	Environmental sustainability		
			Resource use (materials, energy)
			Emissions into air
			Emissions into water
Concentrations of substances produced by society	Environmental sustainability		Emissions into soil
			Waste and hazardous waste
			Biodiversity and ecosystem quality
			Organizational governance
Degradation of eco-systems by physical means	Social sustainability		Human rights
			Labor practices
		Fair operating practices	
		Consumer issues	
Social sustainability: structural obstacles to health, influence, competence, impartiality, and meaning	Economic sustainability	Community involvement	
		Competitiveness/economic viability	

An instrument to improve sustainability practices in the forest sector is forest certification schemes. Forest certification schemes aim to provide information to consumers about sustainability-related issues of forest products as well as to provide their specific requirements producers with information on how to responsibly manage forests. Forest certification is principally practiced by two competing schemes: the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification [33]. Although these schemes have been used now for more than 20 years, rather little is known about the impacts of forest certification, especially indirect and unanticipated impacts; the reasons for this are poor data quality, disagreement on appropriate dependent variables, and research design challenges impeding a full understanding of impacts [33]. Reasons for companies to adopt forest certification seem to be more market driven than regulation driven, as an investment in a certification scheme demonstrates a commitment to sustainability and secures legitimacy [34]. However, more research about these forest certification schemes is needed, as recent reviews identified success and influence factors but not an assessment as to whether these schemes have a positive sustainability impact or not [35].

3.2. Forest Sector and SDGs

In addition to the direct sustainability impacts of the forest sector, its relationship with the SDG’s in general has to also be discussed. The forest sector itself can be grouped to SDG 15 “Life on Land: Protect, Restore, and Promote Sustainable Use of Terrestrial Ecosystems; Sustainably Manage Forests; Combat Desertification; Halt and Reverse Land Degradation, and Halt Biodiversity Loss”. Target 15.2 says that “By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation globally”.

SDG 15 is directly related to other SDGs. While it is not prominently interlinked with other SDGs like SDG 12 “Responsible Consumption and Production”, it is directly related to SDG 13 (“Climate Action”), SDG 2 (“Zero Hunger”), SDG 6 (“Clean Water and Sanitation”), SDG 8 (“Decent Work and Economic Growth”), SDG 10 (“Reduced Inequalities”), and SDG 12. In addition, there are indirect links, for instance, to SDG 7 (“Affordable and Clean Energy”), which is linked via SDG 12 [36] [37]. These relations can be both positive and negative as highlighted by [38]: SDG 15 has after SDG 12 most trade-offs with other SDGs, especially with SDG 1 (“No Poverty”), SDG 3 (“Good Health and Wellbeing”), SDG 4 (“Quality Education”), SDG 6 (“Clean Water and Sanitation”) and SDG 10 (“Reduced Inequality”). Some of these trade-offs with SDG 15 occur on a country level (SDG 1, SDG 4, and SDG 10), while others have been observed on a global level (SDG 3, SDG 6) [38]. These trade-offs can be explained by the fact that an improvement of those SDGs that show a tradeoff to SDG 15 is based on a higher level of income that increases the pressure on ecosystems and biodiversity [38].

The challenge is to balance environmentally-related SDGs like SDG 15 with other human-centered SDGs. Coherent policies are needed across different SDGs and sectors [40]. The direct outputs of the forest sector (see section 3.1: timber production, manufacturing of forest products, and tourism) can support the achievement of several SDGs. Well managed forests can have a positive impact on biodiversity (SDG 15), create income to fight poverty (SDG 1), provide wild fruit and game to fight hunger (SDG 2), provide medical plants (SDG 3), provide freshwater for drinking and irrigation (SDG 6), and capture and storage carbon (SDG 13) [39] (see Figure 1).

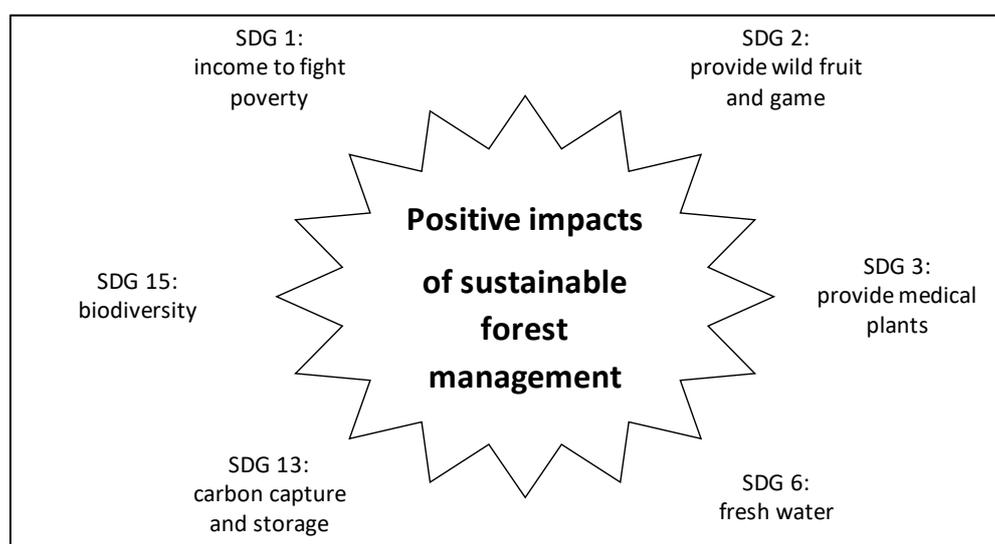


Figure 1. Positive impacts of sustainable forest management on other Sustainable Development Goals (SDGs) (based on [39]).

However, there is also the risk of unintended consequences and goal conflicts between use of forest-based goods and services. The use of forest-based products can lead to lower greenhouse gas emission due to substitution of fossil and non-renewable resources. However, there are trade-offs between this substitution and biodiversity [41]. For instance, Céline et al. report that agricultural expansion and fuel wood and timber extraction are main drivers of deforestation and habitat degradation in the Congo Basin [42]. Another tradeoff is between an intensified timber production and reinforced nutrient withdrawal [43]. Increased demand for food or for bio-based energy sources will increase the pressure on forests and increase the risk of deforestation.

Deforestation can make it more difficult to achieve the SDGs, e.g., regions can face an increased vulnerability to extreme weather events (SDG 1), there can be a loss of rainfall and crop pollinators (SDG 2), more respiratory illnesses can be caused by forest fires (SDG 3), there can be faster sedimentation of hydroelectric dams (SDG 7), there can be a higher risk of damages from landslides and floods (SDG 9), or there can be a loss of coastal fisheries habitat (SDG 14), due to deforestation [39]. An important policy is to increase community control over forest lands through aid and trade

policies. This can be done by ensuring that companies and investors follow the UN Voluntary Guidelines on the Responsible Governance of Tenure (VGGT) and development aid strengthens local peoples' tenure rights and improves land governance [44].

It is important to consider that forests are based on the use of land, which is a fixed resource; changes in land use are path-dependent, and today's changes in land use have implications for the services they can provide in future [45]. SDGs call for integrated land use management [8], as relations between different SDG strategies are complex, and a focus on a specific SDG can reinforce trade-offs with other SDGs [45]. For instance, biodiversity protection initiatives in low-income nations can lead directly and indirectly to reductions in average household incomes in the vicinity of protected areas [46]. Thus, it is important to provide an integrated assessment perspective to identify trade-offs between SDGs whenever forest-related policies are planned and implemented [45]. The FSSD, with its sustainability principles as introduced in section 2, can be recommended to identify trade-offs and to analyze whether a specific project or activity is supporting the SDGs.

4. Discussion and Conclusion

Sustainable forest management is a key issue in any transition towards sustainable societies. Target 15.2 of SDG 15, which requires a sustainable forest management, should be achieved by 2020. Recognizing the role of forests within sustainable development is not new; the first sustainability definition referred to forestry. Forestry itself can have positive and negative sustainability impacts. Additionally, forestry can help to achieve SDGs, especially SDG 15 but also other SDGs. However, there are trade-offs between forestry and other SDGs, like the conflict between bio-diversity and intensified timber production for woodfuel. These trade-offs can create obstacles in regional and national processes to reach the SDGs, and not being able to anticipate these trade-offs will increase the risk of problem-shifting and potentially magnify the challenges facing sustainable development agendas; in the worst case, incoherent strategies could put many of the SDGs out of reach by 2030 [45].

These trade-offs and related impacts have to be identified and assessed in a comprehensive way, and approaches like the FSSD or specific methods like life cycle assessment (LCA) [47] or life cycle sustainability assessment (LCSA) [48,49] have to be used for this purpose. A critical point in the application of these methods is the definition of the system boundaries, as these methods are suitable to assess direct impacts along a lifecycle. However, they are less applicable to assess trade-offs between forestry itself and impacts on other SDGs. There is a need for much stronger, effective linkages between processes within the forest sector and with other sectors locally and across countries [50]. Using systematic integrated assessments is a solution [45], but they apply a macro-level perspective and require the quantification of all effects. This can be challenging, especially when activities and strategies of individual forest actors have to be assessed. To identify and evaluate trade-offs, a wider sustainability perspective is needed. While first-order sustainability performance describes the direct impacts of the analyzed system (i.e., forestry), second-order sustainability performance also includes the impacts of a system on the whole system, i.e., applying a systemic perspective [26,51]. Zimek and Baumgartner operationalized the concept of second-order sustainability performance [51] for the case of individual companies; this example can be transferred to forestry in future research.

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