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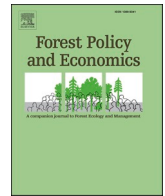
To log or not to log? Actor preferences and networks in Swiss forest policy

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ABSTRACT

Forests play a fundamental role in climate change mitigation. While there are calls to store carbon by increasing the forest stock, other actors oppose this, arguing that carbon stored in processed timber is more adequate. Applying an adapted version of the policy network analysis (PNA) framework, we uncover both the actors' policy preferences regarding the goal conflict between carbon storage in the forest versus in timber products as well as the actors' perceived importance and information sharing in the forest policy network in a Swiss region (canton Lucerne) via an online stakeholder survey. We find that an increase of carbon storage in the forest does not stand a chance in the Lucerne forest policy network, being rejected by nearly two-thirds of the actors. A majority views increased harvesting for wood products as a superior climate change mitigation measure than harvesting less for carbon storage. We also find that these proponents of wood are more central actors within the policy networks than those in favour of carbon storage in the forest. These findings are relevant for a context where the majority of the forest is privately owned and where interests in timber harvesting might dominate those on carbon storage. The analysis reflects the challenging situation within the timber market, where measures for increased wood harvesting might provide a more acceptable policy option than carbon sequestration for private forest owners.

1. Introduction

The climate crisis is a highly pressing issue requiring multi-faceted solutions. Apart from the need to vastly reduce carbon emissions, global carbon sinks play a major role in climate change mitigation. Forests are one of the major sinks, providing large-scale nature-based solutions (FAO, 2005; IUCN, 2016). At the same time, wood is also a carbon sink, if used for long-term purposes, for instance as a building material. Wood's carbon footprint is even better when one takes its substitution effects – compared to cement or metal – into account (Churkina et al., 2020; Eriksson et al., 2012). There is scientific consensus that the tropical old-growth forests are vital for the world's global atmosphere (Goodman and Herold, 2014). However, the following question remains highly debated: whether forests in the Northern hemisphere should be used as carbon sinks (*increased carbon storage* in the forest) or harvested more for long- or short-term wood use (*timber harvest increase for wood products*) (Tausz, 2017; Favero et al., 2017; Gorte, 2009; Seidl et al., 2007). As shown in Table 1, there are varying arguments in the literature regarding the pros and cons of the two options and contradictory findings. Underlying this question is a goal conflict with regard to climate change mitigation.

The decision of how to deal with goal conflicts in forest policy is ultimately political, contingent on the design of forest policies (Sandström et al., 2011). For forest policy to address this respective goal conflict, a diverse range of actors who have an influence on policy-making and their preferences play a pivotal role. One means to study such goal conflicts at the level of tensions between different aims in forest policy is the network approach. This provides a means to explain how the preferences of actors relate to their position, and more specifically to their power and interaction, within a network (Knoke, 2011; Knoke et al., 1996; Glück et al., 2005). Research in forest policy has increasingly focused on policy networks (Arts, 2012). For instance, Sotirov et al. (2017) have used the network approach to analyse how conflict (and cooperation) in forest policy networks can lead to learning in forest policy. Gallo et al. (2018) deal with the role the networks played in the implementation of Natura 2000 habitats in Slovenia, and how conflicts arose between different stakeholders engaged in the process. Baycheva-Merger (2019) shows that goal conflicts are often a result of the actors' different views within a network. We build on this research by applying an adapted version of the policy network approach (PNA)

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Table 1

Arguments for increased carbon storage in the forest versus increased timber harvesting (own illustration, based on Tausz, 2017; Favero et al., 2017; Gorte, 2009; Seidl et al., 2007; Stephenson et al., 2014; Pugh et al., 2019).

Increased carbon storage in the forest	Increased timber harvesting
Arguments regarding climate change mitigation	
Older forests store more carbon than younger forests.	Forests have the risk of emitting carbon, e.g. when storms occur, compared to stored carbon in long-term products (e.g. houses).
Carbon in forests is generally stored long-term, and even century old forests still sequestrate large amounts of carbon.	Substitution effects (regarding carbon) of short- and long-term wood use is positive (e.g. fuel wood compared to coal, timber compared to steel).
Older trees grow faster and absorb more carbon than younger trees.[a]	Younger forest stands store more carbon, being able to sequester it more effectively.[a]
Carbon emissions when timber is harvested needs to be taken into account (e.g. by forest machines and unused wood).	Younger forests (after reforestation) are less affected by external impacts (e.g. diseases) and thus less vulnerable to emitting carbon.
Arguments regarding financial benefits for forest owners	
Forest owners could be compensated via carbon certificates.	Timber sale is still the dominant form of generating revenues for forest owners.

[a] There are contradictory findings regarding this point. Some studies conclude that old forests store more carbon (for example, see Stephenson et al., 2014), while others find that younger forests are bigger and more efficient carbon sinks (for example, see Pugh et al., 2019).

and utilising social network analysis (SNA) as an empirical tool[1] to identify the actors' preferences regarding the goal conflict between carbon storage in the forest versus in wood products, their perceived importance and information sharing in the respective networks (Brockhaus and Di Gregorio, 2014). This combination of approaches has – to our knowledge – not been applied in the forest policy sector. In doing so, we seek to answer the following research question: *How do actor networks relate to actor preferences regarding the goal conflict between carbon storage in the forest versus in wood products*? Regarding the aforementioned debate, the insights gained in this study could then be used to identify strategies to solve the respective goal conflict.

As in many other countries, there are ongoing discussions about the forest's role in climate change mitigation in Switzerland. Covering around a third of Switzerland's territory, Swiss forests have been carbon sinks in the past twenty years (BAFU, 2019).[2] Some actors have used the forest's sink to, for instance, sell voluntary carbon credits. These actors also see its potential for climate change mitigation, calling for increasing the carbon uptake in forests (Verein Wald-Klimaschutz Schweiz, 2020). Other actors point to the already large timber stock in Swiss forests, and call for increased harvesting (Lignum, 2013). At the same time, this goal conflict is deeply embedded within the overall challenging situation of an ongoing drop of the timber price in forestry in many countries, and especially in Switzerland (Rüssli, 2019).

The discussion about carbon storage in the forest has just recently emerged at the Swiss federal level and gained importance with the debate about the complete overhaul of the Swiss carbon law. The Swiss National Council rejected a first bill, as domestic compensation measures – and carbon storage in the forest as well as timber harvesting increase count as such – were removed from the original draft, being the central reason the leftist parties eventually opposed the bill. The new bill was adopted by both parliamentary chambers in September 2020. It defines that 75% of the CO_2 reductions have to take place domestically, which is a prerequisite to officially recognise any compensation with

regard to the forest or wood products. As to how far the forest will be included in domestic compensation measures remains to be seen, but it will surely play a key role (as the federal state already takes the forest sink in international agreements, like the Kyoto protocol, into account).

To address the question regarding whether forests should be used as carbon sinks or harvested more for long- or short-term wood use, we focus on forest policy in the Swiss canton (constituent state) of Lucerne. This case fits our purpose, because the goal conflict has become particularly salient due to the large-scale private ownership (more than 70%), which contrasts with the general Swiss situation, where a third of the forest is privately owned (BAFU, 2019). In addition, the management in Lucerne is rather unique in Switzerland, with regional organisations coordinating the private actors (Seeland et al., 2011). Against this backdrop, the Lucerne case is as an extreme case within Switzerland.

The paper proceeds as follows. We first explain our conceptual approach, that is our adaptation of the PNA, before outlining the material and methods used, which comprise a more detailed description of the case study, the data collection process and the data analysis. In the subsequent results section, we firstly present the preferences of the actors regarding the goal conflict, before portraying the results of the SNA with regard to the perceived importance of actors and information sharing between actors. In the following part, before concluding, we discuss the results and draw the line to insights from the existing literature.

2. The policy network approach

A prominent framework to explain how the preferences of actors relate to their position within a network is PNA (Marsh and Rhodes, 1992; Marsh and Smith, 2000). According to PNA, a policy network is a model for reflecting the relationship between different actors, and particularly between different interest groups and the government (Marsh and Rhodes, 1992). The PNA approach generally focuses on the relationships between state and non-state actors, e.g. non-governmental organisations (NGOs) and government agencies (Marsh and Rhodes, 1992). Especially the role of state actors as well as political parties – with their strategic goals – are considered key (Richardson, 2000).

PNA scholars have developed the 'dialectical approach', which illustrates how shared aims in a network lead to a policy outcome, explaining this through structure and agency (Marsh and Smith, 2000). More recently, Normann's, 2017 analysed policy networks with regard to carbon capture and storage in Norway, showing the interplay between state actors, political parties and private actors, such as private companies in, for instance, the energy sector. He adapted the dialectical model by adding the interests dimension of actors, emphasising interaction – and thus change – in networks, which then both, together with the network structure, influence policy outcomes. Against this background, Normann's, 2017 was able to depict the influence of network change within the setting of the examined network more precisely.

As Jordan (1990) has put forward, policy networks can change, for example via partnerships, negotiations and compromises. Possible outcomes of negotiations and compromises depend on who actually bargains and how the bargaining process evolves, which – again – influences the overall network structure (Normann's, 2017). A core tenet of PNA is that actors' position in the network matters. Central actors can then influence and even change the policy preferences of other actors and thus influence the networks and the outcomes (Beyers and Braun, 2014). Consequently, it is not only relevant to examine the actor's preferences, but also incorporate the interaction within networks (Adam and Kriesi, 2007) as well as power dimensions (Brockhaus and Di Gregorio, 2014). Interaction can feature "a great variety of patterns … between public and private actors in policy making" (Adam and Kriesi, 2007, 130). Adam and Kriesi (2007) distinguish between three forms of interaction, namely collaboration, conflict/competition and bargaining/negotiation.

We have adapted Normann's (2017) model (Fig. 1), putting

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[1] The paper's goal is to use the SNA method as an empirical tool that enables grasping forest policy actor constellations. Our aim is not to make a contribution to the SNA literature.

[2] Except for the year 2000, where the storm 'Lothar' caused many tree losses, which subsequently emitted carbon (BAFU, 2019).
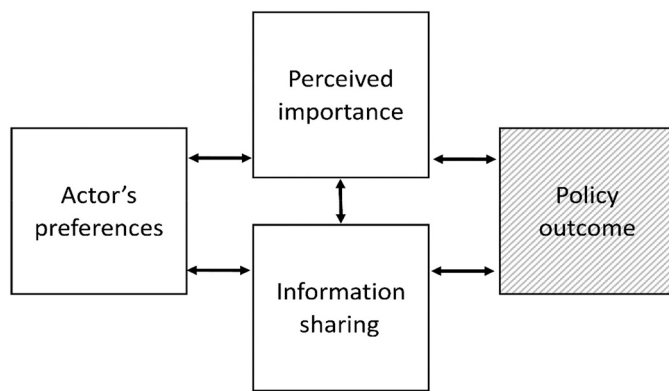
Fig. 1. Policy networks and their interrelational factors, adapted from Normann's, 2017. The arrows indicate how the factors (boxes) affect each other, starting with the actor's preferences, which influence (and are influenced) by perceived importance and information sharing. Eventually, these then lead to the policy outcome, which can also affect the previous factors. The shaded box indicates that it is not the paper's intention to explain policy outcomes, but that the focus is set on the preceding factors.

emphasis on the following. First, the actor's preferences regarding the goal conflicts. Following PNA, we understand actors as strategically basing their decisions and actions on their agreement or disagreement with certain policy options (Marsh and Smith, 2000). Second, networks can be characterised by power relations (Marsh and Smith, 2000), which can be understood as the actors' unequal ability to influence policy processes (Morrison et al., 2019). A proxy to study *one* of the many manifestations of power is in terms of actor's perceived importance (Fischer and Sciarini, 2015; Brockhaus and Di Gregorio, 2014; Lieberherr and Ingold, 2019). Third, network interaction, which refers to the pattern of interaction, namely, for our purposes, information sharing between relevant actors in the network (Adam and Kriesi, 2007). These three factors will then ultimately affect the policy outcome. However, since the paper's aim is neither to explain nor predict the policy outcome, its box is shaded in Fig. 1.

The fact that arrows link all boxes in the figure implies that they are all interconnected. For instance, the actors' preferences are always shaped by information sharing, while information sharing is at the same time also influenced by the preferences of the actor's in the network.

3. Material and methods

3.1. Case study

We conduct a case study of the canton Lucerne, a constituent state located in central Switzerland (Fig. 2), comprising an area of about 1494 qm^2 (DSG, 2020). More than one fourth of the canton, about 26,8%, is covered by forests (lawa, 2018). While forests in Switzerland are mostly publicly owned (about 70%), the situation in Lucerne is quite the opposite: 74% of the Lucerne forest is private property (BAFU, 2019). Moreover, the absolute number of forest owners is extremely high, about 12,000, resulting in the respective forest plots only having an average size of about 2,3 ha (Seeland et al., 2011).

On the one hand, the average small plot sizes put pressure on the small-scale forest owners, as the economies of scale are to their disadvantage (Nair, 2007), and thus hinders efficient forest management. On the other hand, also the geographical situation in Lucerne plays a role, partly being located in the midlands, partly in the pre-Alpine region. Generally, forest management in the midlands is easier, plainly because the respective plots can be directly accessed, and are thus also less cost-intensive than the management of forests in the pre-Alpine region, where slopes are steeper (Frutig and Thees, 2013). Moreover, about one sixth of the forests in Lucerne are marked as protective forests and

consequently not managed for commercial interests (lawa, 2018).

The problematic situation on the timber market, where the prices for round wood have dropped constantly in the last years, especially since 2015, further intensifies the fragmented forest ownership in Lucerne (Stitzel, 2016).[3] In addition, massive bark beetle infections – because of two extremely hot summers in a row with long droughts (2018 and 2019) – resulted in many unplanned timber harvests, which has led to more wood being offered on the market, letting the price decline even more (Plozza, 2019).

The developments over the last few years have entailed that forest owners look for new income alternatives, as already nowadays, some of 50% of Swiss forest owners can solely offset their management costs with the timber revenues, and about 20% even incur a loss (BAFU and SECO, 2017; BAFU, 2013). While there is no scientific consensus if increasing carbon storage in standing forests is a better climate change mitigation than harvesting timber and subsequently storing carbon in processed or constructed wood (Tausz, 2017; Favero et al., 2017; Gorte, 2009; Seidl et al., 2007), the former option has the advantage for Swiss forest owners to (possibly) be compensated for the (additional) carbon uptake in their forests. In that context, projects in Switzerland have already been implemented with the aim of reducing the timber harvest so that more carbon is stored, while receiving financial compensations through CO_2 certificates (see Verein Wald-Klimaschutz-Schweiz, 2020 for a project in the canton of Solothurn; for a project from a civil community in the canton of Schwyz, see OAK, 2017). Similar discussions are present within the political landscape in the canton of Lucerne, where certain actors want to store more carbon in forests, while others argue for increased harvesting (Scherer, 2019). In the meanwhile, the cantonal parliament has prompted the Lucerne government in the summer of 2019 to consider two policies. Firstly, public high-rise buildings should predominantly be built with (Swiss) timber, and secondly, the cantonal building stock ought to be managed carbon neutrally, while exceeding carbon emissions should be compensated by investments in the Lucerne forest (Kantonsrat, 2019). In that sense, the cantonal parliament has already considered both approaches to some extent.

3.2. Data collection

We surveyed actors who are relevant for Lucerne forest policy. Concretely, we operationalised the concepts from PNA as presented in Table 2 in order to derive indicators for actors' preferences, perceived importance and information sharing.

We set up a two-part survey with the online tool Unipark. The first part focused on actor's policy preferences regarding the goal conflict. These data were collected via a four-level Likert scale.[4] The second part of the survey gathered data on perceived importance and information sharing. For these two dimensions, we let the actors answer the questions whom they perceive as important in the cantonal forest policy-making process and with whom they have cooperated by sharing information regarding cantonal forest policy within the last 10 years.

To identify the relevant actors for the survey, we employed a combination of the decisional, positional and reputational approaches (Knoke, 1993). Following the decisional approach, we first identified

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[3] 'Regional organisations' (ROs) have been designed to counter these developments (Hansmann et al., 2016). In doing so, a central actor coordinates several private forest owners. Their aim is to ensure cost-efficient forest management, harvesting and timber provision. However, whether the ROs actually improve the situation noticeably, remains to be seen.

[4] A four-level Likert scale has the benefit of excluding less meaningful neutral responses, compared to a five-level scale, as it has an uneven number of response options. The four levels were: (1) fully agree, (2) mostly agree, (3), mostly disagree and (4) fully disagree. Additionally, there was always the possibility to refrain from answering (no indication). The questions inquired by the online questionnaire can be found in the appendix.
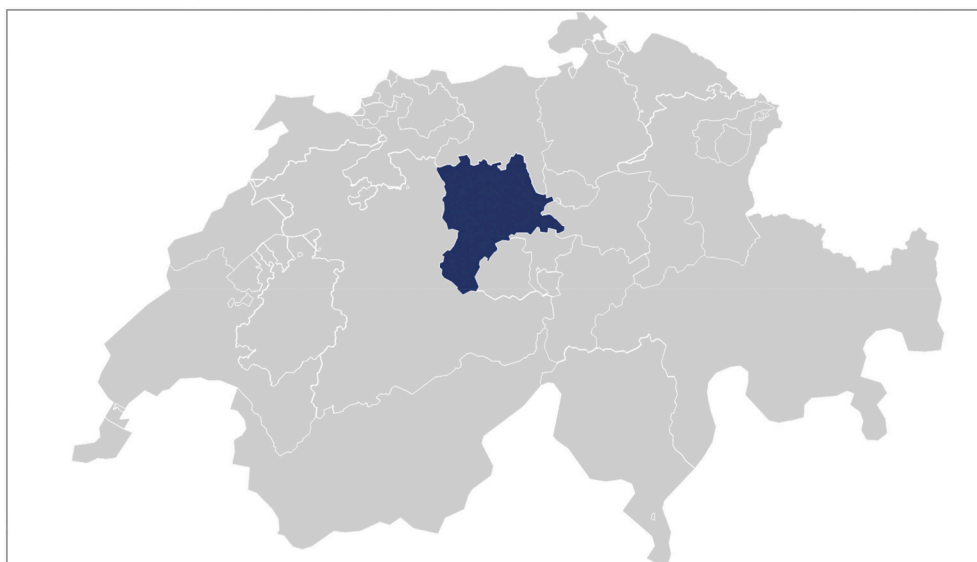
Fig. 2. A map of Switzerland, the canton of Lucerne is coloured in blue (geographical coordinates: 47° 6′ N, 8° 12′ O). Source: Wikimedia Commons (CC 1.0, 2.0, 2.5 and 3.0), Sandro Senn. (For further interpretation of the colour markings in this figure legend, please see the web version of this article.)

Table 2
Operationalisation of the main concepts. Own illustration, adapted from Normann's, 2017.

Concepts	Description	Indicators
Actor's preferences	Actors agree and disagree with various options, and place their action on them as subjects calculating strategically (Marsh and Smith, 2000).	Actors' degree of agreement with position statements related to either carbon storage in the forest or stronger wood utilisation.
Perceived importance	Power relations operationalised as actors' perceived importance, as *one* form of many manifestations of power (Fischer and Sciarini, 2015). It can serve as an indicator for the ability of actors to achieve a desired policy aim (Brockhaus and Di Gregorio, 2014; Lieberherr and Ingold, 2019).	Actors viewing others as important for issues in (cantonal) forest policy.
Information sharing	The pattern of interaction, defined as *one* of its three forms, namely information sharing between actors in the network (Adam and Kriesi, 2007).	Actors sharing information and working together towards the same goals in (cantonal) forest policy, as they pursue similar goals.

Table 3
The grouped participants of stakeholders in the online survey.[a]

Stakeholder group	Sent out	Replies[b]	% of total
Federal administration	4	2	4
Cantonal administration	6	5	10
ENGOs	4	4	8
Agriculture	2	2	4
Political parties	6	5	10
Science and education	8	6	12
Timber industry	6	5	10
Recreation and leisure	4	3	6
Forest owner associations	14	12	23
Other associations	12	7	13
Total (percentagewise)	66 (100%)	51 (77%)	(100%)

[a] The number of organisations within one group is based on the existing cantonal structures. For example, 14 forest owner associations in Lucerne were addressed, as there are 14 associations in the canton of Lucerne, compared to, for example, 6 political parties that are part of the cantonal parliament. Consequently, although the group sizes therefore differ, the exact sizes of the groups simply represent the (political) situation in the canton.

[b] The fact that in the results section *n* has different values simply relates to the fact that respondents always had the possibility to not state their preference for a question, which was then treated as a missing value.

actors that are engaged in Lucerne environmental and forest policy-making. This was done by checking which actors participate in the cantonal environmental policy area (e.g. consultation procedures). While these are mostly actors from the cantonal level, also stakeholders who engage at the federal level and are influential for the cantonal forest policymaking were included. Consequently, applying the positional approach, we added actors occupying important strategic positions within the Lucerne and Swiss political system (e.g. political parties). Lastly, we checked in three test interviews (with one federal, one cantonal and one environmental non-governmental organisation (ENGO) representative) whether any relevant or powerful actor was missing, applying the reputational approach, and thus added relevant

actors not yet listed. Subsequently, we assorted the actors identified to 12 thematic stakeholders groups (Table 3).[5]

The online survey was sent to 66 potential respondents on 7 January 2020 and was open until 31 January 2020, with a reminder being sent on 21 January 2020. We received answers from 51 respondents, resulting in a response rate of 77%,[6] which we consider as appropriate to make valid conclusions about the (undirected) network, as the respondents also had the chance to name additional organisations or actors not listed in the survey. Since this resulted in only one further actor being named, we conclude that all relevant actors are represented in the network.

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[5] These groups were: federal administrations, cantonal administrations, ENGOs, recreational organisations, political parties, agricultural associations, timber industry associations, research and science, forest owners and forestry organisations, forest consulting agencies, and other organisations and associations (e.g. association of forestry personnel and certification organisations).

[6] A complete list of organisations approached can be found in the appendix.

3.3. Data analysis

To analyse the actors' descriptively gathered policy preferences, we used the software IBM SPSS 26 (IBM Corporation, 2019). To assess perceived importance and information sharing, we use measures from SNA which show the structure of networks (Borg et al., 2015). The data analysis for the SNA was performed using the Ucinet software package (Borgatti et al., 2002). We use SNA to visualise the network and thus depict the ties between the stakeholders involved in the policy process (Hauck et al., 2015). In doing so, we apply SNA as a basic empirical tool that helps us to detect given structures, while it is not the paper's aim to contribute to the SNA as a method. As the unit of analysis, we focus on ties in the networks between actors, following Knoke et al. (1996). For the two networks, there is a tie as soon as one actor mentions another actor as important or indicates that information sharing occurred.

Concerning the analysis of the networks, we calculate two values in order to analyse perceived importance and information sharing. First, the density, that is the number of ties in the network presented as the proportion of all possible ties, and second, the average degree centrality, that is, the number of ties a node possesses on average (Borgatti et al., 2018). For perceived importance we also provide reciprocity, which refers to the number of ties in a network that are based on mutuality (Prell, 2011). At an actor level, we calculate the indegree centrality as an indicator for perceived importance, that is, the number of times the same actor is mentioned by other actors (Borgatti et al., 2018). Thus, we also include actors who did not complete the survey; these actors are defined as the number of ties an actor receives from others. A higher value thus indicates that the respective actor is considered as more important, allowing for conclusions on the actor's perceived importance within the network. For information sharing, we calculate the undirected degree centrality, defined as the number of immediate contacts one actor has in a network, no matter whether the actor indicates information sharing or if another actor indicates it (Prell, 2011). This implies that we view information sharing as given if one actor states that information sharing is present, even if the other actor did not indicate so.[7] In this case, a higher value indicates more information sharing with other actors and shows how actively an actor is participating in this domain.

4. Results

4.1. Actors' preferences regarding the goal conflict

Here we wanted to know whether the stakeholders are in favour of carbon storage in the forest or whether they favour an increased timber harvest, that is, wood production. As Fig. 3 indicates, nearly two third of the stakeholders, namely a majority of 64%, does not favour an increased carbon storage in the forest.

Associations representing forest owners are vastly against more carbon storage in the forest. Only a small group (about one fourth) holds an opposite view. With regard to federal administrations, two out of four did not wish to participate in the survey or only completed the 'non-political' SNA part on importance and interaction, arguing that the questions on the preferences are "politically too delicate".[8]

Moreover, more than 81% of the respondents backed the statement that an increase in harvesting for wood use – either for building or energetic purposes – should have priority over carbon storage in the forest,

Fig. 3. "The forest should contribute more to climate change mitigation by increasing its carbon uptake and harvesting less wood, so that more CO_2 can be stored." ($n = 44$).

with nearly half of all organisations indicating that they 'fully agree', as Fig. 4 shows. Again, it is the timber associations that unanimously favour an increase for material or energetic uses, by fully agreeing (100%); but also the forest owners favour it with an overwhelming majority (92%). ENGOs are the only group who view carbon storage in the forest positively, with two thirds rejecting (67%) measures increasing the use of wood.

The data concerning the main goal of forest management are aligned with the above results. When asked to give their view on the statement that the provision of wood should be the central aim of forest management, 69% support this, and one fourth even fully agrees (Fig. 5). Especially the group of forest owners are totally in accordance with this. Again, it is the leftist parties (Greens and Social Democrats) who disagree, as well as all ENGOs and four out of six actors from the scientific community.

All three figures (Figs. 3, 4 and 5 clearly show that an increase in harvesting for wood use – either for building or energetic purposes – should have priority over carbon storage in the forest has a majority. Possible reasons for the actors' views include the following: It is not so much the fact that the actors consider both approaches as mutually exclusive, i.e. more carbon storage in the forest (less harvesting) *and* conducting forest management for timber purposes; only a slight majority of 51% actually rejects this. Rather, an overwhelming majority of 93% considers built-in wood as a better climate change mitigation measure than solely increasing carbon storage in the forest (Table 4).

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[7] Since not all organisations responded, this approach is adequate, as taking a directed measure would imply that actors who have not completed the survey would automatically participate in no information sharing, as they did never indicate that information sharing occurred, because they did not complete the survey.

[8] This statement was made from one employee of a federal office when being asked to complete the survey.
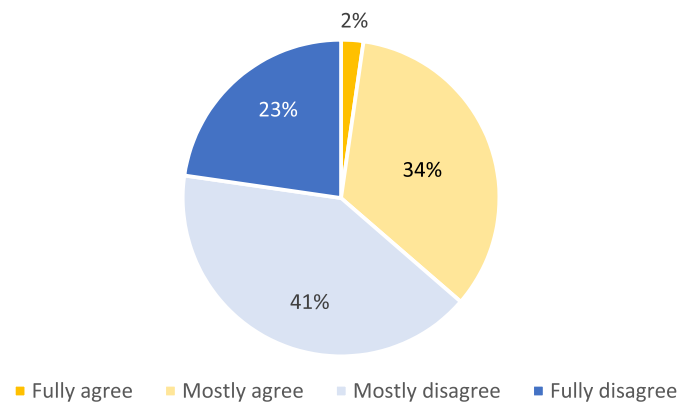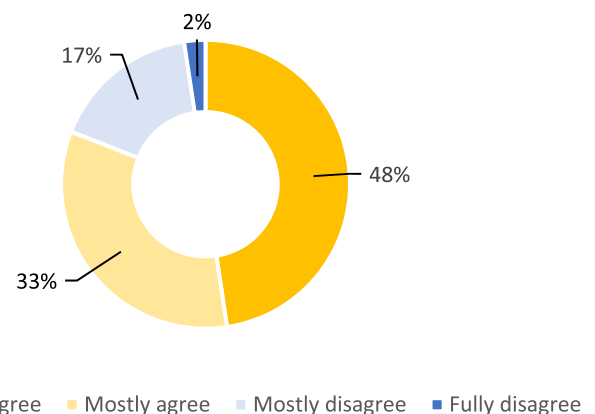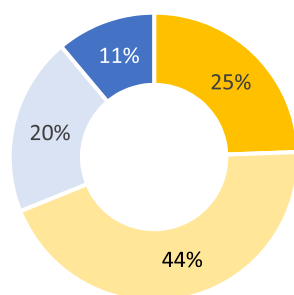
Fig. 4. "An increase of the material or energy uses of wood should take precedence over increased carbon storage in the forest." ($n = 42$).

Fig. 5. "The main goal of forest management should be the provision of timber." (*n* = 45).

Table 4
Actors preferences regarding built-in wood for climate change mitigation and the simultaneously harvesting timber and conducting a timbers stock increase.

Statement	Support (in %)[a]
Sustainably logged and subsequently built-in wood can contribute more to climate change mitigation than increasing the timber stock. (*n* = 41)	93
The simultaneous enhancement of timber harvest and carbon storage in the forest is possible and does not constitute a contradiction. (*n* = 41)	49

[a] Support implies the aggregated figures of actors who opted for "fully agree" or "mostly agree". The missing values that add up to 100% are made up of "mostly disagree" and "fully disagree".

4.2. The networks of Lucerne forest policy

4.2.1. Perceived importance

Focusing on the network of Lucerne forest policymaking, the perceived importance network shows a rather dense shape (see Fig. 6), having a value of 31.9%, and reciprocity amounts to 15.6%. Moreover,

the average indegree centrality is 21.1, which means that on average an actor was mentioned 21.1 times as being important. With regard to the most important actors, taking the indegree centrality as the measure, the group that is most represented is 'cantonal administration', having three actors in the top eight: Office for Agriculture and Forest (lawa), lawa, Forest Region Lucerne, and lawa, Forest Region Midlands (Table 5).

However, the actor perceived as *most* important is one from the federal level, namely the Forest Division of the Federal Office for the Environment (FOEN), having a value of 41 (the highest possible value is 51). The FOEN together with another administrative office, the cantonal Office for Agriculture and Forest (lawa), are the most important regarding cantonal forest policymaking. The forest economy association Lignum follows in the third place (34), just before the forest owner association ForestLucerne (32). Also within the top places is an actor from science and education, namely the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the main institution for forestry research in Switzerland (29). In addition, an actor from the recreation and leisure group, the cantonal hunting association, occupies a place within the top eight (25 ties). In contrast, we find no political party within the most central actors of the perceived importance network.

When linking perceived importance to the data regarding carbon storage in the forest, the actors favouring this approach feature a significantly lower density value (21.7%) than those actors who are opposed to it (28.3%). Accordingly, actors who reject increased carbon storage in the forest perceive actors who also object it as generally more important.

When focusing on the preferences of the most central actors regarding increased carbon storage in the forest, four are in line with the majority, rejecting it (slightly below the overall average of 64%). However, when leaving the FOEN Forest Divison – which did not specify its view – aside, the three highest ranked actors are all opponents of increased carbon storage in the forest. In contrast, only three actors, and therefore just about a third of the most central actors, are in favour of increased carbon storage, being the minority.

4.2.2. Information sharing

The information sharing network clearly exhibits lower values than compared to the perceived importance network: the density value is 24.0% and the average degree is 15.8 (the lower density is also visible
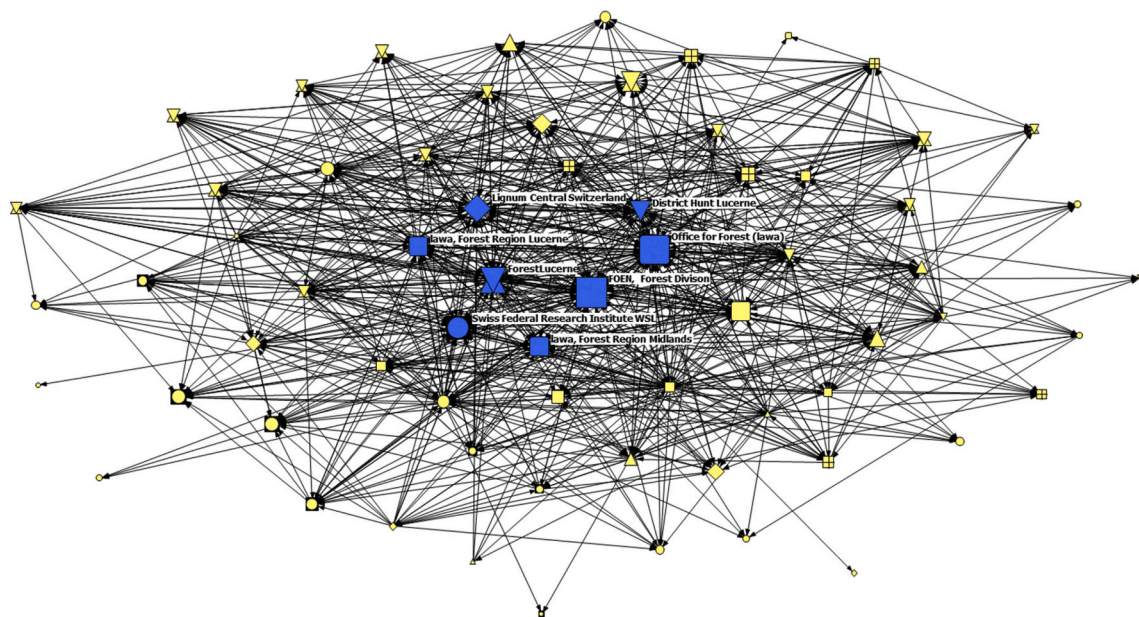

Fig. 6. Perceived importance of actors within Lucerne forest policy (indegree centrality) (*n* = 51). The most central actors are marked blue. The definition of the symbols can be found in the appendix. Node size adjusted to centrality. (For further interpretation of the colour markings in this figure legend, please see the web version of this article.)

Table 5

Indegree centrality of the most central actors (first eight actors) regarding perceived importance. The highest possible value is 51, the overall participation figure. If organisations are italic, it implies that they are also part of the most central actors in the information sharing network.

Organisation	Indegree centrality	In favour of increased carbon storage in the forest
FOEN,[a]Forest Divison	41	Not specified
Office for Agriculture and Forest[b](lawa)	40	No
Lignum Central Switzerland[c]	34	No
ForestLucerne[d]	32	No
Swiss Federal Research Institute WSL[e]	29	Yes
District Hunt Lucerne[f]	25	Yes
lawa, Forest Region Lucerne[g]	24	No
lawa, Forest Region Midlands[h]	23	Yes

[a] FOEN is an acronym for "Federal Office for the Environment".

[b] The "Office for Agriculture and Forest" is the Lucerne cantonal administration dealing with all kinds of forest related issues. In German: "Dienststelle Landwirtschaft und Wald (lawa)".

[c] In German known as "Lignum Zentralschweiz", the cantonal branch of Lignum, which is the Swiss forest economy association.

[d] In German "WaldLuzern", the cantonal branch of WaldSchweiz (Forest-Switzerland), which is the association of forest owners.

[e] WSL is the acronym for Switzerland's federal research institute for forest, snow and landscape research. In German: "Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft".

[f] District Hunt Lucerne is a cantonal association of hunters. Its German name is "Revierjagd Luzern".

[g] Forest Region Lucerne is a subdivison of lawa (Lucerne's Office for Agriculture and Forest), being responsible for the forest district of Lucerne. In German: "Abteilung Wald, Waldregion Luzern".

[h] Forest Region Lucerne is a subdivison of lawa (Lucerne's Office for Agriculture and Forest), being responsible for the forest district in the Lucerne midlands. In German: "Abteilung Wald, Waldregion Mittelland".

when comparing the graphical representations in Figs. 6, 7).

The actors that respondents have indicated to share information with the most are displayed in Fig. 7 and listed in Table 6 (undirected degree centrality), and again, the group that is represented the most is 'cantonal administration': Office for Agriculture and Forest (lawa), lawa, Forest Region Midlands and lawa, Forest Region Entlebuch.

ForestLucerne, the cantonal forest owner association, is by far the actor with the most information sharing (54 ties). The cantonal Office for Agriculture and Forest (lawa) is in second place (38 ties), just like it is with regard to perceived importance. While the Working Group on Forest (AfW) was not mentioned in the top eight in terms of importance, it has the third highest information sharing centrality (35 ties). Forest Lucerne Hinterland, a regional organisation consisting of different private forest owners (30), is also within the top five, thus being the second

Table 6

Undirected degree centrality of the most central actors (first eight actors) regarding information sharing. If organisations are italic, it implies that they are also part of the most central actors in the perceived importance network.

Organisation	Undirected degree centrality	In favour of increased carbon storage in the forest
ForestLucerne	54	No
Office for Agriculture and Forest (lawa)	38	No
Working Group for the Forest AfW[a]	35	No
lawa, Forest Region Entlebuch	32	No
Forest Lucerne Hinterland[b]	30	No
lawa, Forest Region Midlands	29	Yes
FOEN, Forest Divison	28	Not specified
District Hunt Lucerne	27	Yes

[a] AfW – in German "Arbeitsgemeinschaft für den Wald" – is the acronym for the "Working Group for the Forest". It is a committee consisting of 28 member organisations which are all engaged in forest policymaking. The working group seeks to foster exchange between the organisations.

[b] "Forest Lucerne Hinterland" is one of the eight regional organisations (RO). For more information, see footnote 3.
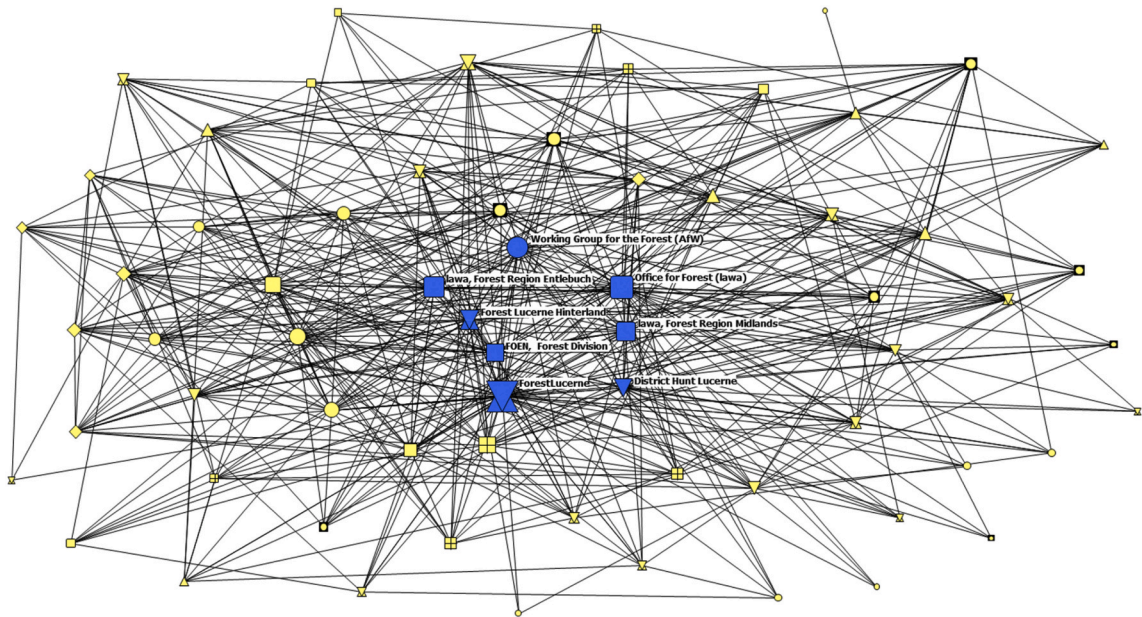

Fig. 7. Information sharing of actors within Lucerne forest policy (undirected degree centrality). The most central actors are marked blue. The definition of the symbols can be found in the appendix. Node size adjusted to centrality. (For further interpretation of the colour markings in this figure legend, please see the web version of this article.)

actor (next to ForestLucerne) from the group of forest owners. The only actor from the federal administration within the most central actors is again the Forest Division of the FOEN (28 ties); the same accounts for the only actor from the recreation and leisure group, District Hunt Lucerne (27), which was also part of the most central actors regarding importance.

The majority of the actors – and simultaneously the five actors with the most information sharing – are consistently opposed to increased carbon storage in the forest, while only two actors are in favour of it. Moreover, these two actors (lawa, Forest Region Midlands and District Hunt Lucerne) are, compared to the other ones (in Table 6), situated rather at the bottom of the information sharing ladder. When shifting the view from the most central actors, but focusing on information sharing between all *opponents* of an increase of carbon storage in the forest, we can confirm this tendency. The information sharing between the actors who reject increased carbon storage in the forest, and by definition support an increased timber harvesting, is relatively dense (Fig. 8), but the central actors are nevertheless actively engaged with the surrounding actors. The density (34.4%) as well as the average degree (9.3) underpin this, exhibiting even higher values than the overall information sharing network.

In contrast, the actors favouring increased carbon storage in the forest do by far not engage in such a strong information sharing as their antagonists do. Although the network consists of less actors, this circumstance is still visible when viewing the graphical network representation (Fig. 9) and comparing it to the one of the opponents of increased carbon storage in the forest (Fig. 8). To that effect, also the statistical figures confirm this, given a density of merely 20.8% and an average degree of just 3.1.

5. Discussion

We show that an increase of carbon storage in the forest does not stand a chance in the Lucerne forest policy network, given the current actor constellation. Most actors simply view increased harvesting for processed wood as a superior climate change mitigation measure than harvesting less for increased carbon storage. We also find that these proponents of processed wood are more central figures within the policy networks than those in favour of increased carbon storage.

We discover that the most central actors of both policy network remain relatively stable between importance and information sharing, implying that the majority of the most important actors are also those who share information in the centre of Lucerne forest policy. Furthermore, we also find that the actors who are for increased timber harvesting not only comprise the majority of actors, they also enjoy more pronounced perceived importance and clearly share information more often than actors in favour of increased carbon storage in the forest.

While it is – from a mere data point of view – regrettable that some federal state administrations did *not* declare their preferences, although they consider the issue relevant, their abstention does nonetheless provide considerable findings. Firstly, it shows the survey's focus is a highly contested political issue for the forest policy domain. Secondly, since the issue is still rather new, having emerged in the last years, the Swiss Federal Council does not have an official view (yet), resulting in no concrete content-related guideline for its offices, which could be a reason for the refusal of some federal administrations to complete the survey. At the same time, while there is no federal standpoint, most cantonal actors in Lucerne do share the same view, rejecting an increase of carbon storage in the forest. Moreover, it is no surprise that also the stakeholders from the timber industry do consistently reject the idea of increased carbon storage in the forest, as they are inherently dependent on timber supply (Lignum, 2013), which could possibly be hampered if measures for less timber harvest were implemented. At the same time, forest owners – however not as consistently – vastly reject an increase of carbon storage in the forest, as they still view the sale of timber as the primary goal of forest management. In contrast, the only group who generally views increased carbon storage in the forest as positive are ENGOs. This goes in line with their often declared position that there should be less harvesting in forests, as this could lead to higher biodiversity, which ENGOs often emphasise (Pro Natura, 2020). For this reason, they possibly also take a positive stance on increased carbon storage in the forest.

Interestingly, none of the ENGOs are part of the most central actors in the two networks. As forest policy is ultimately a part of environmental policy – and the fact that not one ENGO is perceived as important or shares information frequently – this either implies that ENGOs do not
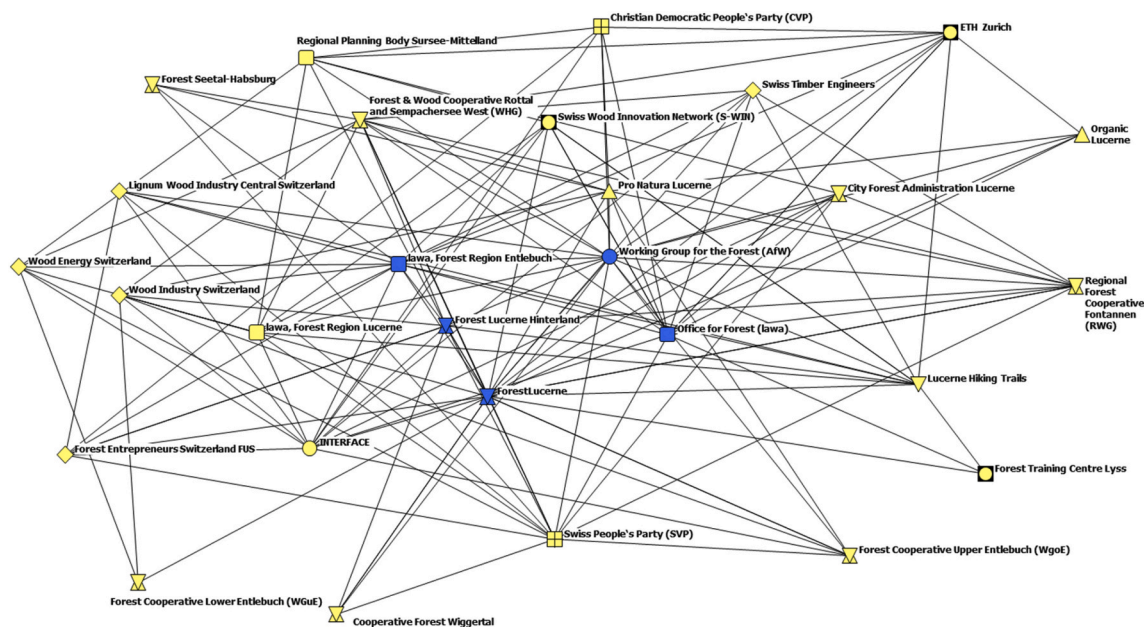

Fig. 8. Information sharing between the actors opposing increased carbon storage in the forest (undirected degree centrality). The most central actors are marked blue. The definition of the symbols can be found in the appendix. (For further interpretation of the colour markings in this figure legend, please see the web version of this article.)

Fig. 9. Information sharing between the actors favouring increased carbon storage in the forest (undirected degree centrality). The most central actors are marked blue. The definition of the symbols can be found in the appendix. (For further interpretation of thecolour markings in this figure legend, please see the web version of this article.)
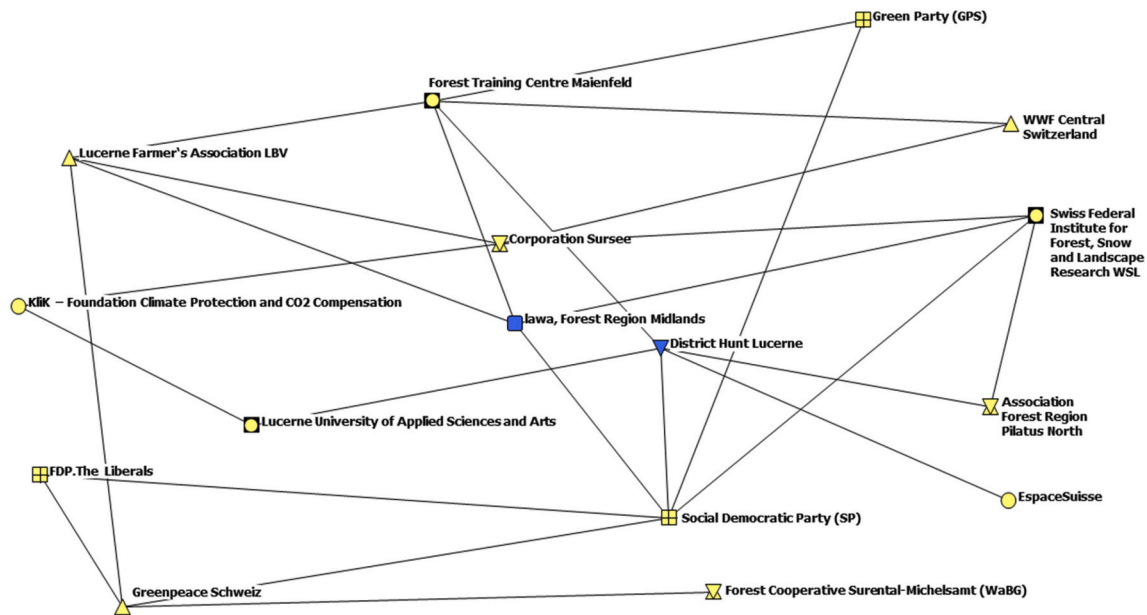
invest enough resources in this subfield or that they are not as successful as other actors (independent of the exact reasons). Indeed, other network analyses on Swiss forest policy have shown that ENGOs are central actors when it comes to policymaking (Schulz et al., 2018; Zabel and Lieberherr, 2016). However, these studies were at the federal level, dealing with actual policy making in the form of law making, while our study focused on a pre-parliamentarian stage. Accordingly, whether ENGOs would actually become more central if this goal conflict were to be dealt with in parliament, remains to be seen.

In line with the PNA literature, we find that especially state actors occupy central positions in the policy networks, giving them the opportunity to influence the policy outcome (Marsh and Rhodes, 1992; Fawcett and Daugbjerg, 2012; Smith, 1993). This also corresponds with network studies not explicitly drawing on PNA, which highlight that state actors on the one hand simply have more resources helping them to occupy key positions in networks, and on the other hand often have the power to structure policy processes (Klijn and Koppenjan, 2000). Acknowledging our case with its specificities, namely that Swiss forest policy is a joint task of the federal government and the cantons (BAFU, 2013), it is no surprise that we find state actors from the federal and the cantonal level in both networks. The Forest Division of the FOEN is the only federal administrative body within the perceived importance as well as information sharing network. While the FOEN is the *most* important actor, confirming the federal's influential role for the basis of forest policymaking, it does at the same time show that implementation processes are very much characterised by cantonal actors, thus being in line with Ingold's (2014) finding of a related policy field, namely that sub-national actors are key for land-use planning in Switzerland. What is more, actors from the cantonal administration are not only vital within the perceived importance network, they are also key actors in the information sharing network. We detect that in the information sharing network more regional cantonal actors crop up in the centre, who are pivotal for cooperation on the ground. As this study has focused on cantonal forest policymaking, it should be no surprise that cantonal administrations are central stakeholders within both dimensions.

On another account, our findings do *not* back PNA's foundation, namely that political parties are key in policy networks, trying to influence policymaking via their strategically set goals (Richardson, 2000). The fact that no political party is present in the importance nor

sharing information network could relate to the political system in Switzerland, where parties generally exhibit less power (Vatter, 2016). Another explanation might be based upon the fact that political parties do not (yet) consider the topic as so relevant as to position them strategically, but might focus on other, in their view more important issues. However, if the goal conflict gains momentum, the political parties might want to play a more central part, which could then also affect their position within the networks.

6. Conclusion

Our paper delivers new findings regarding the preferences and network structures in a Swiss region regarding an issue that will most probably affect Switzerland and Europe in the coming years. We find that the actors who prefer increased timber harvesting do not only comprise the majority, but they are also the more central actors in the networks than those in favour of increased carbon storage in the forest. These findings are relevant for a region in Switzerland where two-thirds of the forest is privately owned and where interests in timber harvesting might dominate those on carbon storage (also related to associated issues regarding nature conservation due to less harvesting). The ENGOs are those actors who predominantly favour carbon storage in the forest. However, the ENGOs were not central in our networks. While our findings reflect regional preferences, in the federal system of Switzerland, these very well have implications for national policy. This is timely given the latest amendment of the Swiss federal CO_2 law in September 2020. As it remains unclear as to how far the forest will be included in domestic compensation measures, and how the trade-off between carbon storage and increased timber harvesting will be dealt with, our findings are of high policy relevance. The case of Lucerne reflects the challenging situation with the timber market, where measures for increased timber harvesting might provide a more acceptable policy option than carbon storage for private owners. However, the Swiss forest policy landscape also has some very strong ENGOs (Schulz et al., 2018). Hence, if actors wanted to support carbon storage, they could focus on information sharing between ENGOs in contexts where private forest ownership is high. Moreover, the green and social democratic parties might want to get active to promote carbon storage while the conservatives and liberals might push for timber harvesting.

We also expect that debates over this goal conflict will evolve not only in Switzerland in the near future, but in other (European) countries too. For instance in Germany, where forest owners are increasingly pressured financially and thus even make use of derelictions (ND, 2018; WAZ, 2018), the issue could be intensified by calls of forest owners to be compensated, e.g. via carbon certificates. In that context, studies from other European countries are essential to enable cross-country comparisons of actor's preferences as well as the network structures. We have set the starting point of the analysis of a goal conflict that might certainly be relevant for actors who are concerned with forest policy in the near future, being the first study of its kind to systematically analyse the respective goal conflict in a case study. Based upon the actor's preferences and network structures, the data are at the same time naturally limited, as the study only focuses on the canton of Lucerne and on one given point in time. Consequently, studies dealing with other cantons and especially the federal level could detect how the actor's preferences and network structures are in other Swiss regions, which could then be compared to other countries, and thus contribute to attain a more thorough view on the issue. With regard to the time dimension, a follow-up study could detect changes in the networks, and examine if new actors emerged or if a federal actor like the Federal Office for the Environment is relevant for network stability, as some scholars argue

(Angst and Hirschi, 2017).

Author statement

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Questionnaire of policy preferences (originally in German, translation by the authors). Results listed in percent. The value "not specified" is not included in the results, but was nonetheless a response option

Statement/Scale	(1) Fully agree	(2) Mostly agree	(3) Mostly disagree	(4) Fully disagree	(5) Not specified
The forest should contribute more to climate change mitigation by increasing its carbon uptake and harvesting less wood, so that more CO_2 can be sequestrated. ($n = 44$)	2	34	41	23	
The main goal of forest management should be the provision of timber. ($n = 45$)	24	44	20	11	
An increase of carbon sequestration in the forest detracts from the fact that in order to mitigate climate change, CO_2 emitting activities have to be halted/reduced. ($n = 45$)	31	43	22	4	
Also in future, timber will be the most importance income base for forest owners. ($n = 44$)	11	64	20	45	
The simultaneous enhancement of timber harvest and carbon sequestration in the forest is possible and does not constitute a contradiction. ($n = 41$)	20	29	46	5	
Increasing carbon sequestration in the forest would limit the use of Swiss wood (even more). ($n = 41$)	18	34	34	14	
Sustainably logged and subsequently built-in wood can contribute more to climate change mitigation than increasing the timber stock. ($n = 41$)	59	34	5	2	
Increasing carbon storage in the forest would entail positive effects for biodiversity. ($n = 40$)	8	45	33	28	
An increase of the material or energy uses of wood should take precedence over a carbon stock increase in the forest. ($n = 42$)	48	33	17	2	
Increasing the carbon stock in Swiss forests would lead an increase of timber imports. ($n = 41$)	37	18	34	7	
Sustainable, economic forest management without state assistance is – given the current and expected future market conditions – not possible anymore. ($n = 41$)	20	41	37	2	

Appendix B. List of organisations and their respective symbol definition in the network figures

Organisation[a]	Symbol definition of the groups and survey answer received by single organisations (yes/no)
Federal administration	*Square*
Federal Office for the Environment FOEN, Forest Division	Yes
Federal Office for the Environment FOEN, Climate Divison	No
Federal Office for the Environment FOEN, Legal Affairs Divison	Yes (but only the SNA part)
Federal Office for Spatial Development ARE, Settlements & Landscape	Yes
Cantonal administration	*Rounded square*
Office for Agriculture and Forest (lawa)	Yes
Office for Agriculture and Forest (lawa), Forest Region Lucerne	Yes
Office for Agriculture and Forest (lawa), Forest Region Midlands	Yes
Office for Agriculture and Forest (lawa), Forest Region Entlebuch	Yes
Regional Planning Body: Region Lucerne West	No
Regional Planning Body: Region Sursee-Midlands	Yes
ENGOs	*Up triangle*
Pro Natura Lucerne	Yes
BirdLife Lucerne	Yes
WWF Central Switzerland	Yes
Greenpeace Switzerland	Yes
Agricultural associations	*Up triangle*

(*continued*)

Organisation[a]	Symbol definition of the groups and survey answer received by single organisations (yes/no)
Lucerne Farmer's Association LBV	Yes
Organic Lucerne	Yes
Political parties	Box
Christian Democratic People's Party (CVP)	Yes
FDP.The Liberals	Yes
Green Party (GPS)	Yes
Green Liberal Party (GLP)	No
Swiss People's Party (SVP)	Yes
Social Democratic Party (SP)	Yes
Research and science	*Circle in box*
Swiss Federal Institute for Forest, Snow and Landscape Research WSL	Yes
ETH Zurich	Yes
School of Agricultural, Forest and Food Sciences HAFL	No
Lucerne University of Applied Sciences and Arts	Yes
Swiss Wood Innovation Network (S-WIN)	Yes
Forest Training Centre Maienfeld	Yes
Forest Training Centre Lyss	Yes
HSR Technical University Rapperswil	No
Timber industry associations	*Diamond*
Lignum Wood Industry Central Switzerland	Yes
Wood Energy Switzerland	Yes
Wood Industry Switzerland	Yes
Forest Entrepreneurs Switzerland FUS	Yes
Swiss Timber Engineers	Yes
ISP – Interest Group Swiss Parquet Market	No
Recreational organisations	*Down triangle*
Lucerne Hiking Trails	Yes
District Hunt Lucerne	Yes
Lucerne Tourism	No
Swiss Cycling Lucerne	Yes
Forest owner and forestry organisations	*Thing*
Association of Lucerne Coporations	No
ForestLucerne	Yes
Association of Lucerne Communities (VLG)	No
Forest Cooperative Lower Entlebuch (WGuE)	Yes
Regional Forest Cooperative Fontannen (RWG)	Yes
Regional Forest Cooperative Surental-Michelsamt (WaBG)	Yes
Forest Cooperative Upper Entlebuch (WGoE)	Yes
Forest & Wood Cooperative Rottal and Sempachersee West (WHG)	Yes
Association Forest Region Pilatus-North	Yes
Forest Lucerne Hinterland	Yes
Corporation Sursee	Yes
City Forest Administration Lucerne	Yes
Cooperative Forest Wiggertal	Yes
Forest Seetal-Habsburg	Yes
Forest consulting agencies	*Circle*
INTERFACE Research Consulting GmbH	Yes
SILVACONSULT AG	No
Sigmaplan AG	No
IMULS AG	No
Other associations	*Circle*
Swiss Association of Forestry (SFV)	Yes
EspaceSuisse	Yes
Working Group for the Forest (AfW)	Yes
FSC Switzerland	No
FEFC Switzerland	Yes
KliK – Foundation Climate Protection and CO2 Compensation	No
Climate Foundation Switzerland	No
Other organisation named by respondents	*Rounded square*
Cantonal government[b]	Only named by a respondent in the SNA part

[a] Names of organisations in German were translated to English by the authors.

[b] Only in the perceived importance network, as solely named by one actor.

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