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Creating the landscape, one stand at a time: The dual roles of timber buyers in the nested domains of Swedish forestry

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ABSTRACT

In Sweden forest owners have a high degree of freedom in management decisions, but that does not necessarily imply decisions in isolation. Landowners are often influenced by forestry advisors, shaping forest management practices and the resulting condition of forests. As the State is withdrawing resources from the Swedish Forest Agency, advisory services are widely provided by private actors, particularly timber buyers. This study applies Hägerstrand's framework of nested domains to explore the role of timber buyers, with emphasis on their spatial competence. We expand Hägerstrand's theory by integrating private domains, which play an important role in landscape governance. Semi-structured interviews reveal the dynamics of timber buyers' dual role. Despite access to extensive data when giving advice, timber buyers rely largely on personal experience and information at the stand and property level, and environmental data are largely overshadowed by data related to timber production. Despite the buyers' greater spatial competence in comparison to landowners, they lack incentives to actively apply a landscape perspective in forest planning and management. There is underutilised potential for effectively balancing timber production, climate change mitigation, and biodiversity conservation at the landscape level through the advisory services by private actors. Our operationalized framework is helpful in analyzing FOKIS in Sweden, where compatibility of different types of advice providers needs further attention.

1. Introduction

Forest management practices must handle increasing tensions between competing goals, e.g. management for production of timber and pulp, climate change mitigation, and biodiverse climate-adapted forests (Felton et al., 2020). Countries around the world have developed distinct mixes of policy instruments to address these challenges. The Swedish forest sector is characterized by a 'more of everything' ideology that presumes prioritization of multiple goals (Lindahl et al., 2017) often pursued through public-private partnerships and with few strict regulations (Appelstrand, 2012). The Swedish forest sector relies largely on advisory services to private forest owners to meet the policy goals (Brukas and Sallnäs, 2012). In this study, we focus on of the most widespread type of private advisor, the timber buyer, and their crucial role in linking forest governance and forest management practice.

According to the Swedish Forestry Act, which has been in place since 1994, the equal goals of nature conservation and timber production are officially mandated. Swedish forest owners have 'freedom with responsibility' to manage their properties according to these goals. Large decision freedom has been an important precondition for developing a highly efficient forest sector (Brukas et al., 2015). Forest management decisions are mostly taken at the stand and property level (Brukas et al., 2013), but the accumulation of these independent decisions can have unintended consequences at the landscape level (e.g. Odum, 1982). Such cross-scale impacts of intensive forest management have resulted in negative effects on forest biodiversity and ecosystem services (Gustafsson et al., 2015; Felton et al., 2020; Rist et al., 2014). Since Sweden's Environmental Objectives related to forests are far from being met (Naturvårdsverket., 2022), neglecting the cross-scale impacts creates doubts whether existing soft policy instruments can adequately handle forestry challenges (Brukas et al., 2013), and what the 'freedom with responsibility' should entail (Löfmarck et al., 2017).

Related research looks into higher-level forest governance (e.g. Lindahl et al., 2017), including recent national (e.g. Fischer et al., 2020) and regional forest programs (Hertog and Brogaard, 2021). Other lines of research looks at landowner preferences and behavior (e.g. Ingemarson et al., 2006; André et al., 2017). However, since Swedish landowners are often not making management decisions alone (Eggers et al.,

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2014), there is a need to understand other key actors involved in forestry decision-making. We refer to Lawrence et al.'s definition of advice provider as a key dimension of FOKIS (FOrestry Knowledge and Information Systems), "the people who act as sources or channels of information" (p5), including private sector advisors and forest owner associations (2020). The Swedish Forest Agency's (SFA) official capacity for advisory services has decreased over the years, linked to tight budgets and other priorities (Lidskog and Löfmarck, 2016). Private sector actors thus provide a large share of advisory services in Sweden (Lodin and Brukas, 2021), and increasingly in other parts of Europe as well (Lawrence et al., 2020). Despite their growing importance, research on advisory services by private actors has been scarce.

Timber buyers, employed by private companies, are involved in forest management decisions at several stages. There is a variety of titles for this position, but we simply use the most common translation, timber buyer.[1] We see the buyers' role in forest management as unique due to their social connections and the size of their buying areas. Private advisors are mentioned in research on forest owners (e.g. André et al., 2017; Eggers et al., 2014) and alongside public advisors (e.g. Guillén et al., 2015). This paper explicitly addresses timber buyers and aims to describe their role as well as their social and spatial position between other actors. We situate timber buyers in Hägerstrand (2001), and specifically focus on the following research questions:

How do timber buyers describe their role and positioning in the forestry decision-making?

To what degree do timber buyers exercise their spatial competence at different levels?

2. Theoretical underpinnings

2.1. Hägerstrand's nested domains framework

We explore timber buyers beyond forest management, situating them also as key players in the creation of the landscape. There is no agreed-upon definition of the term landscape either from ecological or anthropocentric perspectives. The size and features of a landscape are relative, depending on context or purpose of analysis. A forest landscape, as we understand it here, would include numerous forest estates, ranging from hundreds to thousands of hectares. Torsten Hägerstrand, a human geographer, understood the landscape as a "carrier of the past" (Sörlin, 2020, p716), where macro and micro elements of human and natural systems are 'endlessly' interlinked (Hägerstrand, 2001). There are many challenges associated with the multi-scale nature of these interactions, including exactly where to draw system boundaries and from whose perspective to conduct system analysis (Cash et al., 2006). In Hägerstrand's (2001) view, one of the most fundamental way humans interact with the environment is by assigning ownership and responsibility to pieces of land. Through this process, natural gradients in a landscape can be sharply, and quite arbitrarily, divided by social boundaries. The nested domains framework illustrates the influence of different actors in the landscape and how their interactions cause changes to the environment.

Socially-defined spatial areas ruled by certain actors, or domains, are *nested,* meaning each piece of land is subsequently subjected to additional 'constraints' from each level of the governance hierarchy. The boundaries of these domains delimit a corresponding area over which an actor has an influence. Fig. 1 shows how levels of governance consecutively add rules or constraints down to landed property, e.g. a forest estate, and the 'action spaces' within it (Table 1). Hägerstrand's action space is analogous to the stand concept in forestry. O'Hara and Nagel (2013) describe the stand as the 'operational unit' of forest management. Due to site conditions, management goals, and perhaps most importantly, practical limitations, forest estates are divided so that management and monitoring activities can be carried out within a limited area. One of the core operations of forest management planning is the delineation of stand boundaries (Brukas and Sallnäs, 2012) that often persist over long periods, even as goals change (O'Hara and Nagel, 2013).

Hägerstrand characterizes domains by a combination of an actor's ability to affect others' actions or make physical change themselves (2001). *Spatial competence* is the ability of an actor to influence changes to the landscape "indirect[ly]… through setting legal limits or creating incentives" (Ness et al., 2010, p481). Such 'symbolic transactions' (p38) inherently affect decisions that can be made in subsequent domains, down to individual landowners (Hägerstrand, 2001). We understand spatial competence through how and to what degree an actor can influence the decisions of others.

In contrast, only landowners have *territorial competence*, which is "the ability to make material changes in the land" (Antrop and Van Eetvelde, 2017, p378). The landowners are, thus, part of the landscape and can carry out physical actions that change the environment (Hägerstrand, 2001). Higher-level actors, by contrast, are external, guiding behavior through various policy instruments from beyond the landscape.

The degree to which the domains are integrated with each other is important for effective governance. However, as described by Krott, "forest policy programs rarely exist in a comprehensive form" (2005, p23), meaning scattered policies related to forestry are present in various policy areas, governed by different authorities. Since the symbolic transactions developed by various actors are not always straightforward or clearly explained, lower levels are left to interpret how and to what degree policies are to be followed and enforced (Hägerstrand, 2001). Hägerstrand described the resulting ambiguous policy gaps or overlaps as *'fixed reaches'* (2001, p41), where it is unclear who is responsible for some issues or how they should be addressed (Fig. 2).

Scrutiny of the fixed reaches can reveal direct contradictions between actors, in terms of goals and priorities (Hägerstrand, 2001), and even how the system per se is framed (Lindahl et al., 2017). Such mismatches are common challenges in governance of complex systems, but it is important that related institutions attempt to purposefully manage the implications across multiple scales (Cash et al., 2006). Sweden's relatively limited number of strict regulations on forest management creates a lot of room for interpretation, particularly for the private actors

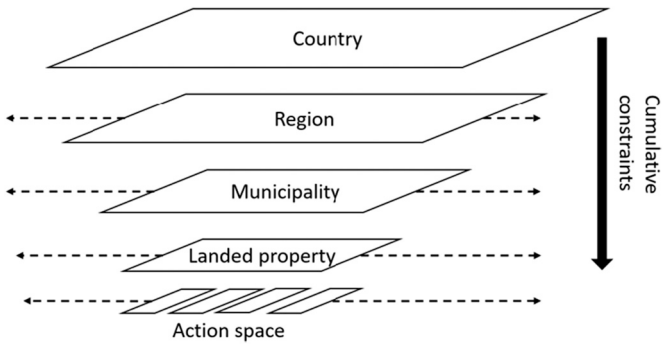

Fig. 1. Reinterpreting Hägerstrand's nested domains. Spatial and governance levels are 'nested' as each level introduces more constraints.

[1] Taking the example of the largest actor in forest advisory services in southern Sweden, the forest owner association Södra, their key personnel at the operational level (forest districts) are tasked with procuring timber to Södra's own industries and with providing advice on forest management to the members of association. Reflecting the duality of their roles, Södra internally refers to these staff as both 'inspectors' and 'timber buyers'. Previous studies also use the terms forest consultants (Lodin et al., 2017) and wood buyers (Lodin and Brukas, 2021). In this study, we choose to use "timber buyers" as common denominator for private forest advisors in Sweden, reflecting one of their primary functions and facilitating differentiation from public forestry consultants at SFA.

Table 1
Defining key terms from Hägerstrand (2001) for the purpose of this study as well as conceptual support to future studies in nested domains.

Term	Definition
Domain	An area that is governed by a given actor. 'Nested' refers to the accumulation of governance levels applied to each domain.
Spatial competence	The ability to influence outcomes within a domain, e.g. regulations that restrict timber harvesting or advice on forest management practices.
Territorial competence	A landowner's ability to make physical changes within their own landed property, e.g. harvesting timber or building a pond.
Landed property	The area where territorial competence is exercised, e.g. privately owned forest estate.
Action space	An 'operational unit' within each landed property, e.g. a forest stand.

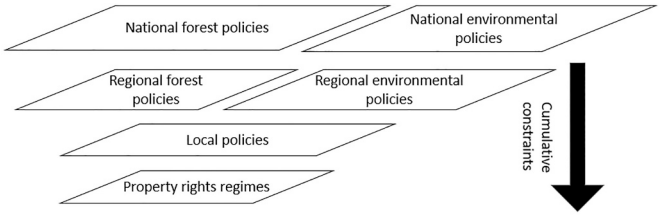

Fig. 2. Visualizing fixed reaches between related policy areas linked to their domains. Gaps, or overlaps, between policies or the responsibilities of actors, can create uncertainty in governance.

(Lindahl et al., 2017).

Hägerstrand's framework has been criticized for its lack of detail about social systems (Sörlin, 2020). Examples of nested domains often focus on formal government and legislation (e.g. Antrop and Van Eetvelde, 2017). This would be an unrealistic oversimplification, if trying to capture the relevant agency behind forest management at multiple scales in Sweden. The biggest weakness of nested domains is that it framed private industry as something that is subject to legislation. Hägerstrand failed to capture that in private-public arrangements, private industries are also part of the governance, not only subjects, and therefore their competences must be examined alongside government institutions. We see nested domains as a blank canvas for situating other actor types and helping to understand their interrelated influence on forest management. We continue refining actor representation in nested domains by integrating private domains. These constitute necessary additions to Hägerstrand's framework in a forestry context, as the decision-making power of the industrial forest actors pertains to multiple levels.

2.2. Nested domains in Swedish forest landscapes

A network of public and private actors drives forest governance, as part of an intentional shift away from government as the single authority (Appelstrand, 2012). The influence of forest companies (Andersson and Keskitalo, 2021), forest certification bodies (Johansson, 2012) and forest owner associations (Guillén et al., 2015) is widely recognized. Swedish forest governance does not rely on stringent regulation but instead steers softly through 'sectoral responsibility' (Lindahl et al., 2017) setting expectations and norms for forest planning and management through information and advice (Brukas et al., 2013). There is a strong expectation that, "through spreading knowledge and norms, forest owners will do more than what the law requires." (Lidskog and Löfmarck, 2015, p151). This means forestry advisors, private and public, are necessary translators of the sector's symbolic transactions into something tangible for the landowners.

Though visualizations of Hägerstrand's domains may implicate clear, strong hierarchies (Ness et al., 2010), Swedish governance is far from a streamlined top-down process. 'Flat' communications and interactions are abound between public and private actors of varying levels and divisions. We argue that the fixed reach of formal government institutions actors is complemented by intermediate, and even more flexible, domains held by private actors. Andersson & Keskitalo describe that Swedish forestry organizations range in size and services provided, but that all "have a direct or indirect (or both) influence on forest management and operations, for instance through advisory services or guidance..." (2021, p6). Private domains are also organized into multiple levels, but these do not necessarily match up with spatial levels of governmental institutions. The private actors effectively extend the reach between levels and sectors and fluidly fill in the gaps between authorities and forest owners. We highlight timber buyers' intermediate position in terms of boundary management, since they are strategically situated as communicators, translators, and mediators between different actor groups (Cash et al., 2003). Fig. 3 shows how we position timber buyers in relation to landowners, government institutions, and the range of other private actors, from large multinational companies down to local harvesting entrepreneurs. Timber buyers represent only one level of the broad, flexible domains of private actors, but have a unique position between regional government institutions, namely SFA's districts, and the forest owners.

Both public and private forestry advisors are involved in forest planning, including translating information from their respective organizations to the landowner (Brukas and Sallnäs, 2012). However, their roles and abilities are not the same, and they face different institutional pressures (Guillén et al., 2015; Lidskog and Löfmarck, 2016). The roles of private advisors are quite loosely defined (Brukas and Sallnäs, 2012), and there is no waterproof way to control for the variation in information advisors might provide (Lodin et al., 2017). Private advisors are usually associated with providing industrially-oriented advice with clear economic incentives (Lodin and Brukas, 2021), and this can create problems with trust between the owner and advisor (Guillén et al., 2015). The timber buyers' decisive influence on decision-making in forestry motivates the focus on private domains, constituting a fresh theoretical and empirical contribution to the studies of forestry governance.

3. Materials and methods

To explore the role of timber buyers, our investigation sampled timber buyers from two large companies, namely, Södra (Southern Sweden Forest Owner Association) and Sydved, a private forestry company. The geographical extent was limited to two regions, Scania and Småland. These regions are representative of southern Sweden's forest ownership structure with prevailing small-scale non-industrial private forest owners (Eggers et al., 2014). In comparison to northern

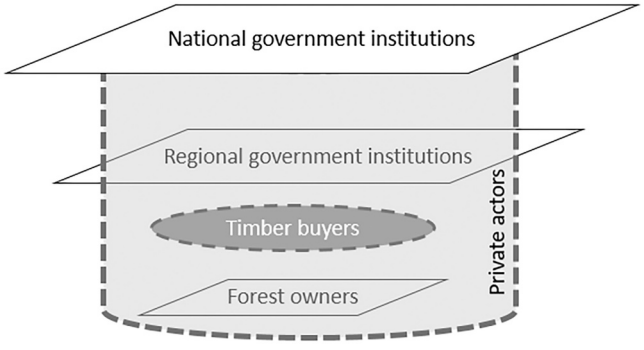

Fig. 3. Actors associated with the nested domains: Timber buyers fill a position between government institutions and private owners relative to other important actors.

parts of the country, southern Sweden has a higher density of human population as well as a higher concentration of species and ecosystem types (Gustafsson et al., 2015), while average forest property size is considerably smaller (Eggers et al., 2014).

Fig. 4 provides an overview of the spatial distribution of the two companies compared and SFA. Södra has 36 forest management areas, with 19 districts and at least nine buying areas within each district. Sydved has five regions, each divided into at least 12 buying areas. SFA has 9 districts in approximately the same area. Timber buyers are responsible for their individual buying area, but SFA employees share responsibilities for the entire district.

To meet potential informants first contacts were initiated in February 2020 at Småland's Regional Forestry and Wood Industry Strategy Day, yielding nine timber buyers with help of snowball sampling (Goodman, 1961). Logistic and time limitations did not permit further interviews. However, the responses were sufficient to reach theoretical saturation, meaning there was consistency in the main themes of the responses (Bryman, 2012). As typical for qualitative case study research, our data do not allow for formal statistical generalization, however, the study gives deep insight into how timber buyers see their work and the forestry system, conducive for informed generalization (Flyvbjerg, 2006). We did not try to compare differences between companies in the analysis, but depending on the size or focus, a company's ability to incorporate new policy priorities might differ, especially for the forest owner associations.

Interviews were carried out by the first author at two district offices of Södra and one of Sydved during February and March 2020. Interviewees were not selected a priori, but depended on which personnel were available during the visit to the district offices. All the participants were male, showcasing general gender distribution in the Swedish forest sector (see Andersson and Johansson, 2022). Three participants had spent the majority of their career as timber buyers and still work alongside them, but currently also have leadership or logistics-focused roles. Interviewees' working experience as timber buyers ranged from 3 to 40 years (Table 2). Many had worked in the industry before becoming buyers, as technicians or entrepreneurs.

One-on-one semi-structured interviews allowed flexibility when asking questions and following up emerging new topics (Bryman, 2012). A semi-structured interview guide was used in all the interviews with questions focusing on description of roles, contact, decision-making capabilities, usage and incentives to use ecological information beyond property level. Specific terminology (e.g. climate change, landscape perspectives, jargon from the nested domains framework) were intentionally not introduced to avoid leading questioning or tactical answers. Instead, participants were asked general questions to find out which spatial or temporal levels and data types are most relevant for them in their daily work. Interviews were conducted in Swedish, and while it is not the first author's mother tongue, the use of Swedish provided opportunities to deepen the conversation, get detailed answers and ask for further explanations about the timber buyers' competences.

Interviews were digitally recorded with the interviewees' consent and field notes were taken during the conversations. Their length ranged between 25 and 75 min, with most interviews lasting circa 50 min. Interviews were transcribed using InqScribe software. We conducted thematic analysis, using ATLASti software, following three main categories: data, landscape and landowner relations. Finally, in order to understand the timber buyers' perception of their role in relation to the landscape further interpretive analysis was carried out, rereading responses and finding patterns related to the usage of landscape perspectives. We chose to frame the research questions around the timber buyer's own description of their role, in contrast to using companies' job descriptions; this allowed to capture their own reflections on how they influence decisions made by forest owners, and ultimately forest management. Selected passages from responses were translated to display our results in the following section.

Table 2
Timber buyer education & experience.

Education type	Amount	Average years of experience as buyer
2 year forest technician	4	28
3 year bachelor	3	15
5 year master	1	5
no formal education	1	10

All the timber buyers were male. Usage of 'he/his/him' pronouns are deliberate and maintain their confidentiality.

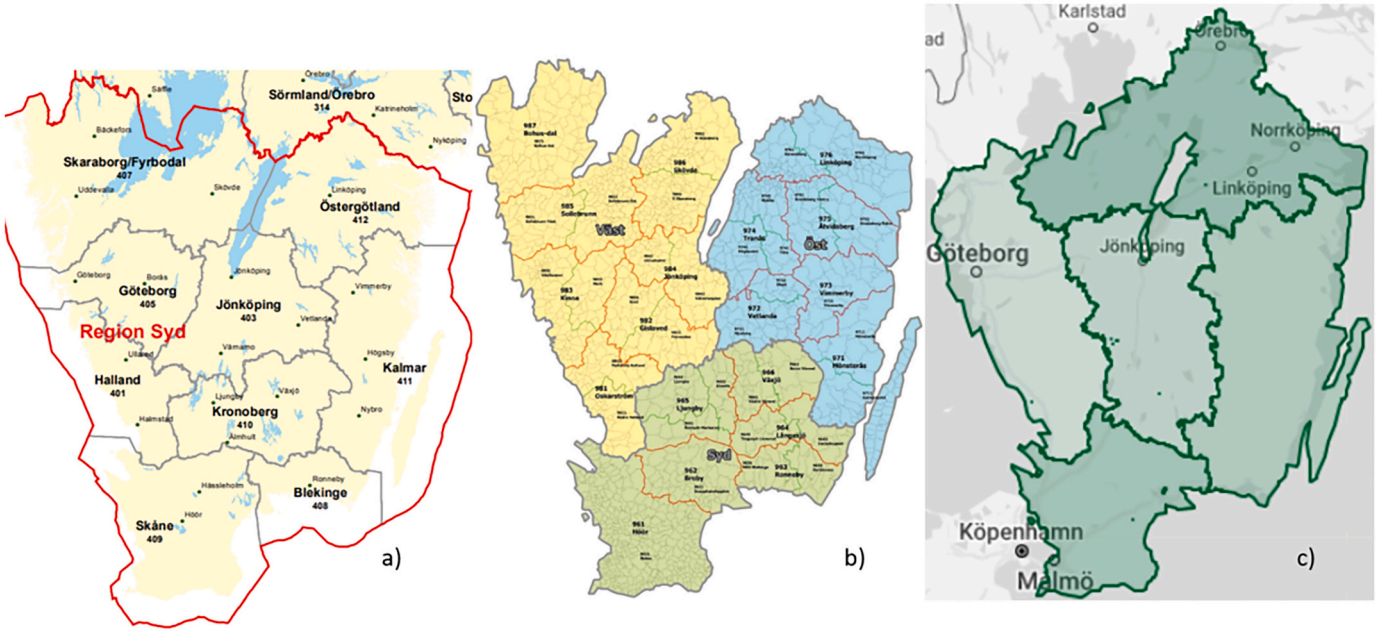

Fig. 4. Overviews of SFA (a), Södra (b) and Sydved's (c) spatial organization in southern Sweden. Similar in extent but with different internal organization boundaries. (Modified from Skogsstyrelsen, 2019, Södra, 2022 and Sydved, 2022).

4. Results

4.1. The duality of advisory-buyer roles

4.1.1. Professional responsibilities

The timber buyers described how they contribute to forest management on privately owned land. Each buyer is typically independently responsible for a given buying area of a few hundred square kilometers. In practice, timber buyers' core task is to acquire timber from hundreds of non-industrial private forest owners within their buying area, which thus constitutes their domain. They work on private estates that average ca 30–40 ha, and plan management activities within a property, typically on 1–3 ha for final harvests and > 10 ha for cleaning/thinning. TB2 explained, *"I am of course the contact person for a number of forest owners. The geographic area that I have is 20 by 20 kilometers, approximately. And I have maybe 200 members who have me as a contact person… All that applies to forests, they can call me. And sometimes they call more, and I have a full job to just take care of those conversations that come in, and sometimes they call less. Then I call them instead, and give support, do visits, write contracts for timber, and then when I visit a property, I look at all the actions that need to be done, cleaning, planting, soil preparation, thinning, and harvesting."* Timber buyers provide advice on a variety of forest management activities that can be executed within a matter of days up to a few years after the contact with landowners (Table 3). Buying timber, as their title suggests, is an important goal, linked to the thinning and final harvest stages in forest management.

The respondents emphasized both the advisory services and timber procurement as central elements of their job. *"I do what all the others do in this office. I work for the forest owner, giving advice. That is one part: going over their forest, looking at what is going on. The other role is the buyer, buying in timber to [my company's mill]. So, two roles. One giving advice and one buying timber. It goes in waves, right now it is a lot of advice,"* TB5. This dual role characterizes timber buyers' unique position in influencing the decision-making by private owners. Building relationships with landowners is often seen as the most important part of the job. They claimed to handle most or all communication with SFA for the landowner, often limited to submitting the final harvesting notification. Timber buyers' perceived their roles as important for local social networks, as well as the financial stability and profitability of the properties in the long-term. Timber buyers said they enjoyed their jobs due to the social connections and time in the forest. All appreciated the degree of independence the job gave them, since they could manage their own time and clients and could freely determine how and what to inventory in the field. TB1 echoed the other descriptions, *"My job is to keep contact with a number of forest owners within the area where I work independently, or together with some colleagues. I am of course a forest advisor, really, for all forest-related questions. We also sometimes help to support those who carry out the job, the production leader and forest improvement leaders… That is largely how it is. A lot of contact with landowners and carrying out different services."*

Table 3
General steps of a timber buying contracts.

Step	Description
Initiating contact	An owner seeks out advice or timber buyer follows up on an existing forest management plan. Alternatively, the timber buyer contacts the owner in conjunction to a nearby field visit, or when he checks existing forest management plans in the company's system.
Walk and Talk	Timber buyer meets owner in the forest to discuss management options, in certain stands or for the whole property. Depending on the owner's confidence in her objectives or level of engagement, this step is sometimes omitted.
Providing advice	Timber buyer suggests tactical measures for one or multiple stands. This includes several potential management stages including planting, pre-commercial and commercial thinning, road building, final harvest, etc. If agreed, a contract is drawn up and can be signed at that or at a later moment.
Independent inventory	Timber buyer carries out additional inventory to draw stand boundaries, physically in the forest and/or in his field computer. If contract is signed directly, this can take place the same day that the advice is provided. This step is often done alone and the methods used depend on the preferences of the buyer.
Management activities	Forestry activities are carried out by independent entrepreneurs. Forest products are delivered to the industry by other independent entrepreneurs. Depending on the size of the timber buyer's company, they either facilitate these activities themselves or through a colleague.
Payment	Timber buyer contacts owner when the harvesting is finalized to discuss payment. Since planting, cleaning, pre-commercial thinning and other necessary steps can be expensive, income from late thinning/final harvest is often used to cover those costs. A landowner might choose to receive the profit as a lump sum or to divide up the income over several months or years.

4.1.2. Digitalization and professional development

Recent changes in technology in the forest industry have drastically affected timber buyers' work, mainly by simplifying inventory and information sharing. Some useful improvements include access to extensive GIS information and ability to digitally update stand boundaries and site information in the field. Landowners and buyers can easily see, share, and update information about the forest estate in the company apps. Proposed contracts can be digitally signed on the spot if the landowner agrees with timber buyers' suggestions, and landowner activity with the company is recorded to update their forest management plans. Mandatory harvesting requests are nearly always submitted to SFA through these apps.

Although such advancements in technology and digitalization make some aspects of communication and data collection easier, several informants were critical of the double-edged sword of technology, since their results are constantly measured. "*One is watched over more now… what one does, or doesn't do! Everything in our work is measured, of course. What we do, how much timber we buy, and how many hectares cleaning, how many forest plans we have ordered… so everything is compared*" (TB2). Timber buyers feel increased pressure to manage more landowners and sales since the technology makes the administrative paperwork more efficient. Both the positive and negative aspects of technology were central to all the interviews and are closely linked to how the timber buyers interact with different types of data.

4.2. Data, expertise and social skills enable timber buyers' spatial competence

4.2.1. Usage of ecological and socio-economic data

The data timber buyers have access to, collect themselves, and use for decision-making is important for understanding their perspective. These data could be categorized into socio-economic and ecological, with some overlapping (Fig. 5). Many described that the data they choose to collect is based on their own experience. Each described his own unique approach to forest inventories, including what information is needed and how to weigh different factors. In practice, existing forest management plans are the starting point. Data related to timber supply gets most attention and is collected with ever-increasing precision. Regarding environmental consideration, the requirements for certification set the standard. Soil damage from heavy machinery was a serious concern, as well as the presence of spruce bark beetle. Other types of ecological data are treated as relatively auxiliary and their relevance depends on the interests of the particular timber buyer or landowner. Timber buyers emphasized that socio-economic data influence the timing of silvicultural measures to strategically plan income and taxation or to ensure future income for family members. Similarly, timber buyers said they sometimes reprioritize harvesting of certain stands depending on timber market prices, which can in some cases cause conflicts with landowners.

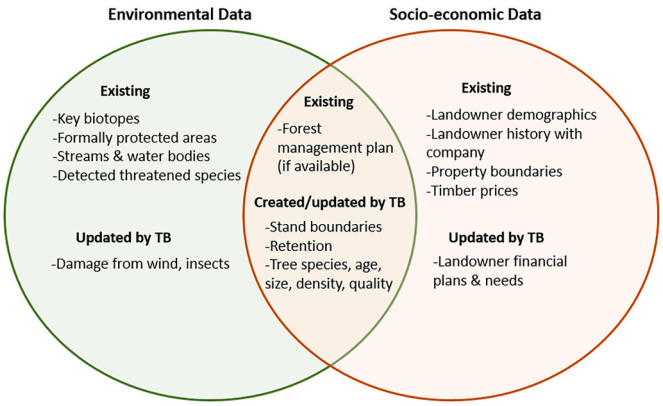

Fig. 5. Common data types available to or gathered by timber buyers (TB). Some data include both data types.

The timber buyers have company-specific GIS programs and access to huge amounts of information provided mostly by state agencies. These digital maps are fundamental to how timber buyers make decisions, and sometimes management decisions are made using only these, without visiting the field. Most described a ground-truthing process focused on checking stand boundaries and measuring the amount and quality of timber volume, and only sometimes other information they deem important. Some described that 'all I need', regarding ecological information, is available in the company's GIS. Necessary ecological data mentioned by the timber buyers included mostly key woodland habitats, water features, or cultural remnants.

4.2.2. Local expertise, local influence

Timber buyers expressed that their local expertise is a key factor for successfully carrying out their jobs, emphasizing local knowledge of the forests, as well as the local people and social communities. Much of their advice comes from personal experience. Their expertise is obtained through some combination of company training, informal knowledge transfer through peers and landowners, and years of work in the same area. Many were confident that their field experience should be trusted by landowners.

There was a range in education and experience of those interviewed (Table 2). Many had worked other jobs in the forest industry, mostly as entrepreneurs or technicians, before starting as timber buyers. However, as TB5 said, "*you can get this job without some kind of forest education.*" Getting the job, in this case, refers to the social skills that are fundamental to connect with the forest owners. Participants shared that it was more important to have good communication skills and build relationships than to have a specific education or knowledge about ecological processes.

Related to the social skills, timber buyers claimed their work requires an element of "psychology", in other words, being able to convince owners to carry out recommended silvicultural measures. TB3 explained, "*I do not want to stand up and point at you, 'you shall do it like this, all else is wrong!' No, I want to be on the same level and have a dialogue, and lead the person in to saying what I said! Like that. So it really is, it's more psychology than being good with insects or forestry. It's more psychology. Because if I get them to sign the contract, I'm not going to take their hand and make them sign it! I'm going to say, here is a suggestion, how do you want to do it? 'Okay, we'll do that,' and they sign themselves!*"

Several informants described strategies to actively convince owners towards certain management decisions. As TB2 put it, "*[The landowners] know I have experience, and can give advice for their questions. So it is not always that we have the same thought when we meet, but if I know that I am right with my ideas, I try to convince the forest owner. I see a little further ahead than what the forest owner sees, of course.*" They felt it was necessary to redirect management behavior particularly when they perceived that landowner goals were unclear or that landowners do not adequately understand the future impacts of their own choices. However, they described contrasting approaches, depending on the landowner, including 'the customer is always right' where they follow all the landowners' instructions, sometimes against their own better judgement. They also described "*acting as a sounding board*" for forests owners' ideas. It was generally important to simply encourage owners to be actively engaged in their forest management and to help landowners set realistic expectations for management impacts. Thus, timber buyers take an active role in influencing different choices by utilizing data and information, expertise and social skills in their everyday work.

4.3. Timber buyers are balancing goals at multiple levels

4.3.1. Timber buyers' spatial competence

Many timber buyers compared their expertise within the buying area to the relatively limited perspective of individual forest owners. They claimed to see the "big picture" while landowners might tend to have "tunnel vision" (TB3) about their property. Making this distinction between their perspectives illustrates the scope of their spatial competence relative to the landowner's limited territorial competence. Timber buyers also compared their abilities in terms of time – they see farther ahead than landowners, can better predict effects of management decisions, and 'remember' disasters like the Gudrun storm[2]more clearly. Again, this direct comparison to landowners suggests that the buyers themselves are aware of their own influence and abilities across their buying area.

4.3.2. Dealing with multiple spatial levels

We found that timber buyers are constantly at the cross roads of decisions at multiple spatial scales: the forest stand, the forest estate, and their buying area/landscape. A key part of their job is to balance each landowner's goals against their company's need for timber supplies. Timber buyers mostly referred to forest management activities at the stand level, as well as making decisions for one stand based on the condition of neighboring stands. Depending on the landowner's goals or level of engagement, timber buyers might give advice with consideration to the entire property. Production and conservation goals tend to be spatially separated into different stands, and retention areas are left within production stands.

In order to make management choices, they described a fair amount of qualitative judgement throughout their own inventories, personal opinions, weighing the forest conditions, and the forest owners' goals. Several interviewees see their work as important or meaningful in regards to the landscape, encompassing effects on the local community as well as the forest. "*I think [my job] is important, the work I do, for the landscape. I like that it looks nice and neat, or even if I don't think it looks nice and neat, but, in the landowner's opinion, it does*" (TB8). Further, local knowledge and experience plays a role on how a landscape perspective could be woven into a specific management activity. "*If [someone] comes from Kalmar, … they might say clearly that juniper should be removed because juniper is a problem on Öland. Meanwhile, if someone comes from around here, they save it as much as possible*" TB1. There can be very different perspectives depending on past experiences and views on aspects of forest management, and timber buyers work to find common ground between their company's needs and the landowner's goals.

4.3.3. Landscape perspective in practice

As they evaluate the different data types and goals, timber buyers must somehow "see the landscape" beyond the property they are working on. Timber buyers referred to two situations when conditions

[2] Gudrun was a devastating storm in January 2005 that damaged ca 70 million m3 of timber. Spruce forests were most heavily damaged (Valinger and Fridman, 2011)

outside a given landowner's property would be particularly relevant. The most notable example involved harvesting a stand with neighboring mature (or nearly mature) spruce stands. In such cases, they try to contract the neighbor to harvest as well, or at least alert the neighbor of the increased risks for windfall. TB5 explained, *"It can be that we want to harvest an old forest… and if we take this forest, the [neighboring stand] will blow down. Then we take contact with the neighbor there and say that if we harvest this here, it will affect your forest! Do you want us to harvest your forest now, or do you want to wait until it blows down? It's usually a good argument!"* Their descriptions were detailed and sometimes emotional. TB9 emphasized for example that it *'feels better to talk [to the neighbor]"* in these cases, describing a sense of duty felt by others as well. However, they were clear that whatever the neighbors opinion, *"we of course do not adjust silvicultural activities for one property based on what kind of forest the neighbor has"* TB7.

The other main factor that might influence management across property lines was the presence of a key woodland habitat, or other previously inventoried area with recognized natural values, within or immediately across the border. In these cases, timber buyers were particularly deliberate in the location or size of nearby retention areas. Sometimes the timber buyer would preemptively contact the Swedish Forest Agency to ensure their plans were adequate.

Another line of reasoning displayed some awareness of general public interest in a landscape perspective. When they mentioned landscape perspectives, it was mostly in terms of planning around unique features, or trying to leave a 'special' ecosystem that is rare in that area. Some participants shared specific critiques of certain aspects of the Swedish forestry model, and reflected on the pros and cons of widespread trends in forestry. "*In Swedish forestry we have a very strong tendency that everyone runs this way, then we all run that way, … so I like to say that the trends in Swedish forestry swing very powerfully, so everybody runs the same way. It is really good if one does something else. Because it becomes, one calls it diverse, so different things get done…, it is much more varied. And I think that is good. Because if everyone does things a little differently, and maybe some do it wrong, but many have done it right, and those that did it wrong 10 years ago, maybe they're doing it the right way in today's perspective,"* TB7. Generally, timber buyers supported variety in management across the landscape, where each forest owner does management differently. TB3 gave a typical response, "*It's better that you do so on your hectares, and another does it a totally different way. All shouldn't go with the same plants, all shouldn't do the same… the most important is that everyone does [forestry] a little differently, because it won't be as vulnerable, so I believe in… variety.*" This 'variety' was seen as a form of risk spreading, and also embodied the 'freedom' that landowners have to manage forests as they wish.

5. Discussion

Based on timber buyers' responses, we describe their position using the nested domains framework. We focus on spatial competence, how different types of data are used, and new framings of timber buyers' role in forestry decision-making. Our final reflection on using nested domains can help future researchers and practitioners examine land use policies at multiple spatial levels as well as the role played by advisory services.

5.1. Comparing competences

5.1.1. Timber buyers and landowners

To use Hägerstrand's terms, we see timber buyers' spatial competence as a form of geographic integration, since each buyer operates in one particular area (2001). This contrasts with the traditional description of geographic integration, referring to a government body managing a nature reserve, for example (Antrop and Van Eetvelde, 2017). Even if timber buyers' influence is powerful, it is not necessarily secure, since landowners could switch to contracting other companies that operate in an area. Some of our interviewed timber buyers maintained relatively stable buying areas for decades, but this is not always the case, as shown in (Guillén et al., 2015).

Our informants mentioned repeatedly that social skills were arguably more important than forestry knowledge for their work. The timber companies rely on private landowners as suppliers, so the companies *need* their buyers to be liked by landowners. This suggests the companies are highly dependent on the personality of each buyer, combined with the benefits a given company can provide to an owner, like the income security after a disaster and regular financial return (Guillén et al., 2015).

Our results indicate that timber buyers believe that they do influence landowners and outcomes in the forest. Informants recognize their position as important for 'their' landscape, in terms of forest management, as well as the local community and economy. They do this in practice by attempting to balance each landowner's unique set of goals. Eggers et al. (2014) support that in most cases landowners have multiple goals in forest management. However, from the timber buyers' perspective, landowner goals are not always deemed adequate for implementation. Since our interviews present only the timber buyers' perspective, it is impossible to evaluate how landowner and timber buyer perspectives align on this matter. However, our findings question the extent to which the research on landowner preferences and objectives can predict management behavior, since timber buyers implied it is often their own ideas that are or should be implemented. Andersson and Keskitalo (2021) show that the companies are aware of the influence timber buyers have on landowners, which can be even stronger when the forest owners are less familiar with forestry practices. Lodin and Brukas (2021) also support that timber buyers are key players in perpetuating 'silvicultural ideals,' even if these ideals are not always met for multiple reasons.

Timber buyers referred to seeing the 'big picture' compared to landowners, alluding to the needs of many landowners across their buying area and effects of management decisions over long time. However, the buyers emphasized genuinely trying to give each landowner individual attention and focus on their specific goals and needs within the property. This suggests timber buyers are 'shrinking' their spatial competence in the name of a service-minded approach. Since timber buyers are aware of effects of forest management on neighboring stands, this 'shrinking' represents a tension point in their role, especially in relation to implementing a landscape perspective.

Swedish forest policy is guided by a combination of landowners' freedom under responsibility and sectoral responsibility, but there is ambiguity regarding what responsibility entails in practice (Löfmarck et al., 2017). Emphasis on the landowner's responsibility (Appelstrand, 2012), risks overshadowing, to some degree, the responsibility that timber buyers have on management impacts. Löfmarck et al. explain that since the forest owners must place their trust in others to carry out management, the burden of responsibility becomes diffus (2017). We propose two reasons why timber buyers should be seen as partially responsible. First, when landowners sign a contract (Table 3), they entrust their timber buyer to take over management responsibility. However, Guillén et al. (2015) mentioned examples of landowners who think the buyers sometimes take more than they should. Second, by reaching out to a timber buyer for advice, landowners are putting their trust in advisors who claim to 'know better' than landowners. As described by Lidskog and Sjödin (2016), advisors are seen as professional experts who hold epistemic authority on matters of forest management. We argue that this claim of 'knowing better' then shifts at least some of the responsibility to the advisors. In addition, actors with small domains cannot be held wholly responsible for issues encompassing larger domains. Hence, negative repercussions of forest management that arise at the landscape level, should fall under sectoral responsibility instead of landowners' responsibility. It is beyond the scope of this paper to go deeper into this topic, but there is need for further examination of where freedom and responsibility lies at different levels.

5.1.2. Timber buyers and SFA

SFA is officially operating at a higher domain than timber buyers are, since SFA's districts encompass entire counties, but the companies divide their organization into smaller areas (Fig. 4). However, SFA's capacity to provide advisory services per se is currently much more limited. André et al. (2017) showed that forest owners evaluate forest companies and SFA similarly in terms of importance and frequency of communication, but "important does not necessarily equate to influencing decisions" (p893). Timber buyers claimed to take over communication with SFA for landowners in most cases, and that SFA's involvement with landowners directly is mostly associated with particular questions or problems, like subsidies or restrictions on harvesting. Regular contact with landowners is necessary for trust-building (Guillén et al., 2015) and maintaining authority (Lidskog and Löfmarck, 2015). If timber buyers are indeed taking over contact with SFA at a large scale, this could damage the agency's capacity to build trust and be seen as leaders.

SFA's limited ability to provide advisory services raises a critical question: How should sectoral responsibility for informing and advising forest owners be exercised? It remains unclear exactly what the dominant role of private advisors will mean for reaching the goals of Swedish forest policy. In any case, this study illustrates how timber buyers, and private actors as a group, address fixed reaches of government actors, by filling in widening gaps created by SFA's reduction in services. However, they are not simply 'replacing' SFA's role, because timber buyers' advice has a clear economic objective. Further, timber buyers repeatedly emphasized having a great deal of independence in applying their knowledge to forest management, mostly through what they inventory and how they incorporate personal experience into their advice. Even though SFA employees no longer provide as much advice, and do not have personal economic incentives, Lidskog and Löfmarck (2016) also gave examples of SFA's advisors specifically not following procedure in advisory settings. These examples show that it is difficult to evaluate the actual content and quality of advice that forest owners receive from any actor.

5.1.3. Timber buyers' intermediate position

Timber buyers are important intermediary actors who must translate and balance goals of their employers and landowners. Further, they claim to see and evaluate multiple management goals at multiple spatial levels, although it is less clear how or if this ability is applied in practice. The timber buyers, or at least their company, manage communication between entrepreneurs and landowner, which impacts when and how management activities actually take place. Brukas and Sallnäs (2012) referred to forest planners as social intermediaries necessary for the implementation of policy instruments like forest management plans. We see that timber buyers also, or even more so, embody this positioning. Their work involves some characteristics of 'boundary work,' which involves strategically communicating, translating, and/or mediating information between different types of actors (Cash et al., 2003). Framing timber buyers as boundary agents highlights the importance of their dual roles of advisor and buyer. They are subject to a combination of duties and incentives that gives them a particular perspective and power within their buying areas. Hägerstrand yearned to understand the fundamental transition from 'abstract knowledge to action on the ground' (2001, p36). Timber buyers represent this key stage in forest management, by transforming forest management norms and 'ideals' (Lodin and Brukas, 2021) into concrete actions on privately-owned land.

Managing such boundaries between actor types involves major challenges related to the cross-scale nature of environmental management (Cash et al., 2006). Boundary agents should ideally provide information that is considered salient, credible, and legitimate by all sides (Cash et al., 2003), but all three of these aspects could be challenged from a wider perspective. The issue of plurality, where each actor has distinct views of the system in question, (Cash et al., 2006) is particularly problematic in Swedish forestry. Industrial frames, emphasizing freedom and ecological modernization (Lindahl et al., 2017), are associated with rather limited system boundaries compared to the point of view of ecologists (e.g. Rist et al., 2014). Such boundaries can then be reinforced by relying on particular data types.

5.2. Data, expertise, authority - digitalization & simplification of nature

Digitalization was a central theme in all the interviews. New communication and data collection systems are transforming the forest sector, including advisory services in many countries (Lawrence et al., 2020). Although technology makes many parts of their job easier, timber buyers suggested the advances contribute to a corporate 'time is money' attitude, and that negatively affects their relationships with landowners. This is in line with perceptions of landowners in Guillén et al. (2015).

Digitalization is also strongly linked to the data timber buyers have access to, collect themselves, and use, which is important for understanding their role and authority. The timber buyers named a multitude of ever-expanding data sources, mostly GIS layers. It is impossible to say exactly how and to what degree they use all of this information, since timber buyers described very individualized approaches to their work. Particularly in terms of ecological data, some described having 'all I need' in the company GIS, but it is unclear which types of information are deemed 'needed'. Again, due to their independent inventory styles, some might be better at or more creative with finding ways to record additional factors in their GIS. Otherwise, timber buyers seem to generally utilize quantitative, production-oriented guidelines, strongly associated with economic targets.

Drawing a parallel to the equal nature and production goals in forestry, the amount and quality of data considered for decision-making for these goals would normatively have an equal value. The environmental factors mentioned by timber buyers were the ones that are relatively clearly codified in the Environmental Code (12§6) (1998), basic requirements of certification (see Södra, 2021), and cultural heritage laws. Instead of measuring particular ecological indicators, however, they instead often referred to their personal preferences or even a 'special feeling' about certain areas. This suggests there are limited procedures for timber buyers, and their employers, to collect and apply various types of environmental data in their work, but that they are able to deal with the ones that have clear legal frameworks or market incentives.

Since timber buyers' focus remains on easily quantifiable elements in each stand, such data could falsely suggest that decisions made at the stand or property level result in outcomes for only that immediate area (c.f. Rist et al., 2014). This suggests that complexity of forests could be simplified by omission (Robertson, 2006), putting environmental processes at risk by externalizing them (Rist et al., 2014). Methods for measuring production metrics are extremely precise, and getting more and more advanced (e.g., Maltamo et al., 2020), while methods for monitoring and prioritizing other ecosystem services and biodiversity in production systems are lagging behind (Rist et al., 2014). Hence, timber buyers and other actors will be better suited to applying a landscape perspective if methods for monitoring and measuring environmental goals are improved, which is ultimately the responsibility of the forest sector, not individual timber buyers.

5.3. Can a landscape perspective be compatible with practical (private) forest management?

5.3.1. Lacking implementation of landscape perspective

The nested domains framework allows highlighting some forest policy weaknesses and accentuates the landscape perspective as implemented in practice. While the timber buyers agreed that certification was the foundation of their advice to landowners, only one even mentioned the 'requirement' of a landscape perspective in certification (see Södra, 2021). Several leading companies in the forest industry have created some sort of landscape plans (see Aulén et al., 2014), or claim

that 'biodiversity is maintained and enhanced across forest landscapes' as part of their management (cf. Stora Enso, 2021). Curiously, none of the timber buyers mentioned such plans or initiatives when talking about which data and policies inform their decisions, which suggests that the companies have not thoroughly integrated landscape priorities into their work on the ground. Södra, for example, invested a great deal of time in identifying regional priorities for management together with external ecologists and researchers (see Aulén et al., 2014), but actual implementation seems to be lacking. The group certifications held by the companies still apply to management at the property level but lacking implementation of company's own landscape plans is clearly a missed opportunity.

Several timber buyers reflected on the benefits of 'variety' or diversity across the landscape, which they described as being achieved through each owner freely making different choices. Especially since the timber buyers emphasized their independent, experience-based advice, there could be quite some 'variety' in terms of content and quality of advice timber buyers are providing across their buying areas. This approach is in line with the assumptions of rational choice central to the current Swedish Forestry Act (Brukas et al., 2013). However, this simple view on 'variety' does not align well with the importance of strategically including functional green infrastructures that increase connectivity and functionality within the intensively managed forested landscape (Andersson et al., 2013).

The roles of timber buyers manifest the norms, assumptions, and system boundaries set by the rest of the forest sector. As the outward-facing representatives of their companies who make decisions closest to 'the ground' timber buyers are an easy target for analysis and critique. Although some aspects of their work might be linked to negative environmental outcomes, this is only a symptom of some problematic practices upheld by the entire forest sector. Timber buyers' behavior is constrained by sectoral expectations, which ultimately influences the decision-making of private landowners. Without functional incentives or tools, timber buyers alone cannot account for the wide variety of environmental concerns relevant to forest and landscape management.

5.3.2. *Using private sector landscapes?*

Our results are largely in line with existing research that touches on the roles of timber buyers. Using Hägerstrand's terms, however, our problem framing reveals new opportunities for private-public governance. A timber buyer's working area represents one way that landscapes are actively delineated by purely socially-defined boundaries. A timber buyer's view of the landscape aligns in some ways with Hägerstrand's view, since the people living in and working with the landscape are seen as central to defining the landscape. Blennow et al. (2021) proposed an individuals-oriented landscape approach in order to understand environments and problems from the point of view of various local actors. Blennow et al. (2021) referred to landowners' territorial competence, but we see that their 'toolbox' could just as well apply to timber buyers, and other actors. Seeing the landscape through timber buyers' eyes could be an appropriate starting point for private companies to practically implement some form of landscape-level planning.

Some can be uncomfortable with using private actors' definitions of landscape, which might seem like moving away from ecologically-defined boundaries (cf. Gustafsson et al., 2015). However, no matter where we draw stand or ecosystem boundaries, in Hägerstrand's view, they are always inherently socially-defined. Since industrial actors already wield power in forest management, it could be effective and practical to harness their existing position to improve forest planning at the landscape level. Even if there are problems with how current system boundaries are defined in many environmental contexts, it can still be useful to hold on to some practical concepts, as with the forest stand (O'Hara and Nagel, 2013). However, new and better ways to measure and incorporate ecological aspects into forestry decision-making must be developed for multiple spatial and temporal levels, as suggested in (Felton et al., 2020). How forest planners (e.g. Brukas and Sallnäs, 2012) and entrepreneurs handle different types of information and goals should also be addressed in future research. With better decision-support tools regarding landscape-level priorities, timber buyers and other actors could avoid contributing to the 'tyranny of small decisions' across the landscape (Odum, 1982). Acknowledging and actively working with the influence and spatial competence of timber buyers could, for example be an important contribution to operationalizing green infrastructure initiatives (e.g. Andersson et al., 2013; Naturvårdsverket., 2022).

5.4. *Applying nested domains to forestry and land-use research*

The nested domains framework allows users to visualize and describe multi-level environmental governance, and this paper aims to operationalize Hägerstrand's terminology for practical application in forest and land use policy research. Our biggest contribution to the framework is elevating private sector domains to the same status of formal government domains. We see this as a much more realistic depiction of how Swedish forest governance functions, and it can be applied to other research on public-private governance. The key element is that private actors are not merely governed, as implied by Hägerstrand (2001) and Antrop and Van Eetvelde (2017), but that they are actively governing as well. In the Swedish case, Löfmarck et al. write that "the inherent flexibility of the freedom with responsibility principle can lead to conflict and uncertainty" (2017, p34), we see that the sectoral responsibility principle is just as, if not even more, problematic. Scrutinizing sectoral responsibility, especially in terms of spatial competence, raises questions about who really holds the power in forest governance, and who decides what 'responsible' forestry is. Future research should go deeper into expectations of sectoral responsibility and the spatial competences of and interactions between private and public actors.

There is particular value in bringing a spatial element to the analysis of advisory services. By using Hägerstrand's nested domains we can better elucidate the complexity of FOKIS in Sweden, where the compatibility of advice providers with differing spatial competences have not yet been examined. Lawrence et al. (2020) emphasize the need for applying a system perspective to better understand forest knowledge and information systems. Our paper can serve as an illustrative case study, also exposing ample opportunities for further research, in Sweden and elsewhere. Nested domains can serve as a fitting framework for examining how can advisory services be developed with due consideration of different spatial levels and domains. Focusing on the fixed reach of different actors can increase the understanding of how or if various policies are complementary, or contradictory, across scales.

6. Conclusions

The aim of this study was to explore the roles and spatial competence of timber buyers in southern Sweden. We found that their dual role of buying and advising defines their unique position, where they must balance the needs of landowners and their employers. Their domains encompass the territories of hundreds of landowners, and across these, timber buyers are able to influence forest management outcomes. Even though their spatial competence applies across their entire buying areas, timber buyers described mostly making decisions at the stand level. Although recognizing their specific positioning and capacities, timber buyers lack incentives to apply a landscape perspective in their work.

The analysis through the lenses of nested domains highlights the role of private domains across forest governance, and timber buyers' specific position between landowners and governmental institutions. Timber buyers are main providers of information and advice to landowners and key players in forestry decision-making. As the private sector takes over advisory services, further scrutiny of private actors is certainly needed. By incorporating private domains, we set a precedent for using Hägerstrand's framework to analyze natural resource governance across

private and public sectors operating at multiple levels.

CRediT authorship contribution statement

Keeli Curtis: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft. **Luis Andrés Guillén:** Conceptualization, Writing – review & editing. **Vilis Brukas:** Conceptualization, Writing – review & editing.

Declaration of Competing Interest

One author, Vilis Brukas, serves on the Editorial Advisory Board of this journal, but otherwise we have no conflicts of interest to disclose.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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