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Article

Governing Competing Demands for Forest Resources in Sweden

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Abstract: Changing and competing land use, where we make use of a growing share of resources, potentially undermines the capacity of forests to provide multiple functions such as timber, biodiversity, recreation and pasture lands. The governance challenge is thus to manage trade-offs between human needs and, at the same time, maintain the capacities of forests to provide us with these needs. Sweden provides a clear example of this kind of challenge. Traditionally, timber has been the most apparent contribution of the forest to Swedish national interests. However, due to competing land use, the identification of the wider role of forests in terms of multifunctionality has been recognized. Today, a number of functions, such as water quality and biodiversity together with cultural and social activities related to forests, are increasingly included as potential demands on forests in competition with traditional functions such as timber production. The challenge is thus related to trade-offs between different functions. How to balance the relationship and guide trade-offs between different functions of forests is, to a large extent, a matter of policy choice and the design of appropriate governance institutions and pro-active management activities. Based on perceptions among stakeholders on future competing demands and a literature review, the paper explore the multifunctionality of the Swedish forests and how it is affected by competing demands for land use; how multifunctionality is currently governed; and concludes by suggesting promising decision support methods to manage trade-offs between different functions.

Keywords: land use change; multifunctionality multi criteria decision analysis; literature review; participatory planning

1. Introduction

Land use, "the total of arrangements, activities, and inputs that people undertake in a certain land cover type" [1] is considered to be of multi-scale significance, due to changes to forests, farmlands, waterways and air, driven by the need for food, water, shelter and fiber for the growing world population. These changing patterns of land use are shaped by the interaction of institutions, *i.e.*, formal and informal rules and norms [2] and ecological, economic and social (including political) and technological drivers on global, national and local scales. To understand the challenges of competing land use and to help policy makers design and implement effective governance institutions for sustainable resource use, now and in the future, it is necessary to take these drivers into consideration and to assess how these drivers affect land use on a national and local level. Governance is defined as "the body or rules, enforcement mechanisms and corresponding interactive processes that coordinate the activities of the involved persons with regard to a concerted outcome" [3]. As such, governance is constituted and legitimized by institutions [4,5]. The demands for increased sustainability of resource management, or the need to make trade-offs between different forms of land use, often include a call for institutional change [6,7].

Sweden is a heavily forested country. According to Swedish definitions, around 23 million hectares of the land area, or 53%, is covered with productive forest land [8,9]. The large-scale industrial use of timber and wood by sawmills, and pulp and paper industries, emerged in the second half of the 19th century. Already around 1900, Sweden took a leading position in the international timber market. The forests and forest industry have since then been identified as one of the most important foundations of it being a rich and prosperous country. The use of forests for industrial production has thus been increasingly prioritized and regulated during the 1900s, at the expense of agrarian and other uses of forest resources [10-12]. In recent decades however, old and new competing stakeholders have been provided more room in the forest sector. Researchers and politicians are now talking about multiple-use forestry, a concept which is framed within the wider concept of multifunctionality [13]. This means that a number of functions such as water quality and biodiversity, together with cultural and social activities related to forests, are increasingly included as demands on forests in parallel with traditional functions such as timber production. Forests do not only produce private but also public goods and services *i.e.*, "end products that yield human wellbeing" [14]. Society has, to a large extent relied on the delivery of these goods and services as by-products of different forest related activities. When pressure on land was much less, there was an abundance of these by-products. However, due to societal development, driven by population and economic growth, the supply of public goods and services from forests has diminished considerably all over the world [4]. The pressure on forests is expected to increase even more during the 21st century due to, for example, changes in demography and climate, which sets an even greater challenge for land owners and policy makers to manage trade-offs between different functions of forests now and in the future. Since multiple functions also

involve multiple stakeholders, this changing focus is connected with the development of new modes of governance, for example, participation in decision making [15]. How to balance the relationship and guide trade-offs between different functions of forests is to a large extent a matter of policy choice and the design of appropriate governance institutions and pro-active management activities like the introduction of decision support techniques [6].

We fully acknowledge that land use change will affect forestry at large. In this context we do, however, distinguish between functions which are traditionally linked to the wood production sector like the growing and logging of timber, the processing of timber into, for example, sawn timber, pulp and paper and board and bioenergy [10] and other functions provided by the forests like biodiversity, fodder production and recreation, *i.e.*, ecosystem goods and values that do not always have clearly established monetary values and are thus not always accounted for in governance processes [16]. Trade-offs between functions within wood production are to a large extent regulated by the market, while trade-offs between functions provided by the forest sector and other functions to a large extent are a matter for politics and policy-making. This text primarily focuses on the need to make trade-offs between market-driven and non-market driven functions and the objective is thus: (1) to explore the multifunctionality of the Swedish forests and how it is affected by competing demands for land use now and in the future; (2) how multifunctionality is currently governed; and (3) finally to suggest promising decision support methods to manage trade-offs between different functions.

2. Material and Methods

The article is based on an analysis of perceptions of future competing demands on Swedish forests among the Panel of Practitioners linked to the research program Future Forests. The Panel of Practitioners consists of 25 persons representing main stakeholder groups related to Swedish forests. The members of the Panel have three main roles: (1) to bring their personal/practical knowledge and perspectives into Future Forests; (2) to discuss new scientific results generated in Future Forests with researchers and college members of the Panel and in that way develop their own understanding of results; and (3) to bring this self-acquired knowledge into practice [17]. The members of the Panel were asked to collaborate and rank what they perceived as current and future demands for Swedish forests. The panel agreed on a number of challenges which are likely to affect the competition of forest resources in the future. It was assumed that the trends in forestry and forests of today would continue into the future, at least 30–40 years ahead, since forests have long rotation periods in Sweden. Even though rapid changes in societies might occur, these changes may not be reflected immediately in forests, but may take time to materialize. The Panel of Practitioners thus assumed that many of the driving forces that are relevant to land use changes today would also apply in the future but vary in strength. The results of the perceptions among the Panel of Practitioners was supplemented with a literature review on what has been published on competing land use by accredited scholars, researchers and relevant international organizations in relation to possible governance options and management tools relevant to a Swedish context. The review on the topic has been collected manually as well as with the help of computerized methods (in particular scientific data bases and Google scholar) to identify articles, books and outreach reports. A meta-synthesis was made to integrate, evaluate and interpret the common core elements and themes put forth by the Panel of Practitioners and the

literature review on the subject [18]. All in all, seven themes could be identified: biodiversity, hunting, recreation, reindeer husbandry, agriculture, water protection and non-timber forest products (NTFPs). The review was also part of a process defining scenarios for the Future Forest research program in Sweden [19]. The remainder of this text is structured as follows. Section 3 presents the theoretical framework used for the meta-analysis of the literature review; Section 4 summarizes institutional drivers affecting multifunctionality in Sweden; and Section 5 identifies competing demands related to multifunctionality. Subsequently governing institutions and pro-active management activities are identified in Sections 6 and 7 and discussed in Section 8.

3. Common Good Aspects of Forested Landscapes

Forests, which are composed of individual stands in different phases of development and vary in terms of characteristics [1] constitute, as a whole, landscapes consisting of heterogeneous rather than homogenous goods with different ecological, economic, social and aesthetic functions. Forests thus share attributes with many other resource systems that make their governance and management difficult [20]. These multiple functions of forests may be defined with reference to the level of rivalry and possibility to exclude users from consumption of the forest goods and services (see Table 1). Neither excludability nor rivalry in consumption is however an unconditional criterion. but vary due to costs of exclusion and the abundance of the goods and services in question [16,21]. Depending on these characteristics, goods and services can be classified either as private, club/toll, common pool or public goods and services. These features operate as incentives, for example, for investment, rent seeking and free-riding behavior, but are also linked to different types of governance [15,22].

Table 1. Goods dimensions of forested landscapes. Adapted from [20].

	Rivalry	**Non-rivalry**
Excludability	**Private goods** Timber production, biofuel, pulp and paper	**Club/Toll goods** Protected forests with restricted access
Non-excludability	**Common pool resources (CPR)** e.g., forests as pasture land, biodiversity, berry picking, recreation	**Public good** e.g., recreation, biodiversity, watersheds or forest landscapes with cultural services or an aesthetic appeal

Private goods are characterized by rivalry but with the possibility of excluding actors from consumption. For forestry, this means that the same forest can be harvested only by one forest owner at a time. *Club or toll goods* share the possibility to exclude users with private goods which means that rivalry can be avoided. A protected forest with restricted access, for example a national park with an entrance fee, is an example of such. This type of goods is however rare in a Swedish context due to the Right of Public Access, which is an institution allowing people to roam freely in the countryside. *Public goods* are characterized by both non-rivalry and difficulties to exclude users from the resource. An example of such is a forested landscape with an aesthetic appeal which everyone can have a view of without infringing on the possibility of others to view the same forest landscape. Public forests used

for recreation are another example of a public commodity given that there is enough space and not too many users at the same time. A *common pool resource* is where both rivalry and difficulties to exclude users can be expected. Examples are functions like forests as pasture land, but also for example the use of non-wood products like berry picking (at least when it becomes large scale and industrial, *i.e.*, not only for household use). The problem increases when there are a number of uses on the same land *i.e.*, multi use commons [23]. Biodiversity and recreation could thus also belong to this category if the recreational activity affects other resource users negatively. Conflicts can, for example, occur between snow mobile users and skiers that use the same snow trail [24]. Each of these is thus associated with a specific problem of collective action and demands different types of institutions and decision support tools for its solutions [25]. The distinction between private, common pool, toll and public resources are critical since it helps to explain why in some situations there is a substantially higher risk that conflicts occur.

Due to the multifunctionality of forests, different functions are linked to different types of goods and services. Timber production is a typical economic function of forests and as such a private good. Ecological and social or socio-cultural functions often have a public or common pool resources (CPR) character. According to Röhring and Gailing [26] institutions concerning landscapes can be divided into at least three categories; institutions regarding socio-economic functions of landscape like timber production; institutions relating to the protection of ecological or cultural functions, e.g., biodiversity and heritage protection, and those concerned with the integration of both aspects. Institutions may be of a formal or informal character, where the formal ones often are written like laws and regulations while the informal ones often concern social norms and values [2,22]. As illustrated in Table 2 the socio-economic functions of forest landscapes which tend to be private goods are usually regulated by formal institutions, e.g., laws and regulations influenced by market forces and sector policies. Also the ecological functions, which are more of public goods or CPR character, are often regulated by a number of formal laws and directives. The cultural and aesthetic functions which also are of a public goods character are, however, frequently influenced by more informal values and norms. Formal regulations of the use of forest resources are thus more concentrated on socio-economic and ecological functions and not so much on cultural and aesthetic functions. When this type of norms and values is present in management situations, it is often not sufficient to solve the problem only through the incorporation of formal rules and objective information, but also important to identify and consider the subjective norms and values of society and stakeholders affected by management [15,27]. To understand problems and prospects of changing land use demands it is thus necessary to take into account the character of the institutions, formal and informal, and the character of the goods, *i.e.*, to what extent it is private and/or public [28].

Table 2. Character of institutions guiding different functions of forests. Adapted from [18].

more informal		Aesthetic/recreational functions
Character of institutions		Cultural functions
more formal	Socio-economic functions	Ecological functions
	more private	more public
	Character of goods	

3.1. Drivers Affecting Land Use

Changing land use demands are expected to reinforce already existing conflicts or create new ones between the different functions of forests [29]. The drivers of land use change are characterized as a complex of socio-economic as well as political, technical and cultural variables that may operate directly at a local level or indirectly from the national or global level. In previous research these drivers are often grouped into categories [29,30] as direct or indirect drivers for land use change. Examples of direct drivers are: *agricultural expansion* causing deforestation; *wood extraction*; both commercial (timber, fibre, *etc.*); non-commercial (wood fuel); and illegal logging causing degradation; and e*xpansion of infrastructure*, like the development of roads, mines and dams. Indirect drivers are: *demographic factors* leading to e.g., urbanization; *economic factors; technology; cultural factors*; and the introduction of new *policies and institutions.* The latter are supposed to affect consumption and values related to sustainable use of forests [29] but also competing demands between, for example, the use of forest for wood production and the protection of forest for biodiversity.

3.2. Multiple Criteria Decision Analysis

A fundamental problem in situations of competing land use involving multiple functions and stakeholders is that values related to these different functions in most cases are conflicting and cannot be measured with, and compared on, the same scale. Basically, there are two ways of handling this incommensurability: (i) all values are converted to be measured on the same scale or, alternatively; (ii) methods can be used that allow comparison of values despite different units and scales. For the first approach, cost-benefit analysis (CBA) is frequently used for monetary valuation by comparing the expected costs to the expected benefits of a set of alternatives in order to choose the best or most profitable alternative from a societal perspective [31]. This type of method may be used in relation to private goods, e.g., when we need to make trade-offs between timber and bioenergy production. However, to convert all values into monetary terms, in particular when the goods are more of a public or common pool character, may not always be feasible or appropriate [32], e.g., in situations with multiple stakeholders. The alternative approach is to use methods that enable comparison of values measured by different scales, e.g., multi criteria decision analysis (MCDA).

MCDA techniques are mathematical methods that make it possible to optimize decisions for multiple functions based on the values of the decision maker, and they provide a formalized procedure for decision analysis that supports the structuring and exploration of problems. This process can be described in four steps [33-35]:

(1) Structure the decision problem, *i.e.*, specify objectives. An *objective* can be defined as a statement of something that one wants to achieve [35,36]: The objectives describe the decision problem and can be structured in an objective hierarchy, a tree-like structure where criteria are organized according to how they relate to each other.

(2) Generate alternatives and assess possible impacts of each alternative. *Alternatives* are the means for achieving the stated objectives, *i.e.*, plans, strategies, items of choice, actions, *etc.*, which the stakeholders have identified [36,37]. *Attributes* describe characteristics of the alternatives; *i.e.*, one or more attributes are used to measure how well an alternative performs in terms of a certain objective [35,36]. *Criterion* is a general term that includes both objectives and attributes [34,36].

(3) Elicit preference values from decision makers. *Preferences* are subjective judgments made by the decision maker(s) on the importance of a criterion or an alternative.

(4) Evaluate and compare alternatives.

Originally developed as a tool for a single decision maker, the multi-criteria character also makes MCDA useful as a tool for participatory planning and group decision making. MCDA is mainly a tool for analyzing problems of a complex nature where ordinary, unstructured decision making is insufficient to find a solution. Furthermore, MCDA supports exploration and structuring of the decision problem and includes objective information and subjective preferences into the decision making. In the literature there are a number of different MCDA methods available. Each MCDA method is based on different assumptions concerning: (i) type of information as input; (ii) preference elicitation and modeling procedure; (iii) decision rule for ranking of alternatives [38]. Thus, a specific MCDA method should only be used when the characteristics of the situation match the assumptions of the method.

4. Institutional Changes in Sweden Affecting Multifunctionality

Policy and institutional change are considered to be one of the most important drivers of land use change [29]. During the last two or three decades, Swedish forest policy has undergone relatively comprehensive institutional change affecting the multifunctionality of forests. The ownership structure in Sweden is categorized by many individual private forest owners as well as rather large forest companies, including state-owned companies. The distribution of ownership on the 23 million hectares of productive forest land is approximately 50% individual private owners, 6% other private owners, 3% state-owned, 14% state-owned companies, 1% other public ownership, and 25% private-sector companies [6]. Forest management on all forest land is regulated through the Swedish Forestry Act (1979:429), which has specific regulations for, *inter alia*, the minimum allowable age for final felling, regeneration after felling and nature conservation [39].

Although forests always have been used for multiple functions, the concept of multifunctionality was introduced as late as in the 1960s and reinforced in the early 1990s when the concept of

sustainable forest management (SFM) had its great breakthrough on a global level. A set of principles for SFM, the "Forest Principles", taking into consideration ecological and social as well as economic functions, was first adopted at the United Nations Conference on Environment and Development, Rio, in 1992 in line with general principles of sustainable development [40]. Many European countries like Sweden have since changed their forest policy, emphasizing a balance between economic, ecological and social functions of forests [41]. In the portal paragraph of the Swedish Forestry Act (1979:429), it is now stated that the forest is a national asset that should be managed in a sustainable way, taking into account the multifunctionality of the forest. A central element in the new Swedish forest policy from 1993 is increased flexibility offering 'freedom with responsibility', which presupposes a willingness of owners and users to take various kinds of voluntary action to, for example, protect valuable forests [42]. The forest policy marked a shift from a more government-oriented into a more governance-oriented policy, opening up opportunities for a more decentralized forest sector [43,44]. The most important part in the new policy is, however, the change from a uni-dimensional focus on productivity into multifunctionality, in particular towards biodiversity and other ecosystem goods and services. The focus on multifunctionality combines private, public and sometimes CPR elements of forest goods and services strengthening public rights at the expense of private rights to land. This is in line with the practice of SFM, which, in consideration of multiple functions, frequently involves multiple stakeholders. In the Rio Declaration, Principle 10 concerns public participation in environmental decision making [40], which was further developed in the Aarhus Convention on access to information, public participation in decision making and access to justice in environmental matters [45]. In both the Pan-European Forest Process and the Montreal Process, there are also indicators referring to the need for public participation in decision making.

In addition to this institutional change affecting land use, Swedish forest management is also influenced by market-driven processes of forest certification in which the practices of companies and private forest owners are assessed against certification standards. The most common certification standards are those of the Forest Stewardship Council (FSC) and the Program for the Endorsement of Forest Certification (PEFC) [46,47]. Approximately 10.4 million hectares or half of the forest area in Sweden is certified by the FSC standard and about 7 million hectares of forest are certified to PEFC standards [48,49]. The increased demand for public participation is also reflected in the forest certification. For example the criterion 4.4 of the Swedish FSC standard states that "*management planning and operations shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups (both men and women) directly affected by management operations*" [46]. This also includes indigenous peoples by recognizing that the "*legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected*" (criterion 3).

5. Competing Demands Related to Multifunctionality

The recent institutional changes in Swedish Forest Policy explicitly acknowledging multifunctionality has thus contributed to the strengthening of a number of functions in parallel to wood production. When asking the Panel of Practitioners linked to the Future Forest research program to identify these functions, they particularly highlighted biodiversity, hunting, recreation and reindeer

husbandry as functions or social and economic activities that currently are competing for land. From the literature review it is also possible to identify agriculture, water protection and non-timber forest products as additional functions or demands on forest resources in Sweden.

5.1. Agriculture

One of the most apparent land use conflicts through the centuries in Sweden has been the one between agricultural and forest interests. Figure 1 gives a rough overview of the changes in Swedish policy concerning the use of Swedish forests for production of either food or wood between the 13th century and 1994.

Figure 1. A history of competing land use between wood and food production, expressed by the changes in Swedish forestry policies since the year 1250. Laws on the left of the field promoted food production. Laws on the right promoted wood production. Vertically one can see how the legislation is related to the question of who had the power to control the use of land. Laws at the top promoted a strong governmental power while laws in the lower part stressed self-determination or decentralization. Adapted from [50].

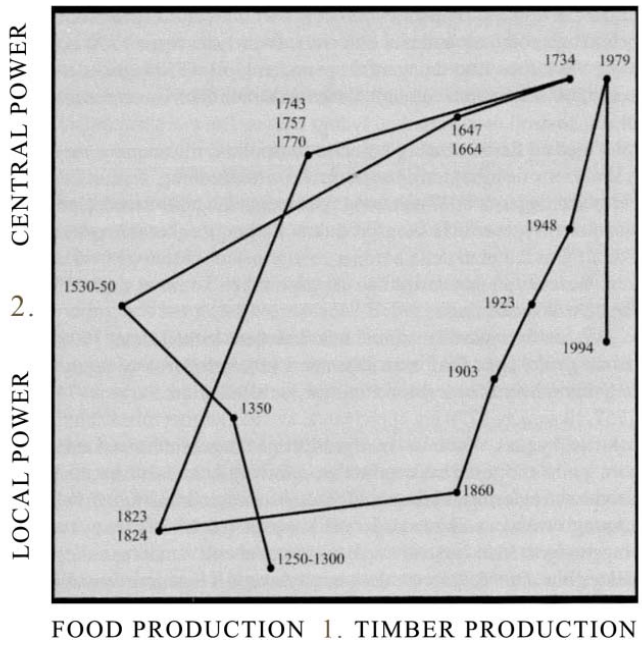

Figure 1 clearly indicates how the interest in using land for forest products has increased and overcome the interest in production of food during the last century. Since the 1950s, arable land in Sweden has decreased by approximately 950,000 hectares or 26%. Statistics Sweden (SCB) and The Swedish National Forest Inventory (Riksskogstaxeringen) further estimate that forest land has increased by 600,000–800,000 hectares since the 1920s [9]. Swedish membership in the EU (since 1995) and commitment to the Common Agricultural Policy (CAP) have only occasionally influenced the downward trend of farms and farmland. The concentration of farmland to the south of Sweden has continued, as well as the abandonment of farmland in central and northern Sweden. This decrease has happened despite the fact that CAP subsidies, like “the single farm payment”, have made it less profitable to let old arable land become overgrown or forested. However, analysts have implied that

the existing and future CAP is at least slowing the downward trend of agricultural land use in Sweden [51-53].

Globally, demand for agricultural land is expected to increase in the future due to climate change. This is assumed to affect forests primarily in terms of deforestation through the transformation of woodland into farmland [29]. An increasing temperature will affect different localities in different ways, with potential benefits to some food growing areas, but making agriculture more difficult in some other regions (e.g., many drought prone areas in Africa). Shortfalls in food production, caused by climate change, are expected to increase the demand for agricultural land also in Sweden in the future [54]. Competing claims for land, based on the needs to produce agro fuel/bioenergy, ostensibly to address climate change and food, is also supposed to increase in the future [55]. At present, the competition between agriculture and forestry is rather modest, but is likely to grow in the future, particularly due to climate change.

5.2. Water, Biodiversity and Cultural Heritage

Although water is not considered as a scarce resource in Sweden, issues related to water and water quality have received increased attention during the last decade. A large part of the lakes and streams in Sweden are located in the forest landscape involving a large array of different actors, both as users of the water, but also as owners of the water resource. As a result, the way the forest is managed influences the water quality. Hydrological issues and biological and chemical processes in the water are influenced by activities such as harvesting and fertilization. These ordinary forest operations tend to affect the water quality negatively compared with the status of unmanaged land [56,57]. According to the E.U. Water Framework Directive (WFD) [58], the water quality in pristine areas, unaffected by human activities, should act as reference for determining the surface water status. The vision is to achieve good ecological and chemical status of lakes and streams in Europe by the end 2015. It is likely that the requirements to enhance water quality stipulated by the WFD will influence how the forest is managed. Thus, it is likely that the WFD will have consequences for how timber production can and should be conducted at stand level, as well as at watershed level. We thus foresee that the conflict between timber production and water quality will increase in the future.

In the 1970s Non-Governmental Organizations (NGOs), researchers and authorities began to claim the need for making trade-offs between production of timber and the maintenance of biodiversity and cultural heritages in the forests (e.g., [59]). Consequently the two goals (*i.e.*, production and protection of forests) were included in the Swedish environmental objective concerning forestry. Despite the fact that Swedish policy changed in favor of preservation of biodiversity and cultural heritage, the conflicts around trade-offs remain. Three main reasons why there are difficulties to achieve the environmental quality objective, concerning sustainable forests, are the continued damage of historical sites, the loss of habitat (e.g., due to extensive logging activities in old-growth forests), and fragmentation of forests (*i.e.*, the transformation of homogenous areas into smaller homogenous areas that are scattered with disturbed areas) [60-62]. A number of leading Swedish ecologists claim that the Swedish forestry business has turned Swedish forests into a giant cultivation area and that biodiversity is thereby continuously being threatened [63]. The implementation of the official policies has thus failed according to the critics. The critics imply that, in practice, production is prioritized over biodiversity,

with the effect that a large number of species and ecological processes have been forced back and become endangered. The assessment of the Swedish environmental quality objective concerning biodiversity—a rich diversity of plant and animal life—confirms the view of the researchers. The objective will be very difficult or impossible to achieve within the time frame set, *i.e.*, by 2020, even if further action is taken. The same is said about the objectives related to cultural heritage. As an interim target to achieve by 2010 the Swedish Parliament stated that "forest land will be managed in such a way as to avoid damage to ancient monuments and to ensure that damage to other known valuable cultural remains is negligible." [64,65]. Prospects for achieving the milestone by 2010 was not considered good. A new strategy to promote conservation of cultural heritage was for that reason adopted in 2008 [65]. In summary, both direct and indirect drivers of land use change will affect the possibilities to protect biodiversity, water and cultural heritage.

5.3. Reindeer Husbandry, Hunting and the Use of Non-Timber Forest Products

In parallel to timber production there are a number of functions provided by forests that are based on different types of property rights; e.g., usufructuary rights, lease rights or Rights to Public Access. For example, the indigenous people in Sweden, the Sami, have the right due to immemorial land rights to herd reindeer (*Rangifer tarandus tarandus*) on approximately 40% of the Swedish land area. Due to the strengthening of international indigenous policies (conventions as well as certification schemes), the rights of the Sami has successively been strengthened in Sweden as well. Since a large proportion of the land used for reindeer herding in northern Sweden is productive forest land which can be either private or publicly owned, the same land is thus used for timber production and reindeer husbandry, but for different purposes, causing conflicts. In the wake of increasing demands for wood raw material the conflict between timber production and reindeer husbandry is expected to increase [23].

The right to hunt in Sweden is tied to owning land or property rights. Any person owning land has the exclusive right to hunt on his/her own land. If landowners do not want to exercise these rights, they can lease them out in whole or in part. Hunting takes place to a greater or lesser extent on most land in Sweden where it is legally permitted. There are almost 300,000 hunters in Sweden and many of them are also landowners. Approximately 50% lease shooting rights or belong to co-operative associations. Hunting is highly valued among hunters, both in terms of recreation but also in terms of meat value. A survey showed that the hunters value hunting up to 1.5 million per year or € 517 per hunter. Moose (*Alces alces*) hunting was shown to have a dominant position in the valuation, and accounted for 61% of the total hunting value [66].

Hunting, in particular moose hunting, is considered an important economic, recreational but also wildlife management activity. A high density of moose which is preferred by many hunters will however cause damage to forests, in particular to pine forests. As a consequence, the logging industry and hunters associations disagree on how to manage the moose and the forest to avoid moose damage, a conflict that has endured for more than 50 years [67]. The Forestry Research Institute of Sweden has estimated the loss due to moose damage to approximately € 1.3 million per year only in young pine stands at an injury level of 5–7%, and to about € 54 million at an annual injury rate of 2–3%, for a ten year period of exposure. The losses in the continuing refinement of the timber must be added to this. The conflict is thus to a large extent driven by economic factors, technological development and

institutional deficits due to the mismatching of ecological and social scales [68]. The conflict is however expected to be solved in the future through the implementation of a new moose management system.

Another parallel land use to timber production is non-timber forest products (NTFPs) *i.e.*, "all biological materials, other than timber, which are extracted from forests for human use" [69], such as mushrooms, berries, fruits, leaves and nuts. Although the general public's interest in harvesting of berries which is linked to the Right to Public Access has decreased over the years in Sweden [70], the amount of berries extracted from the forest have increased in recent years due to the growing berry industry. At the same time we can see a structural change in the Swedish berry industry. The berry industry has, for a long time, been characterized by a short processing chain where the final products primarily have been jams, syrups and the like. In addition to food, the interest in the Nordic berries is now extended to medicines and dietary supplements. The nutraceutical status of berries has attracted significant interest and has changed the economic status of the product. In the future, the berry industry is thus considered to have a great development potential and different actors are now building networks and clusters to develop the sector. The current development is, however, not favored by everyone. In particular land owners whose land is used, based on the right to common access, for commercial purposes, consider the development to be a threat both to timber production and hunting. This being due to the fact that the berry picking season and the hunting season overlap [71]. Drivers affecting the berry industry are thus primarily economic and technological and the competing demands for forest resources are expected to increase in the future.

5.4. Recreation

Forests or forest landscapes are used by many for recreational purposes [72] even if the recreation activities are today changing from, for example berry picking, to recreational visits in the forests [73]. However, we still may anticipate conflicts between outdoor activities and forestry to occur in the future [73]. Since nearby recreation environments are likely to be favored from the household's point of view, we may expect the interest for urban forests to increase [74,75]. Research indicates that urban forests are an increasingly valuable component of the urban environment, not only for recreational purposes, but also because urban forests may affect the environment by influencing wind, soil erosion, air quality, *etc.* Management of these forests is however often inadequate primarily because decision-makers lack information about the use of these forests and their role in the urban area [76]. Today recreation conflicts are also increasing due to the development of new equipment, activities and technology, e.g., All-terrain-vehicles [77]. Important drivers for land use change are thus both direct e.g., infrastructural development, but also indirect, e.g., urbanization.

6. Governing Multifunctionality

A problem, in the face of the competing demands on the Swedish forests described above, is an often long-lasting trend of managing single resources in isolation without consideration of cumulative effects on the land base from multiple competing demands [78]. There are no, or few institutions, in place when trade-offs between multiple functions of forests become necessary.

Trade-offs between functions with a more private goods character like timber and agricultural production, where no parallel use can be expected on the same land, is usually guided by market forces or national formal rules concerning food security *etc.* Furthermore, if Swedish forest policy has undergone a change from government to governance the opposite is the case with Swedish agricultural policy which has been re-regulated under the heading of the EU CAP. Potential trade-offs concerning land use for forest or agricultural products are thus not only a domestic but, to a large extent, a common European issue. With climate change making it more profitable to produce agricultural goods, the trade-off between forestry and agriculture will thus to a large extent be governed through market prices and the common European agricultural policy.

When it comes to functions which have more of a public goods or CPR character, like biodiversity, cultural heritage and water protection have traditionally been directed by centrally administered, top-down, and formal regulatory policies. Except for water governance, which has been governed through the EU WFD for the last few years, this is still very much the case in Sweden [78,79]. Hybrid forms of private and public governance has to some extent been introduced also when it comes to biodiversity governance, e.g., stewardship contracts between authorities and individual landholders, horizontal sector coordination between public authorities, but also coordination between authorities and land users [15]. Although formal institutional rules are in place, conflicts still occur both on a national and a local level. While the conflicts on a national level are more of a political nature concerning how much forests and what types of forests should be protected, the conflict on a local level is more of an implementation problem involving the local land owners and NGOs affected by formal but also informal institutions like subjective values, cultures and traditions [78,79].

The EU WFD which recently has been incorporated in Swedish legislation demands openness and extensive participation in management of water. The directive is built on the idea of integrated river basin management, which means that all sectors of society shall take responsibility for water issues. The governance of water management includes several levels from River Basin District Authorities, Water District Boards and Water Councils. A multi-level governance system is responsible for carrying out consultation through public participation prior to major decisions, such as decisions on environmental quality standards, and river basin management plans. The local level is represented via Water Councils which consist of representatives from municipalities, industries, landowners and interest groups. The water Councils is thus a type of collaborative body which has the responsibility to develop solutions to local water demands [58]. Since these water councils are rather newly established, there are few studies concerning their effectiveness as governance institutions to solve conflicts between multiple functions of forests and water.

Another CPR-conflict which has been extensively covered by researchers is the conflict between reindeer husbandry and timber production. The Swedish parliament decided to introduce consultation procedures between reindeer husbandry and timber production in 1979 to handle the conflict between the two sectors which resembles a common pool resource dilemma. The conflict is thus delegated to the stakeholders involved in the conflict. The consultation procedures covered, to start with, a limited part of the reindeer herding area but were later extended to cover the whole area through the certification system run by the FSC [23,46]. The purpose of the consultation procedures is to solve conflicts between the two sectors by establishing arrangements that allow the two industries to co-exist. However, research points to the fact that the consultation procedures do not fulfill their

intention since conflicts between the two actors are on-going, primarily because there are unsettled issues concerning the property rights situation in this part of Sweden [80]. There is thus a need to develop new governance mechanisms for mitigating the conflict and to reconcile the different functions which may take into account not just formal rules but also informal norms and values related to the two sectors.

Also the conflict concerning browsing damage caused by moose is of a typical CPR character. The management of moose is decentralized to the involved stakeholders, primarily hunters and land-owners. Due to problems related to, for example, management scales, lack of rules regarding the appropriation and provision of common resources and effective monitoring of incentives to contribute to conflict resolution, are rather modest among the stakeholders [81].

Although forests used for recreation often can be considered as public goods they may, like in the case with cultural heritage, biodiversity and watershed protection, be negatively affected by timber production activities turning the situation into a CPR situation. Conflicts concerning recreational use are based on the Rights to Public Access to land and are often managed through public planning or by the stakeholders involved. The institutions directing recreation are however often of a more informal than formal character which makes conflicts difficult to handle. There is thus a lack of governance mechanisms that can reduce recreational conflicts that involve property rights and diverse stakeholders by re-positioning incentives, yet avoid changes in land ownership and property rights, and at the same time have the capacity to adapt to land use change [15].

To conclude, in market economics, private goods and services are often guided by private property regimes and markets, while public and toll/club goods and resources are governed through formal regulations depending on what type of resource it concerns. When it comes to a CPR situation, such as water governance, forest as pasture land either for reindeer or moose, hybrid institutions, combining market, self-organization/participation and state regulatory approaches have been introduced to overcome the difficulty of exclusion which can result in overexploitation of resources, and the rivalry problem which can lead to resource degradation or destruction [22]. These hybrid institutions might look very different and take different forms depending on type of resources and resource users involved [82]. Research has however shown that few of them are successful in managing trade-offs between different functions of forests in Sweden [78] and that institutional change is needed both to meet current and future needs of land use and land use change.

7. Managing Multifunctionality through Multiple Criteria Decision Analysis

A promising approach for balancing the multifunctionality of forests, taking into account both formal and informal institutions, is to combine MCDA with a participatory process [83]. Using MCDA in a participatory process provides a structured way of working that generates knowledge about the problem and the objectives of the different stakeholders [84]. This may promote the stakeholders' understanding of their own and others values and objectives, and, through exploring these in the context of the problem, guide them in identifying a preferred course of future action. Furthermore, MCDA can support a participatory process by making it transparent, fair, and understandable, all of which are important properties for the process to be considered legitimate and accepted by the stakeholders. Transparency means that it is possible to account for the outcome of the process in terms

of the input and the mechanisms of the MCDA technique [85]. Fairness has to do with the power relations between stakeholders and how power differences are handled in the process [86]. MCDA may give stakeholders, without legal rights and who would otherwise not have been heard, influence on the decision. In addition, with MCDA, the influence of different stakeholders on the outcome can be made explicit in the aggregation of preferences. The participatory MCDA process suggested in this paper consists of five stages: stakeholder analysis, structuring of the decision problem, generation of alternatives, elicitation of preferences, and ranking of alternatives.

(1) Stakeholder analysis: The objectives of stakeholder analysis are to identify all relevant stakeholders and to clarify the extent of their participation. A *stakeholder* is someone who is affected by, or can affect, the situation in some way; that is, the stakeholders have vested interests in the decision problem [87,88]. The relationship among the participants in terms of how power, as in control over resources and decision making, is distributed should be made clear. The stakeholder analysis will often be initiated and managed by the party initiating the whole participatory process, e.g., the forest owner(s) or governmental authorities. However, different approaches for identifying stakeholders should be used, e.g., self-selection, identification through registers, through persons or organizations with knowledge about the situation, or identification and verification through other stakeholders [89]. A thorough stakeholder analysis is critical at the beginning of a participatory process to ensure that important stakeholders are included and central questions are addressed so that the overall picture of the situation will be complete. Otherwise, the solution found through the process will not be a solution to the real problem, the process may not be accepted as a participatory process, and implementation might be impaired.

(2) Structuring the decision problem: The aim of this step is to define the decision problem by identifying and structuring the stakeholders' objectives. When using MCDA, the structuring of a decision problem will influence the outcome, since the problems are mostly so complex that the task is not only a matter of solving a problem but also of defining what the problem is [27,90]. Thus, stakeholders should be included in the problem structuring, to ensure that the definition of the problem includes all relevant objectives.

(3) Generation of alternatives: The aim of this step is to generate a number of alternatives to select from. The alternatives, and the way in which they are generated, are critical to the outcome of the process, because if alternatives cannot be modified or new ones cannot be added during the process, the choice is confined to the given alternatives. Often, an iterative process in which alternatives are refined according to stakeholders' preferences would be desirable [91,92] but time and resource constraints can make this unfeasible. Thus, alternatives must be generated carefully; they should be Pareto optimal [37], and not too extremely directed toward any single stakeholder's interests, but at the same time, they must span the objective space sufficiently [93]. Depending on how the alternatives are to be evaluated, the number of alternatives is also important; too many alternatives can make the evaluation by stakeholders too demanding.

(4) Elicitation of preferences: The aim of this step is to incorporate the stakeholders' preferences into the decision making. Varying modes of expression can be used when stakeholders state their preferences: in a group or individually, at a personal meeting or by a form, on one occasion or iteratively. In cases where more complex MCDA techniques are used, a personal meeting with the possibility of adjusting preferences as knowledge of the situation increases would be a desirable

working mode [94]. In situations with many stakeholders, and where actual meetings are difficult because of geographical distance or lack of time, preferences may have to be elicited through inquiry forms or internet-based, user-friendly decision support systems [95].

(5) Ranking of alternatives: In the final step, stakeholder preferences, in the form of weights for criteria and alternatives, are combined by a decision rule resulting in overall weights that make it possible to rank the alternatives in a preference order. The decision rule is defined by the specific MCDA technique used [34]. When MCDA is used in a participatory process, some kind of aggregation of individual stakeholder preferences into a common preference is required to obtain an overall outcome. Belton and Pictet [33] have defined three general procedures for achieving a group decision: (i) sharing—the group can act as a single decision maker and agree on one common preference; (ii) aggregating—the stakeholders can state their individual preferences and a common preference is obtained through voting or calculation; and (iii) comparing—the stakeholders state their individual preferences and these are used in a negotiation process in which the aim is to find a consensus solution. In the procedures for sharing and comparing, a common preference is sought via discussions and negotiations. When aggregation is used, deliberations among stakeholders are to some extent replaced by a mathematical method for computing a common preference. In most studies combining MCDA and participatory forest planning, the overall results have been calculated through aggregation in this sense of the word [96-99]. However, aggregation of preferences in numerical form may feel mechanistic to stakeholders. Thus, the choice of aggregation approach should depend on the situation and be explained to the stakeholders. Moreover, if aggregation methods are used in participatory planning, they should be used as tools for exploring and increasing knowledge about the issue rather than as methods that produce "the optimal solution".

The integrated process described above must be adapted to the particular situation. In many earlier studies the participatory process is adapted to the method and not the other way round, which should be the case. However, the choice of MCDA method and design of process is in most cases not dependent on the specific function at hand. Instead, the choice should depend on the characteristics of the situation e.g., type and number of decision makers and stakeholders, number of alternatives and objectives, available information, level of expertise, *etc.* [38,83].

8. Discussion

There are a number of drivers, both direct and indirect, that may affect or change the prerequisites of existing conflicts in the Swedish forests. At the moment competition between agriculture and wood production is rather low in Sweden. Climate change might however significantly reduce the possibilities to conduct farming in many countries which is why land in the northern parts of the world might become more interesting from an agricultural perspective. If there is a need to convert forest land into agricultural land, there will, in combination with an increase in wood consumption for among other things the need for renewable energy, put even more pressure on forests in Sweden. Regardless of future agricultural needs there are, however, a number of drivers affecting the current demands on Swedish forests. One of the most important drivers is institutional change following the new Forestry Act of 1993, the EU WFD from 2000, and the implementation of forest certification schemes, as well as international conventions, like the Convention on Biological Diversity. There are however also

other drivers like urbanization, technological and economic drivers that will have an effect, often reinforcing, on the competing demands identified in this paper. If we want to maintain multifunctionality, it is necessary to uphold effective governance to meet current and future demands on forest resources.

The different functions identified in this paper have different characters; some are of a more private and others of a public goods or common pool resources character. The different characters of the functions are often related to various forms of formal or informal institutions. In particular socio-economic and ecological functions are governed by formal institutions like international conventions, laws and certification schemes, while others, e.g., cultural, recreational and aesthetic functions are governed by more informal institutions like norms and cultural values. Regardless of the formal and informal nature of institutions, conflicts occur due to institutional deficits or lack of governance institutions or proactive management tools that are (more or less) designed to solve this type of problem.

We have suggested that MCDA as a tool for participatory planning and group decision making could be a useful management tool for handling problems of multifunctionality. The integrated process may be a useful tool in situations of competing land use when goods of a CPR character are concerned. In such situations the integrated process makes it possible to involve relevant stakeholders in the decision making in order to promote socially sustainable land use. For public goods, the integrated process provides a possibility to increase democratic decision-making on both public and private land. For private goods, MCDA may still be used as an aid for the decision maker, e.g., the forest owner; however, in this case the participatory aspect of the integrated process may be of limited interest. An alternative solution to manage competing demands is to transform public goods or CPR to private or club goods, e.g., to create reserves for biodiversity or recreation by purchasing forest land. However, this way of managing conflicting demands tends to be expensive and is therefore only practicable to use in a limited number of situations [85].

In the field of MCDA, focus has been shifting from a problem-solving approach to a problem-structuring approach [84]. In other words, there is a shift from substantive rationality to procedural rationality, from an outcome-oriented to a process-oriented view [100]. Originally, MCDA was a tool created for finding the “best” solution, given the decision maker’s preferences. Nowadays when MCDA is used in participatory planning, the aims are often to describe and understand the decision making problem properly and learn about other stakeholders’ perspectives. Thus, there is a need for more attention to the institutional framework and on the communicative and deliberative aspects of a participatory MCDA process, rather than on technical properties and pure numerical outcomes [101-103]. As pointed out by Stirling [104], using MCDA in an outcome-oriented rather than a process-oriented way means that we risk “closing down” rather than “opening up” the planning process to the influence of stakeholders.

Primarily, the integrated process has been used as a tool for forest planning at different levels and may improve understanding and relations between stakeholders in order to prevent conflict and to include multiple perspectives in order to improve the planning from a societal point of view. In Sweden, this integrated process has, as far as we know, only been applied in a forest planning process at a local level [83]. However, internationally the combination of participatory planning and MCDA has

been used both in local planning processes [105,106] and on policy level in, for example, Australia [96], Canada [107], and Finland [108].

This integrated bottom-up approach however challenges traditional top-down management which is one of the reasons why the implementation of participatory process in environmental governance still is rather limited in Sweden [78]. Another reason is that public participation may be desirable from a normative perspective but rather difficult to implement in practice depending on to what extent it involves the public in information, consultation or decision-making [28,82,109]. In addition, a participatory process may be affected by policies and regulations outside the control of the process concerned and thus the potential to actually influence decisions may be restricted. Further questions that need to be addressed are about *representation*—who is to be involved, *legitimacy*—how are stakeholders involved and with what output, and finally *accountability*—who is responsible and how can these "who" be accountable for decisions made in public participatory processes. The design of institutions governing multifunctionality thus also has to include this type of obstacle to public participation in order to be effective.

9. Conclusions

In this paper we have examined the multifunctionality of the Swedish forests and how it is affected by current and future competing demands for land use. We have mainly focused on functions that are identified as non-market driven functions of a public or common pool resource character, such as protection of biodiversity and cultural services, watershed management, forests as pastureland for reindeers and moose, non-forest timber products and, finally, recreation. In Swedish forest policies, all these functions are recognized as important functions in parallel to traditional market driven functions of a private goods character, such as the growing and logging of timber, the processing of timber into, e.g., sawn timber pulp and paper and board. We foresee an increased competition between these functions in the future due to a combination of direct and indirect drivers of changing demands on forest land.

We have also identified how multifunctionality currently is governed in Sweden. While the market driven functions are guided by formal private property regimes and markets, the non-market driven functions are governed through formal state regulations depending on what type of resource it concerns or some kind of hybrid institution combining market, self-organization/participation and state regulatory approaches. Neither the formal regulations nor the hybrid organizations seem to be very successful in managing trade-offs between different functions of forests, e.g., due to the inability to include informal institutions such as aesthetic values, social capital and cultures, but also difficulties to value functions with a public or CPR character in monetary terms. Considering that many decisions are made by comparing benefits and costs, the lack of clearly established monetary values can have a strong impact on possible trade-offs. There is therefore a need to develop governance institutions that are designed to solve problems of multifunctionality by reinforcing inter-institutional coordination, to consolidate rules and reduce conflict, and to exploit synergies in implementation, *i.e.*, institutions that can govern and manage multifunctionality. One such promising tool that may incorporate formal as well as informal institutions, is the use of MCDA techniques in combination with participatory management processes. However, to be able to handle democratic obstacles related to participatory

processes, there is a need to develop these governance institutions further and try out the applicability in relation to the multiple functions of Swedish forests.

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