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Voluntary agreements to protect private forests – A realist review

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ABSTRACT

There is increasing political interest in the use of voluntary agreements (VA) as a policy instrument. The attraction has grown also in environmental policy, VAs are expected to be less costly, more effective and more cost-efficient than regulation. Using a realist review methodology, our analysis focuses on the effect of contextual factors and mechanisms on private forest owners' willingness to enter into formal voluntary nature conservation agreements. The framework we use to analyse the effects includes: forest owner characteristics, forest attributes, institutional context and process, advisors and other forest owners, and contract design, for contextual factors – and economic attitudes, environmental attitudes, sense of autonomy, sense of justice and fairness, trust as well as knowledge, for mechanisms. The analysis allowed merging findings from different types of VAs in varying contexts in a systematized way, and consolidating evidence of how the mechanisms influence the programme implementation process, and its outcome. 43 reviewed articles, from an originally retrieved set of 2231 papers, provide evidence for environmental attitudes supporting willingness to enter into an agreement. Environmental attitudes are strengthened by forest owners' wishes to protect a heritage, suggesting considerable influence through personal, emotional attachment to the forest. This finding shows the central role played by sense of autonomy, with economic compensation also importantly affecting the willingness to enter a VA. Along with these results, the developed comprehensive analytical framework shows how VAs can become more effective if tailored for different contexts and types of forest owners.

1. Introduction

There is growing political interest in using voluntary agreements (VA) and compensation for nature conservation in privately owned forests and on private land (Mäntymaa et al., 2009; Wunder et al., 2018). In this article, we investigate VAs as formalised agreements between a non-industrial private forest owner and the state (or local government) to protect nature conservation, social or cultural values in the forest. The introduction of voluntary policy instruments has been triggered by a dissatisfaction with the incapability to protect biodiversity with regulatory instruments (Salomaa et al., 2016). Despite global commitment to halting the loss of biodiversity (CBD, 1992), the decline of biodiversity and loss of ecosystem services continue at an alarming rate (Brondizio et al., 2019). The European Union's (EU) Biodiversity Strategy (EC, 2012) and accompanying policies in EU member states reiterate the need for increased conservation efforts, calling for forest owners to protect and enhance forest biodiversity through voluntary contract and payment arrangements. Indeed, engaging private landowners in conservation activities for endangered species is considered critical for protecting and enhancing biodiversity (Sorice et al., 2013). Numerous conservation strategies exist, with various implications for different species (e.g., Mönkkönen et al., 2014). Yet, in practice, the conservation activity for which a VA is made is often strictly defined, so that it would be institutionally feasible (Primmer et al., 2013). The VA might consist of retaining single trees or border zones with high biodiversity value in forest management and/or setting aside specific forest areas for protection of biodiversity.

In nature conservation, VAs are presented as potentially more flexible and cost-efficient compared to regulatory measures, which place all information-sourcing responsibility onto the regulator, and may result in costly and cumbersome expropriation of private land (Börner et al., 2017; Ferraro and Kiss, 2002; Lindfors, 2007). Information asymmetry might, however, result in limited efficiency improvements (Juutinen et al., 2013).

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Voluntary conservation acknowledges land-owners' property rights (Lockie, 2013) and can constitute a new business model for them (Bishop et al., 2009). Building on voluntariness, these arrangements treat landowners in ways that are considered fairer than top-down regulation, potentially reducing conflict between the designer and the target of the regulation (Bergseng and Vatn, 2009; Paloniemi and Tikka, 2008; Segerson and Miceli, 1998). This implies that VAs support freedom of choice and autonomy as well as trust-building.

In the design of VAs for forest protection, the underlying assumption is that forest owners can be encouraged and motivated to set aside forests for protection through information and financial incentives or by relying on their own interest in environmental protection (Boon et al., 2010; Mitani and Lindhjem, 2015). VAs thus depend on private forest owners' interest to protect the environment and to refrain from some management activities for a financial compensation. Also, the institutional context in which contracts are designed and used influences the attractiveness of VAs, like any other instrument (Young and Gasser, 2002). Contextual factors include the forest conditions and property rights as well as the contract terms, including the level of financial compensation, the length of the contract, and the implementation process as such (Börner et al., 2017; Mitani and Lindhjem, 2015). Despite a rather consolidated understanding of the importance of these factors, the specific mechanisms through which they influence landowner decisions to enter a VA is less clear. Furthermore, as the context differs between countries and regions, its contribution varies as well.

To systematically analyse the contextual factors and mechanisms influencing forest owners' adoption of VAs, we conduct a realist review in a relatively uniform social-ecological-institutional context. In this literature review we focus on how VAs work primarily in Finland, Norway and Sweden, which are all part of the boreal forest belt and have a dominance of private forest ownership. The traditional way of conserving forest biodiversity in all three countries is permanent protection (Storrank, 2018). Since around 2000, however, the use of VAs has increased as a part of forestry and environmental authorities' conservation work in all three countries. VAs are implemented in similar ways in the three countries following principles of cooperation between landowners and authorities (Storrank, 2018). In short, the process is as follows: authorities formulate a plan for targeting the contracts based on existing knowledge of valuable forest areas or features needing protection, landowners submit proposals for areas they wish to protect, authorities assess the proposals and if the assessment is positive, negotiations on an agreement are pursued.

In Finland, forest conservation has been very contentious and prone to conflict, especially around the Natura2000 programme (Hiedanpää, 2005). The biodiversity programme called METSO introduced voluntariness to Finland, while increasing collaboration between administrative sectors, and formalising the autonomy of forest owners (Primmer et al., 2013). This resulted in a change of governance style from a "top-down governing approach radically towards a more open and flexible approach" (Borg and Paloniemi, 2012 p. 152). The aim of METSO is to protect biodiversity in forests by compensating private forest owners for voluntary conservation efforts (METSO, 2008). In Finland, time-limited protection, usually for ten years, is one of the alternatives offered to landowners.

In Norway, conflict arose with the implementation of the conifer protection plan in the 1990s and early 2000s. The plan was perceived as coercive, and landowners' opportunities to influence the forms of protection were often considered to be limited. In response to this situation, the Norwegian Forest Owners' Association presented a proposal in the early 2000s on how forest owners themselves could take initiatives to conserve forest. After a two-year pilot project, a system for voluntary forest protection was established (Storrank, 2018).

In Sweden, so called voluntary nature conservation agreements have existed since 1993, based on a civil law agreement between the landowner and the Swedish Forest Agency. The agreements are usually for a period of 50 years. The agreement states purpose, appropriate maintenance measures and regulations regarding use restrictions. In 2008, the Swedish Environmental Protection Agency and the Forest Agency together proposed a complementary working method, based on the land owners' own initiation of VA. This method was first tested in the pilot project "Komet" in 2010, which also boosted the available funding for forest-protection VAs. Following this trial period, this way of working was rolled out nationally (Storrank, 2018).

Forest-protection VAs have been empirically studied using approaches from different disciplines including economics, political science, forest and environmental science. To synthesise this knowledge, and to analyse the effect – and how the effect takes shape – we conduct a realist review of published literature. Our review on Finnish, Norwegian and Swedish VAs seeks to shed light for whom, and under what circumstances, VAs can work. To organise our realist review, inspired by Pawson's approach (2005, 2008), we departed from an initially conceived programme theory, that we developed into a more detailed framework of contextual factors and influencing mechanisms that explain the reason why a given outcome occurs. Our realist review approach and how we adapted it is further elaborated in section 2.

The overall research question we seek to answer is: *what contextual factors influence the willingness of private forest owners to enter into formal voluntary nature conservation agreements and which mechanisms are triggered?* We focus on six mechanisms that we found central to understanding how forest owners respond to VA programmes: economic attitudes, environmental attitudes, sense of autonomy, sense of justice and fairness, knowledge as well as trust. These mechanisms will be activated in different ways depending on the contextual factors, which in our analysis include forest owner characteristics; forest attributes; institutional context and process, advisors and other forest owners as well as contract design.

2. Method

2.1. The realist review methodology

Realist review is a methodology to review literature developed by Pawson et al. (2005). It is a form of systematic review (SR) method that has increasingly been used to assess the effects of interventions on the environment (Miljand, 2020). Realist review is a model for research synthesis that is focused on how complex social interventions or programs work (Pawson et al., 2005). It is based on a set of ideas about how a policy generates change and what mechanisms cause an outcome. Mechanisms are "not the program service per se but the response that the activities generate" (Weiss in Dalkin et al., 2015 p. 3). Each policy is based on a set of assumptions and hypotheses that postulate that if we carry out a certain activity it will generate the changed behaviour on the part of the recipients of the policy, which then generates the intended effects of a programme or policy (Winterford, 2015). Interventions work "because they make resources available for the participants, which in turn change their reasoning and, subsequently, their behaviour. […] Change is therefore not only caused by the intervention itself, but equally by the participant" (Ravn, 2019 p. 172). To produce an effect, interventions require the active engagement of the participants of a programme or those subjected to the intervention (Pawson, 2013).

This view of how programmes or policies work means that how a participant reacts – which mechanism is "triggered" – can differ. An intervention or programme "may work differently for different people and may produce varying outcomes depending on the context in which an intervention unfolds" (Ravn, 2019 p.171–172). The purpose of a realist review is to "unpack the mechanism of how complex programmes work (or why they fail) in particular contexts and settings" (Pawson et al., 2005). It focuses on understanding under what conditions a certain effect arises.

To conduct policy analysis with a realist review, evidence is gathered through a literature review with an aim to understand how different contexts trigger a certain response. Context-mechanism-outcome (CMO)

configurations are used as the main structure for a realist analysis. CMO-configurations should be formulated as so-called middle-range theories. The idea of middle-range theories comes from sociology (see e.g. Merton, 1967), and refers to theories that are specific enough to generate particular propositions to test, and general enough to apply across different situations. In other words, they refer to the level of abstraction. They deal with delimited aspects of a social phenomenon, and specify, which causal mechanism is released in which context and with which outcome (Pawson, 2008). In policy analysis and evaluation (Mickwitz, 2003), the outcome would be the resulting change in the target phenomenon, e.g., improved ecological status or biodiversity and output would be the action supporting this outcome, e.g., a VA for conservation. As the as the VA for conservation is a output of conservation policy implementation, we focus on this output. With our systematic review, we analyse what contexts and mechanisms affect participants' willingness to make these agreements.

2.2. Our application of the realist review methodology

To ensure a thorough understanding of the factors contributing to VA implementation, and also the ways in which VAs have been analysed, the review considered papers with a broad range of theoretical and methodological approaches. Even if this review focuses on forest-targeted VAs in the three Nordic countries of Finland, Norway and Sweden, it also includes literature from other relevant countries within the OECD, excluding the US (because of its different political and legal context in terms of property rights and a federal system).

The analysis was structured around three elements: contexts, mechanisms and outcomes, and sought to unravel the links between these. In the group that carried out the realist review there were researchers with extensive expertise on these issues, which allowed for an initial idea of how VAs are intended to work and what factors may influence the outcome. When we applied the realist review method, we adapted it and decided not rely on an extensive initial program theory that showed how these programs are intended to work, that could then be tested, as suggested by Pawson et al. (2005). Instead, we started with a simple programme theory, identified as: *private forest owners can be encouraged and motivated to participate in a VA programme for forest protection if provided with adequate information and financial support.* This was supplemented with contextual factors and mechanisms that we believed could be of significance for how VA programmes work, based on the review group's expertise. The main reason for this adaptation was that the policy we focused on included so many variables that it was not possible to structure them in one cohesive program theory. We developed this into a systematic analytical framework during several research group meetings, using trial searches for relevant literature to inform this discussion. Our reference group (see also 2.2.) was invited to a meeting to discuss the initial programme theory and the relevant contextual factors. During the review process we also made adjustments according to the results of the reviewed literature.

Following the ideas of Pawson (2005, 2008, 2013), we used an iterative approach to identify relevant contextual factors. We started with a list of potentially relevant factors, based on our shared expertise in the subject area, and updated and regrouped these factors through an interactive process using the literature in order to cover all relevant contextual factors. We also engaged practitioners of VA implementation in commenting on these factors to make sure they were relevant for the situation on the ground. We then came to the following:

- forest owner characteristics
- forest attributes
- institutional context and process
- advisors and other forest owners
- contract design.

The decision as to which mechanisms were relevant was kept open, to critically assess the relevance of the mechanisms identified as potentially relevant prior to conducting the review. This open-ended, iterative, approach did not result in any major revisions of the initial analytical framework. We chose broad definitions of the mechanisms as this allowed accommodating the partially different definitions and interpretations made in the reviewed articles. We then applied the following mechanisms:

- Economic attitudes – the forest owner's perceptions about financial incentives. Also the extent to which forest owners are driven by economic motives.
- Environmental attitudes – the forest owner's perceptions about the environment, the need for conservation, or environmental policy.
- Sense of autonomy – the forest owner's perceptions about the value of autonomy as well as whether something or someone is restricting this autonomy.
- Sense of justice or fairness – the forest owner's perceptions about procedural and distributive justice: whether the policy or process are perceived as fair and just.
- Knowledge – the forest owner's knowledge, both in terms of awareness of specific issues such as the VA-programme, forest and/or environmental issues, and general educational level.
- Trust – the forest owner's perceptions about trust or the extent to which they experience trust towards other actors or the process as a whole.

In the included articles, we sought to identify mechanisms linked to outcomes, i.e. entering a VA (or not) or expressing willingness to enter a VA (or not), participation rate or a need for more (or less) compensation. Other outcomes that occurred in the reviewed material were knowledge uptake, trust and environmental attitudes. In the final analytical framework, we decided not to differentiate between actual acceptance of a VA, willingness to enter into such an agreement or overall participation rate when we synthesised the evidence. Instead we included both hypothetical claims and actual claims under the outcome heading "willingness to participate". Although these are different measurements, we found them to be similar enough to be comparable. This means that we were aware of the somewhat different ways that the included articles measured VA outcomes, but found that they still provide important and complementary evidence to the overall programme theory.

We searched Scopus and Web of Science and initially retrieved 3353 references, 1122 articles were excluded as duplicated (leaving 2231 unique ones). These were screened in stages, see Table 1 for the inclusion criteria (for a full overview see appendix A). First, the titles and abstracts were screened and irrelevant articles excluded. 2075 articles did not address private forest owners and VA, or were outside the geographical and/or temporal focus and an additional 21 references were excluded for being duplicates, not an article or because we could not access the article. Most excluded articles did not focus on relevant countries (858) or the right subject (1154) or both. This left 135 articles that were assessed in full text. After this assessment, 92 articles were excluded (for a list of these and the reasons for their exclusion see appendix B) and 43 remained for review (for an overview of the included

Table 1
The applied inclusion criteria.

Private forest owners	Defined as non-industrial private forest (NIPF) owners
Formalised agreement to protect forests	Some form of formalised protection/agreement between the NIPF-owner and the state/local government to protect nature conservation (e.g. not climate-related measures), social or cultural values in the forest
Relevant countries are	Sweden, Finland, Norway or from other OECD countries except the US
The articles' publication year	Published after 1992 up until August 2019.

articles see appendix C).

We selected two large databases that include extensive literature, however literature not indexed in these databases that could have been relevant for our topic have accordingly not been identified. The ambition to systematically go through all identified articles based on predefined inclusion criteria require a certain delimitation and since our delimitation meant that we went through 2231 unique search results, we chose to not include additional databases. This is a limitation that should be kept in mind when interpreting the results.

We extracted the following information from the included articles; bibliometric details (reference, publication year, journal, country, aim of study); research design (data, analysis method, level of analysis); the policy investigated in the study (VA, actors, instruments); whether the study investigated an actual or hypothetical VA; and the theoretical framework of the study. In a realist review there is also a need to apply a quality filter to reject flawed studies (Pawson et al., 2005). We assessed the transparency and confidence in each study in order to assess "whether a particular inference drawn by the original researcher has sufficient weight to make a methodologically credible contribution to the test of a particular intervention theory" (Pawson et al., 2005 p. 30). This quality assessment was important to make sure low quality research was not included, nevertheless no studies were excluded for lack of quality. Further we identified which contextual factors were examined, which mechanisms were related to these, and what outcomes were examined.

We compiled an extensive excel spread sheet for all the data that we extracted. This file contained information about the articles and our assessments of them. It also contained extracted data about contexts, mechanisms and outcomes derived from the articles. This information was categorised in accordance with our analytical framework. This spread sheet was used to sort, compare and synthesis the information from the different articles.

We then carried out an evidence assessment of what had been investigated in the 43 articles and what conclusions they drew. Since none had investigated the exact same thing, it is not possible to compile the data for a full analysis. Instead, we describe how the authors had investigated a particular issue and whether this differed between articles. In this way, we reveal whether there is consistency in how something is investigated and what general conclusions can be drawn.

To increase the relevance of the review and to understand the point of view of practitioners in the field, a reference group was linked to the project already when planning the review. This group consisted of five Swedish stakeholders from forest associations and national forest and environmental agencies, and one Norwegian researcher in the field. The group convened twice: early on to discuss the direction for the review, and towards the end of the review process to comment on a draft manuscript and discuss the results. Their input concerned both the relevance of the findings and the format of presentation.

3. The reviewed literature

3.1. Theoretical and methodological approaches

The reviewed articles cover a range of disciplinary and theoretical approaches, including economics, political science, sociology, geography and forest sciences. The included articles was published 2003–2019. Both more deductive methodological approaches based on specific theories, such as rational choice and econometric modelling, and more inductive approaches using insights from previous literature were employed (Table 2). While the majority of the included articles used quantitative analysis of data from surveys or other statistical sources, 11 articles were largely qualitative analyses of individual and/or focus group interviews (Table 2).

As a result of our inclusion criteria, Nordic studies dominated, with Finnish studies being the most common, likely due to the early establishment of the METSO Programme in 2002, which generated considerable evaluation research.

Table 2
An overview of which countries have been studied in the included articles, and with which methods and data sources.

Country studied	No. articles	Analysis method used	No. articles	Data used	No. articles
Australia	1	**Comparative study**	3	**Experiments**	2
Austria	1	**Content analysis**	2	**Focus groups**	1
Canada	1	**Discourse analysis**	2	**Interviews**	3
Denmark	4	**Econometric model**	9	**Several methods**	18
Finland	20	**Experimental design**	2	**Survey**	13
France	1	**Policy analysis**	1	**Administrative reports**	4
Germany	1	**Statistical analysis and modelling**	14	**Other**	2
Italy	1	**Thematic analysis**	1		
Norway	3	**Several methods**	6		
Sweden	3	**No info**	3		
Several	7				

We identified several different theoretical approaches as to what dependent variable was in the focus in the reviewed articles. Some examined the VA process per se, others analysed the outcome in terms of participation rate in specific agreements, or the quantity and/or quality of protected forests. Despite this diversity, we found it possible to assess the factors and mechanisms against an outcome.

Economics papers applied mainly rational choice theory to understand the forest owner's choices and how preferences changed according to different options. Issues relating to the design of contracts, the size or the ecological value of protected areas, or the total cost incurred were discussed. The empirical evidence was mostly based on surveys or experimental studies, presenting different hypothetical situations for an agreement, contract design or compensation level. Preferences were investigated related to economic gains as well as social and environmental factors. Some articles were based on empirical data about already signed agreements, thus on real rather than hypothetical evidence.

Many articles applied institutional theory to understand the forest owner's decision-making and analysed the potential conflicts that may arise from perspectives of governance and societal norms. These included economic institutional theory viewing markets as a result of the complex interaction of various institutions. The role of social learning and the local context in social learning processes as well as the cultural and ecological circumstances were examined by several authors. Concepts of ecological and cultural states, the preferences for such states, and the interplay between them, were used.

3.2. Contextual factors

A total of 32 articles concerned the influence of forest owner characteristics, perceptions and experiences on voluntary protection of forests. All but two of these analysed forest owner characteristics at individual level, mainly the influence of economic and environmental attitudes on their willingness – or actual contracting – to enter into an agreement. One aspect relating to the forest owner characteristics that came up as a potential explanatory factor was gender. Siikamäki and Layton (2007) found in their survey that men are less likely than women to hypothetically enrol in incentive payment programmes. In real life situations Mitani and Lindhjem (2015) showed a dominance of male participants in voluntary forest biodiversity protection.

Forest attributes are closely connected to the forest owner's property – thus partly overlapping with the forest owner's perceptions about the need for protection – and specifically included in 16 of the included articles. Two different approaches to forest attributes were detected: articles that used forest size as a measure, often as a control or dummy variable, and, those with more elaborated forest characteristics variables, including both the stand characteristics and in some cases also biodiversity indicators. Forest attributes were mostly used as an independent variable that may or may not co-vary with other variables or mechanisms such as economic or environmental attitudes. In several of the articles such a specific mechanism had not been identified (Juutinen et al., 2012, 2014; Mönkkönen et al., 2009).

14 articles focused on the institutional context and the process framing the VAs. Generally, the mechanisms activated were rather hard to identify in these institutional/process-oriented articles, and especially to link them to a specific outcome. However, most had a real rather than hypothetical outcome. Some of the process-oriented articles went deeper into the roles of different organisations, looking at how advisors and other actors offer and process ideas about conservation, and how they support the take-up of VAs. These analyses also pay attention to land-owner collaboration and dialogue. The mechanisms activated by participation in the process are mainly trust (Bergseng and Vatn, 2009; Borg and Paloniemi, 2012; Salomaa et al., 2016), knowledge (Borg and Paloniemi, 2012; Korhonen et al., 2013; Mayer and Tikka, 2006) and environmental attitudes (Brouwer et al., 2015; Korhonen et al., 2013; Vainio and Paloniemi, 2013), but sense of justice and fairness (Borg and Paloniemi, 2012; Paloniemi and Vilja, 2009) and sense of autonomy (Frank and Müller, 2003) were also mentioned.

Eight articles considered the influence of advisors and other forest owners. Some of these frame advice simply as a factor that could contribute to VAs (Brouwer et al., 2015; Frank and Müller, 2003; Lienhoop and Brouwer, 2015; Nielsen et al., 2018) paying attention to which organisation handled contracts (Korhonen et al., 2013; Mitani and Lindhjem, 2015). These analyses considered advice as a technical factor that influenced contracting, or as a free service for the forest owner, the costs of which are covered by the government. Also, neighbours were considered in some articles in a straightforward fashion, paying attention to whether neighbours had an impact on contracting or not (Nielsen et al., 2018).

Twenty-four articles addressed the contract design aspects, including the length of the contract, the option to end them early, the level of compensation and how it is decided, and restrictions after the contract period is over. The most important mechanism when it comes to the design of the contracts is sense of autonomy, economic attitudes and environmental attitudes.

4. Mechanisms

4.1. Economic attitudes

How payments affect landowners' willingness to enter into VAs was investigated in ten articles (based on eight data sets). The evidence was somewhat scattered. Some factors, e.g. expected timber prize or the maturity of the forest, relating to how compensation affects the landowner were only examined in a single study. All articles, except one, were based on choice experiments, which provided landowners with different contracting options and investigated how the landowners chose different options. Hence, these were hypothetical choices made by the landowner. The evidence in these articles showed that financial incentives do have a positive effect on the majority of landowners' willingness to participate in VAs (Boon et al., 2010; Brouwer et al., 2015; Lienhoop and Brouwer, 2015; Siikamäki and Layton, 2007). There was also evidence suggesting there is a smaller group of individuals who, would not under any contract conditions and regardless of any (reasonable) level of compensation be willing to enter into such agreements (Boon et al., 2010; Lindhjem and Mitani, 2012b; Siikamäki and Layton, 2007; Lindhjem and Mitani, 2012a).

There was also evidence on how the contextual factors of forest size and socio-demographic characteristics of the forest owner influence the economic attitude-mechanism. The effect of forest size on compensation claims and participation was investigated in six different articles consisting of both hypothetical choice experiments and data on actual participation and compensation claims. The evidence concerning the effect of forest size on compensation claims is weak and inconsistent, one article showing a weak negative relationship (Lindhjem and Mitani, 2012a), one a significant positive relationship (Gren and Carlsson, 2012), one insignificant results (Mäntymaa et al., 2009). One article indirectly found a weak relationship showing that forest owners with larger properties are more likely to belong to the group that required the highest compensation (Broch and Vedel, 2012). The evidence is however consistent as to the effect of the size of the property on VA participation, where three articles find a significant and positive relationship (Nielsen et al., 2017; Nielsen et al., 2018; Mäntymaa et al., 2009). This is further supported by Widman (2015) where active and commercially-focused owners with large properties felt that they had less to lose by setting aside forests. How forest attributes affect the forest owner's decision was investigated in five articles, based on four different data sets (Gren and Carlsson, 2012; Kurttila et al., 2008; Lindhjem and Mitani, 2012b; Mitani and Lindhjem, 2015; Tikka, 2003). This was both a question of the timber quality (i.e. maturity of the forest) and the biodiversity qualities of the forest. However, there were no two articles that looked at similar enough issues to compile the evidence.

The review showed that socio-demographic characteristics tend to either reinforce or undermine the willingness to sign a contract. According to Boon et al. (2010) and supported by Nielsen et al. (2017) an influential variable was the owner's age, where the probability of increasing the set-aside area when offered compensation decreased considerably with older age. In the same study by Boon et al. (2010), they found that young owners were more sensitive towards financial compensation.

In addition to these areas where we found evidence, there were other questions that a limited number of the reviewed articles investigated that can help shed light on how the mechanism works, who responds to financial incentives and how.

Several articles looked at how different contextual variables affect the economic attitudes-mechanism. Boon et al. (2010) They found gender differences, as "female owners were more sensitive than male owners to financial compensation for environmental services", and a tendency of women being "more willing than men to set aside areas without compensation" (Boon et al., 2010 p. 570). Two articles looked at how the forest owner's income from the forest estate affects the decisions about VAs. They found that the higher the income from commercial forestry, the less positive attitudes towards forest conservation (Bergseng and Vatn, 2009) and the more economically important the timber sales is, the less likely it is to participate in VAs (Mitani and Lindhjem, 2015). This related to the occupation of the forest owner. According to Nielsen et al. (2017), forest-owner participation in voluntary schemes proved lower for owners professionally occupied in agriculture or forestry than for owners who were not so. Similarly, Broch and Vedel's study of agri-environmental schemes (2012) showed that where the main household income comes from agricultural production land owners demand higher compensation to participate. Another study concluded that the willingness to accept compensation is negatively related to absentee ownership, i.e. more compensation is needed for those not residing close to their forest, while it is lower for the owners with the smaller holdings, suggesting it would also be efficient to target them (Lindhjem and Mitani, 2012b).

In trying to understand how the mechanism works, it is interesting to note that even if (higher) compensation is generally preferred (Lienhoop and Brouwer, 2015), according to Boon et al. (2010) 34% of owners were not further motivated by financial compensation compared to without compensation. Further, 10% of the forest owners were

unwilling to protect forest even with appropriate compensation. The initial willingness to set aside forests turns out to be important for whether forest owners are interested in entering into an agreement or not. Boon et al. (2010), found that owners who were initially unwilling to set aside area were less likely to be motivated by financial compensation than others. The group that initially expressed that they would set aside "nothing" without compensation was less likely to respond positively to the compensation offer than any of the other groups.

Other aspects than the level of compensation relate to economic view of the forest owner. Tikka found that over half of the private forest owners did not ask for economic compensation for nature reserves since they get exempted from tax (Tikka, 2003), and Mitani and Lindhjem (2015) indicated that if forest owners are expecting income from non-timber activities in the forest this can remove barriers to participating in VAs. Primmer et al. (2014) emphasize other motives to contract signing: they noted that the almost unobservable relation between perceived economic impacts and contracting, challenges the emphasis on private costs and benefits in the economics literature on payment for ecosystem services as well as the inherent claim that the contractors' goals can be expressed in monetary terms.

4.2. Environmental attitudes

The influence of environmental attitudes was often investigated by its effect on landowners' willingness to enter into a VA and the effect on compensation. Also, the variation of environmental attitudes among different landowners was examined. There was evidence suggesting that a positive attitude towards nature protection increases the likelihood of participating in VAs (Bergseng and Vatn, 2009; Mitani and Lindhjem, 2015; Mäntymaa et al., 2009; Siikamäki and Layton, 2007; Vainio and Paloniemi, 2013; Vainio et al., 2018; Widman, 2015). However, this influence was not always straightforward. Primmer et al. (2014) revealed that perceptions about positive ecological impacts were positively related to contracting, but some of those who perceive themselves as providers of amenities and responsible stewards of nature tend do not enter contracts. The same study showed that experience with contracting and future hypothetical contracting is driven by social and altruistic motivations, and that experience with contract does not influence willingness to contract in the future. This issue was also indirectly investigated by Siikamäki and Layton (2007) who found that landowners who have already voluntarily changed their forest-management decisions away from timber production were more likely to enrol than others.

While environmental attitudes can be a mechanism, it can also have an impact on how contextual factors affect other mechanisms, i.e. there can be interactions between different mechanisms. Concerning the impact of environmental attitudes on compensation claims, the evidence was not consistent. Both Mäntymaa et al. (2009) and Broch and Vedel (2012) found that forest owners who are more environmentally friendly tend to claim smaller compensation than other owners do, whereas Brouwer et al. (2015) showed that having a positive environmental disposition towards wildlife conservation did not necessarily result in the acceptance of lower levels of financial compensation. A comparative study between Finland, Norway and Sweden showed that among the Nordic countries, Norwegian forest owners are the least positive where 83% of the Norwegian respondents demand a higher compensation level than the present, probably relating to their environmental attitudes (Bergseng and Vatn, 2009).

Several different arguments were made in the included articles concerning how the environmental attitude-mechanism works. While the majority claim that the forest owners' general attitudes to the use and protection of forests strongly influence their attitudes towards protecting their own forest, other intervening aspects were also voiced that complicate the picture. This relates to broader policy questions, as the study of Mitani and Lindhjem (2015) which shows that the forest owners who perceive that conservation regulations are too strict are less likely to participate in the conservation programme. Similarly, Paloniemi and Tikka (2008) noted that forest owners criticize conservation from a cultural point of view, which reflects the economic and historic tradition of earning one's livelihood from nature.

Widman (2015) identified other aspects that suggest different motives than purely environmental, namely that some of the interviewed forest owners expressed environmental attitudes in terms of protection of a heritage. This is revealed when forest owners want to protect the forest from clearcutting by potential new owners. Those active and heritage-focused owners appeared as the most common type, suggesting emotional attachment to their forest. Likewise, Gatto et al. (2019) found that owners willing to deliver regulation ecosystem services in the form of habitat improvement, soil conservation and carbon sequestration without a payment attach a sentimental value as well as a bequest value to their forest and have owned the property for a longer time.

Other more structural aspects can also influence how decisions around managing the forest are taken. The study by Vainio and Paloniemi (2013) showed that women who own their forest together with their husbands take a bystander position, and tend not to engage in the decision. Hence, active women protectors are scarce as result of the gender order. The authors describe a powerful hegemony of masculinity in Finnish forestry that restricts the women's interest in protecting biodiversity since this is seen as a threat to their livelihood and the social system they endorse.

4.3. Sense of autonomy

Forest owners' sense of autonomy and of being in control of their forest was considered an important factor for understanding behaviour. Several articles indicated that sense of autonomy is a mechanism that counteracts forest owners' willingness to enter into an agreement due to the feeling of losing control of their forest. The autonomy mechanism also has implications for the contract design, and is related to institutional context – but the evidence on this mechanism was very diverse. There was clear evidence of the length of the contract affecting the forest owner's decision to enter into a VA or the compensation needed to do so. Brouwer et al. (2015), Lienhoop and Brouwer (2015) and Horne (2006) found that farmers prefer shorter contracts and Siikamäki and Layton (2007) that the length of conservation decreases landowners' propensity to participate. One aspect of the contract length is the option to cancel the contract. Broch and Vedel (2012) found this option to be important and Korhonen et al. (2013) looked at a similar thing, namely trialability. They found that the ability to experiment with biodiversity protection during the first ten-year period was important for early adopters with fixed-term agreements. However, there is some uncertainty about Korhonen et al.'s (2013) conclusions since they are partly contradicted by their own presentation of their results elsewhere in their article.

In addition, several articles had investigated different aspects of how a sense of autonomy affect willingness to participate. Vainio et al. (2018) showed that maintaining the autonomy to decide about one's forest was felt more important to the owners who do not have any conservation contract than it was to the owners who had some kind of contract. According to Widman (2015), maintaining the autonomy to decide about one's forest was attributed to active forest owners, especially those with smaller properties who felt that they might lose income despite not deriving their main earnings from their forest. Widman (2015) also found that VAs were favoured by the owners compared to nature reserves, indicating a preference for temporary contracts to maintain their autonomy. A sense of autonomy can also be gained from the option to cancel a contract. Broch and Vedel (2012) found that the option to cancel might be more important rather than the exact time when (e.g. after 5 or 10 years) a contract can be cancelled.

Contextual factors such as previous experience can play an important role when it comes to the sense of autonomy mechanism. Korhonen et al. (2013) analysed two types of agreements, permanent and fixed-term, which differed as to which types of forest owners participate. Among

the late adopters, there was a group of forest owners who had unsatisfactory experiences from previous conservation processes. This group was afraid of losing authority over their forest if they enter into a permanent contract.

The autonomy-mechanism can be triggered by both broader policies and a personal attachment to one's forest. Those forest owners who experience the implementation of conservation policy as too authoritative and strict (Mitani and Lindhjem, 2015), or requiring the involvement of other citizens (Paloniemi and Tikka, 2008), perceive that as a threat to their autonomy. Hence, these owners would probably also be against the new trends of participatory policy approaches. Widman (2015) showed that regional strategies with emphasis on collaboration work in favour for autonomy and increased the number of VAs. Moreover, Widman and Bjarstig (2017) showed that forest owners who have strong personal connections to their forests often want to experience their forest alone and feel privacy. The contract design was also considered in relation to both environmental attitudes and autonomy by the same authors. Not burdening future generations with conservation obligations and maintaining their autonomy meant more to owners with a fixed-term contract than to those who have made a permanent contract (Vainio et al., 2018). This finding indicates a potential conflict between the government's policy guidelines and the owners' interests in preserving their "forest pearls" from visitors, particularly with consideration with social values.

4.4. Sense of justice and fairness

An aspect addressed by the included articles was perceptions about whether a policy and policy process are perceived as fair. The mechanism justice and fairness also appeared relative to different understandings of forests, as well as to the institutional process for VAs. Different aspects of justice and fairness was investigated in six articles, which found these mechanisms to be important for the forest owner and the contracting process (Paloniemi and Tikka, 2008; Paloniemi and Vilja, 2009; Primmer et al., 2014; Vainio and Paloniemi, 2012; Widman, 2015; Widman, 2016). However, the evidence was very scattered as the articles examined, applying very different aspects of justice and fairness, thus making it hard to provide a synthesis of the evidence.

Examples of the importance of understanding justice and fairness aspects were also provided in the literature. Contextual factors that affect one's sense of justice relate to one's own experiences, perceptions about power in society more generally, and to the institutional setting.

Paloniemi and Tikka (2008) found that forest owners' previous experiences from Natura 2000 violated forest owners' sense of justice (lacking proof of what is valuable in the forest) and made them less interested. They relate justice to the legitimacy of a policy and how the perception of the legitimacy of nature conservation affect the willingness of forest owners to participate in official nature conservation, showing evidence of polarization between forestry and conservation in the policy processes and the presence of power in the discursive constructions and interactions between stakeholders. Further, they identified a dominant status of environmental officials and the 'environment' vs 'people' divide among environmental officials. They detected feelings that the cultural positions or personal well-being of forest owners were not adequately taken into account, hence influencing the legitimacy of the process and refraining many from participating.

Similarly, Vainio and Paloniemi (2012) found that the constructed dichotomy and polarization between 'forestry identity' and 'conservation identity' is tied to a perceived sense of justice, where conservationists are perceived by those with a forestry identity to have an unfair power. Interestingly, Paloniemi and Vilja (2009) showed that through dialogue a reduction in perceived conflict between 'forestry' and 'environment' can be achieved.

Institutional context activates several mechanisms, often in both a positive and negative manner. The justice/fairness mechanism was identified to generate negative effects based on organizational rigidity and invisibility of the programme (METSO) (Borg and Paloniemi, 2012), and lack of resources also affects the mechanism justice/fairness negatively, resulting in low acceptance for the programme (Widman, 2015). Paloniemi and Tikka (2008) affirmed that giving stakeholders a voice is relevant when striving for the experience of legitimacy. They also found that the multilateral policymaking process had overcome the national nature conservation conflict and achieved more widely accepted results than those achieved by authoritative policy-making procedures.

4.5. Trust

An important mechanism for the functioning of VAs in the reviewed articles was the forest owner's trust in authorities and/or in other forest owners. There was evidence showing that lack of trust is correlated with a decreased willingness to enter into VA's, and presence of trust with both previously having a contract and willingness to enter into a new one (Bergseng and Vatn, 2009; Brouwer et al., 2015; Primmer et al., 2014). Three articles discussed perceptions about trust building or rebuilding trust. They showed that one of the reasons to continue with participatory approaches to nature protection was to rebuild trust that was previously lacking (Salomaa et al., 2016; Widman, 2015, 2016).

Trust tends to be related to previous experiences and is related to perceptions about the individual agency officers, authorities and process. Paloniemi and Vilja (2009) found that forest owners trust forest authorities more than environmental authorities. This was supported by Primmer et al. (2014), namely that dissatisfaction and distrust of environmental authorities was expressed in some verbal responses to open-ended questions among the non-contracted respondents. The background to this might be given by Salomaa et al. (2016), writing that unpleasant experiences concerning Natura 2000 are linked to environmental authorities. However, compared to Natura 2000, the METSO programme and wider information sharing were said to be reasons for improving relationships between environmental administrations and owners. Bergseng and Vatn (2009) did not find the variable *which organisation performing the conservation processes* to significantly influence forest owners' attitudes. However, they stated a strong correlation between variables on process satisfaction and organisation, noting that maybe that displeasure with organisation leads to dissatisfaction with the process. Widman (2015) found that forest owners' previous negative experiences in contact with both the environmental and forest authorities could undermine trust. The capacity of the implementing agencies can be a constraint (i.e. lack of time, leadership capacity, and resources), affecting power relations and trust, and in turn rendering lower acceptance of the programme (Widman, 2016). Vainio et al. (2018) found that the owners who had some kind of a conservation contract perceived their goals as similar to environmental actors, trusted in them, and sought information about conservation from them more frequently than did the owners without contract. The survey by Primmer et al. (2014) showed "trust in authorities" to be positively related to past contracting in isolation but not when combined with other perceptions.

Trust-building is directly linked to the mechanism trust, and proved to relate positively to environmental attitudes (Paloniemi and Vilja, 2009), and negatively to the willingness to enter a programme when the forest owners did not have sufficient confidence and trust in the government as the contract provider (Brouwer et al., 2015).

Trust-building and mutual trust between forest owners and authorities therefore constitute an important part of successful processes, while lack of control (i.e. autonomy, see section 4.3) or knowledge (see section 4.6) can hamper the process and limit the outcome. Indeed, many of the articles that explicitly discuss trust are so focused on the process that for them a legitimate process was taken as an outcome in itself.

4.6. Knowledge

Different aspects of the importance and role of knowledge in the voluntary protection process was investigated in eleven articles.

Primarily, they found knowledge to be important for the forest owner and the contracting process including the role for advice by professionals (Brouwer et al., 2015; Gatto et al., 2019; Korhonen et al., 2013; Lienhoop and Brouwer, 2015; Mitani and Lindhjem, 2015; Paloniemi and Vilja, 2009; Salomaa et al., 2016; Vainio et al., 2018; Widman, 2015; Widman and Bjarstig, 2017).

The evidence was scattered with the articles looking at very different aspects of knowledge, including the sources of information used and the role of advisors. One aspect was investigated in a similar way by multiple articles: the knowledge level of forest owners. Yet, the results were inconclusive. Three articles showed that more highly educated farmers tended to be more willing to participate in VA-programmes or to implement environmental measures (Mitani and Lindhjem, 2015; Lienhoop and Brouwer, 2015). Vainio et al. (2018) also detected that the owners without a contract were more likely to have a comprehensive school degree and less likely to have a university degree than those with a conservation contract. However, when Gatto et al. (2019) compared the effect of different levels of education in their study of forest owners in southern Europe, they found that higher level of owner's education resulted in unwillingness to deliver habitat improvement. Since Gatto compared 'primary school education' and 'secondary school and above education', this is a comparison of forest owners with a (very) low education to those with an average or above education, so the situation is very different from the study settings from northern Europe.

The knowledge mechanism is prevalent in Widman and Bjarstig (2017), where lack of information affect knowledge negatively and ultimately also the acceptance of the programme. Knowledge can be an important mechanism that affects forest owner's willingness to enter into an agreement. Increased knowledge about the motives (Widman, 2015) or about different protection possibilities (Korhonen et al., 2013) for voluntary forest protection was a positive factor for VAs. Several articles also showed that having prior experience of the process/programme helped explain the propensity to enter (Siikamäki and Layton, 2007; Paloniemi and Tikka, 2008; Gren and Carlsson, 2012; Salomaa et al., 2016).

Knowledge is both a mechanism in itself, where increased awareness may change the forest owners' behaviour, but it can also spark other mechanisms, such as economic and environmental attitudes, that in turn affect the forest owners' behaviour. Increased knowledge of the programme as such has a positive such effect, as does also prior experience of the process/programme. Advice or connection to a professional organisation that would be in a position to provide advice can also have a positive effect on contracting.

The role of advice was studied in nine articles. Generally, advice or connection to a professional organisation that would be in a position to provide advice, has a positive effect on contracting and also on the formulation of contracts. In most analyses, this was reported as positive impact and discussed very briefly (Brouwer et al., 2015; Lienhoop and Brouwer, 2015; Mitani and Lindhjem, 2015). These analyses considered advice as a (transaction) cost saving, making the process of contracting smooth, or just merely noted that advice likely eased contracting (Paloniemi and Vilja, 2009; Salomaa et al., 2016; Widman, 2015; Widman, 2016; Widman and Bjarstig, 2017). Lienhoop and Brouwer (2015) found that availability of technical advice by rangers to plant and manage the forest throughout the duration of the contract had a significant positive influence. An important contextual factor here was that these are not foresters but farmers, and they felt that they lack knowledge. This finding might not be transferable to a context where those who enter into an agreement are forest owners with knowledge of forest management.

Korhonen et al. (2013) revealed that from whom the forest owner sought advice varies depending on the stage of the agreement process. During the first steps, which Korhonen et al. (2013) refer to as knowledge and persuasion, the forest owner sought information mainly from media and forestry professionals. In the latter stages, decision and implementation, the advice was sought from fellow forest owners, neighbours and family. Korhonen et al. (2013) also found that while some advisors are seen by forest owners as representatives of "forest people", others are viewed as "nature protection people", which affects in particular the initial phase. For late adopters, the effect of personal channels increased while mass media becomes less important. Hence, in contact with late adopters, it will be more important to convey concrete experiences from others, for example through peer-to-peer learning.

5. Concluding discussion

Our realist review shows that the VA literature is scattered, studying VAs in different ways and with different approaches, which poses challenges for compiling the evidence. The different articles focus on both hypothetical and real processes and outcomes, and they pay attention to varying ranges of explanatory variables. Our original programme theory was identified as: private forest owners can be encouraged and motivated to participate in a VA programme for forest protection if provided with adequate information and financial support. In Fig. 1 this is expanded upon to show how contexts, mechanisms and outcomes are interrelated. This figure thus summarizes the evidence into a comprehensive analytical framework showing the middle-range theories involved in a VA programme.

The review shows that the mechanisms of economic and environmental attitudes are most commonly examined, and with quite similar methodological approaches, contributing to reasonably strong evidence. How these contexts and mechanisms influence the willingness to participate in a VA programme, based on our realist review, is illustrated in Fig. 1. Thus, the evidence is stronger for those contextual factors where the underlying concepts are relatively standardised, such as the age and gender of the forest owner, the size of the forest or the length of the contract. With regard to the more complex mechanisms of trust, sense of justice and knowledge, the articles framed these mechanisms in different ways, and examined them differently. There is an apparent research gap to be filled in particular concerning these mechanisms in order to better understand their direct or indirect influence on behaviour.

The review further reveals that mechanisms co-vary and interact, which in some cases makes it hard to judge which are the most important mechanisms contributing to the outcome, as well as to establish a dominant causal chain of cause-effect relationships. Sometimes it is also difficult to know the direction of the relationship. For example, while there is evidence of forest owners with positive environmental attitude being more inclined to participate in VA programmes (Fig. 1), some articles have looked at the opposite direction of influence, namely that having participated in a VA programme affects the person's environmental attitude, indicating that this relationship might be two ways. Having said that, we are still able to pinpoint where the evidence is concurrent and where it is contradictory, and to identify remaining knowledge gaps. As our rich and detailed analysis shows, many articles reveal various interactions between the different mechanisms. More research is needed on these interactions to be able to assess the evidence base more in full and to relate those mechanisms to specific contexts.

This review contribute to further research in this field. Firstly, by pinpointing knowledge gaps, where more research is needed, not least qualitative research on the more complex mechanisms discussed above. Secondly, it should be used in the design of future studies. In particular, when designing broad quantitative studies of VAs, the comprehensive analytical framework in Fig. 1 and the insights drawn in our results section can serve as a basis for identifying important variables to include. For instance, it can provide inspiration on what questions to ask in a survey to obtain a more holistic view of VAs.

While we carried out a very extensive search for evidence it was not exhaustive, as we relied on two databases and applied strict inclusion criteria. The reason why an article has not been included in this review is therefore either because it was not identified in our search or because was judged not to meet our inclusion criteria. Hence, future research

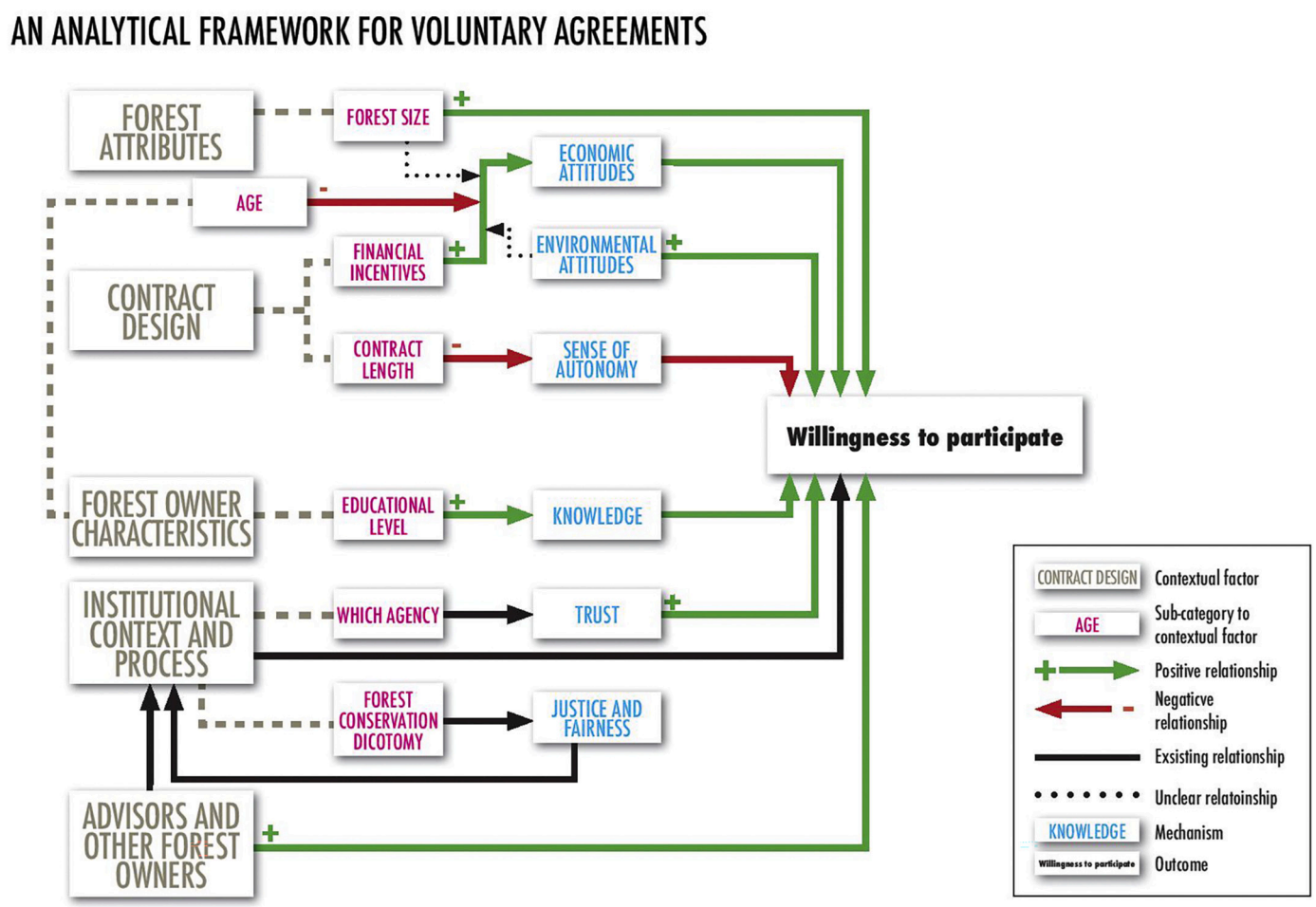

Fig. 1. The figure summarizes the evidence found in our realist review by showing how contexts, mechanisms and outcomes interact in VAs. (For detail on the less clear evidence, see sections 4.1–4.6.)

could add to the understanding of VA by selecting other databases or look at the literature from geographical areas that have been excluded from this review, e.g. the US, to assess whether the mechanisms work the same way in a different institutional context.

The review also provides important insights for practitioners as to how implementing agencies may approach forest owners more effectively by tailoring solutions for different types of forest owners. For example, information campaigns can be specifically designed to target forest-owners with positive environmental attitudes and likely interest in entering into an agreement, while forest owners with strong reliance on economic attitudes may become more interested if the contract design is adapted to sense of autonomy. Focusing on fair negotiations that build on trust and potential win-win solutions can attract the forest owner's interest in the first place.

The contextual factors considered in this review can be divided into those that the authorities themselves can influence and those that they cannot. Examples of contextual factors that the authorities can influence are knowledge mediation and advice as well as the contract design. Awareness of the factors that authorities cannot influence can be used to target the forest owners who are most prone to VAs. Examples of such factors are the forest owner's gender, age, educational level and income, but also previous experience which was identified as an important contextual factor affecting several different mechanisms. A third category of factors can be influenced by authorities but are more complex and needs to be thought of in a longer time frame. These include forest owners' attitudes to the environment, their perceptions about justice and fairness, and their trust in authorities. Actions taken by authorities do influence these perceptions but it is not so straight forward how this will change the forest owners' perceptions.

Our review was based on the realist idea of mechanisms, as essential for understanding how a policy works. We were able to expand the initial program theory to show if and under what conditions it was valid. Further, we expanded it into an analytical framework consisting of middle-range theories. The realist review method has helped us systematise the rather dispersed kinds of methodological approaches in the VA literature in new ways that adds value to this research field. Mechanisms that are implicit (as well as explicit) were extracted from the articles in a more systematic manner than would have been possible without the application of the realist review method. It was thus possible to merge findings from different types of VAs, building on the extracted evidence of how the mechanisms influence certain outcomes along the programme implementation process. Hence, we were able to analyse the state of evidence along this chain of events in ways that create a more holistic picture of the contributing factors to effective design of VAs. Beside the identification of knowledge gaps (i.e. weak or no evidence in the VA literature) that should be addressed in future research, this review contribute insights that can assist in the design and implementation of more elaborated voluntary nature conversation initiatives in the future.

This analysis illustrates how the contract design does not alone determine the outcome of a programme. Rather a number of important mechanisms are crucial for its success. When designing a programme these should be targeted specifically. For example, if there is lack of trust or if there are experiences of injustice among the forest owners, the

programme should include activities aimed at building trust. When setting up a new programme, the risk of any of these mechanisms triggering a negative outcome should be assessed and plans for managing the challenges should be designed.

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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.

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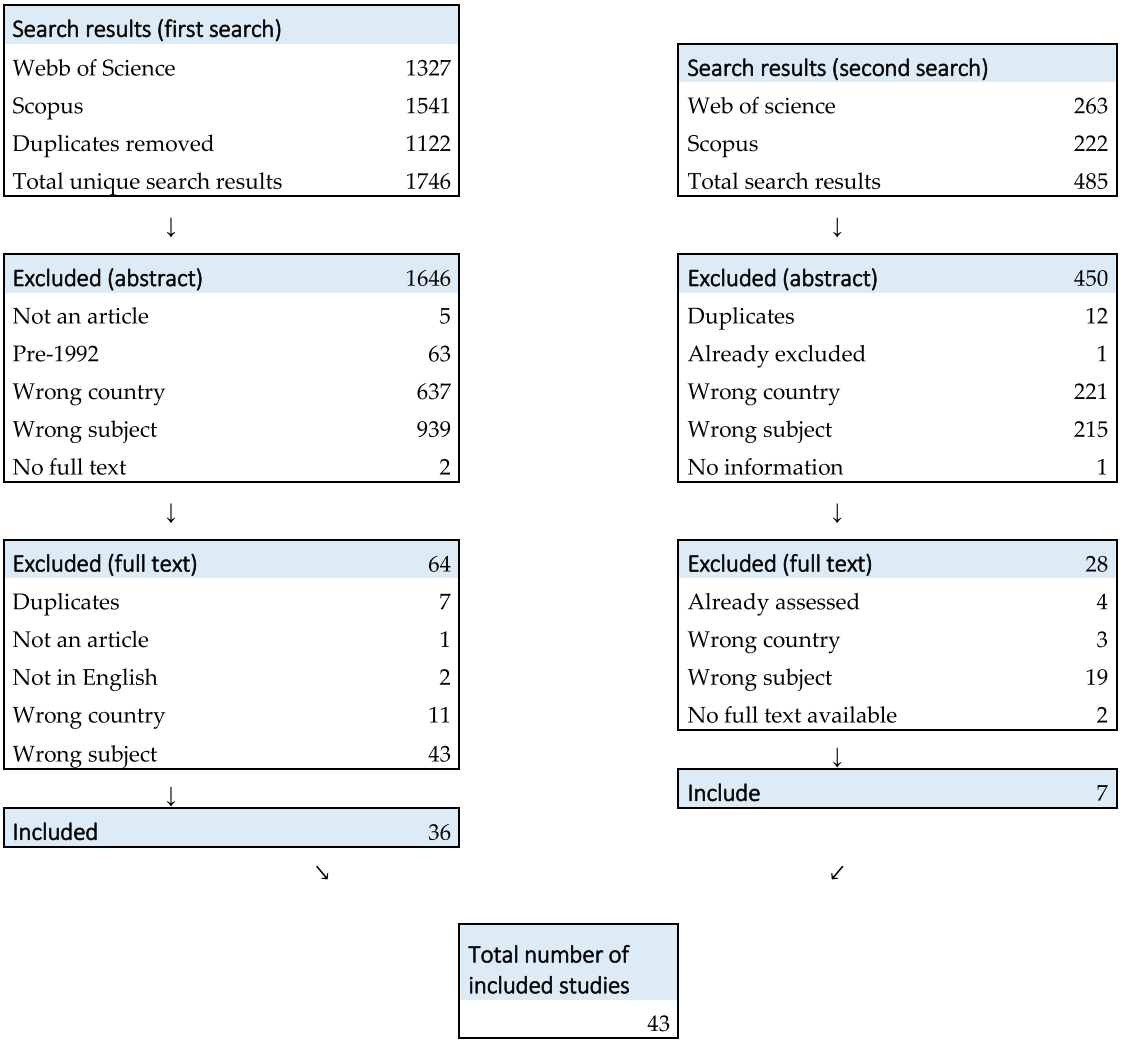
Appendix A. The different stages of the screening process

Database	Search string
Scopus	((private* OR *owner*) AND (forest* OR woodland) AND (protect* OR conserv* OR preserv*) AND (agreement OR contract OR understanding OR deal OR commitment OR record OR participation OR programme OR compensation))
Web of Science	TOPIC: ((private* OR *owner*)) AND TOPIC: ((forest* OR woodland)) AND TOPIC: ((protect* OR conserv* OR preserv*)) AND TOPIC: ((agreement OR contract OR understanding OR deal OR commitment OR record OR participation OR programme OR compensation))



Appendix B. An overview of the included articles

Author Title	Year	Journal	Country	Data	Analysis method
Bergseng, E., & Vatn, A. Why protection of biodiversity creates conflict–Some evidence from the Nordic countries.	2009	Journal of Forest Economics	Norway, Sweden and Finland	Survey	Statistical analysis

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Author Title	Year	Journal	Country	Data	Analysis method
Bergstén, S., Stjernström, O., & Pettersson, Ö. Experiences and emotions among private forest owners versus public interests: Why ownership matters.	2018	Land Use Policy	Sweden	Interviews	Thematic Analysis
Bond, A. J., O'Connor, P. J., & Cavagnaro, T. R. Who participates in conservation incentive programs? Absentee and group landholders are in the mix.	2018	Land Use Policy	Australia	Use of Administrative Sources	Statistical analysis
Boon, T. E., Broch, S. W., & Meilby, H. How financial compensation changes forest owners' willingness to set aside productive forest areas for nature conservation in Denmark.	2010	Scandinavian Journal of Forest Research	Denmark	Survey	Statistical analysis
Borg, R., & Paloniemi, R. Deliberation in cooperative networks for forest conservation.	2012	Journal of Integrative Environmental Sciences	Finland	Several methods	Several methods
Broch, S. W., & Vedel, S. E. Using choice experiments to investigate the policy relevance of heterogeneity in farmer agri-environmental contract preferences.	2012	Environmental and Resource Economics	Denmark	Survey	Experimental design
Brouwer, R., Lienhoop, N., & Oosterhuis, F. Incentivizing afforestation agreements: Institutional-economic conditions and motivational drivers.	2015	Journal of Forest Economics	Germany and the Netherlands	Experiments	Econometric model
Danley, B. Skepticism of state action in forest certification and voluntary set-asides: a Swedish example with two environmental offsetting options.	2018	Scandinavian Journal of Forest Research	Sweden	Survey	Econometric model
Danley, B. Forest owner objectives typologies: instruments for each owner type or instruments for most owner types?.	2019	Forest Policy and Economics	Sweden	Survey	No info
Frank, G., & Müller, F. Voluntary approaches in protection of forests in Austria.	2003	Environmental Science & Policy	Austria	Use of Administrative Sources	Comparative study
Gatto, P., Defrancesco, E., Mozzato, D., & Pettenella, D. Are non-industrial private forest owners willing to deliver regulation ecosystem services? Insights from an alpine case.	2019	European Journal of Forest Research	Italy	Survey	No info
Gren, M., & Carlsson, M. Revealed payments for biodiversity protection in Swedish forests.	2012	Forest Policy and Economics	Sweden	Other	Econometric model
Hily, E., Garcia, S., Stenger, A., & Tu, G. Assessing the cost-effectiveness of a biodiversity conservation policy: A bio-econometric analysis of Natura 2000 contracts in forest.	2015	Ecological Economics	France	Use of Administrative Sources	Econometric model
Horne, P. Forest owners' acceptance of incentive based policy instruments in forest biodiversity conservation-A choice experiment based approach.	2006	Silva Fennica	Finland	Experiments	Statistical analysis
Juutinen, A., Mäntymaa, E., Mönkkönen, M., & Svento, R. Voluntary agreements in protecting privately owned forests in Finland—to buy or to lease?.	2008	Forest Policy and Economics	Finland	Several methods	Statistics, Modelling
Juutinen, A., Mönkkönen, M., & Ylisirniö, A. L. Does a voluntary conservation program result in a representative protected area network?: The case of Finnish privately owned forests.	2009	Ecological Economics	Finland	Several methods	Statistics, Modelling
Juutinen, A., Ollikainen, M., Mönkkönen, M., Reunanen, P., Tikkanen, O. P., & Kouki, J. Optimal contract length for biodiversity conservation under conservation budget constraint.	2014	Forest Policy and Economics	Finland	Several methods	Statistics, Modelling
Juutinen, A., Reunanen, P., Mönkkönen, M., Tikkanen, O. P., & Kouki, J. Conservation of forest biodiversity using temporal conservation contracts.	2012	Ecological Economics	Finland	Several methods	Statistics, Modelling
Korhonen, K., Hujala, T., & Kurttila, M. Diffusion of voluntary protection among family forest owners: decision process and success factors.	2013	Forest Policy and Economics	Finland	Interviews	Discourse analysis
Kurttila, M., Leskinen, P., Pykäläinen, J., & Ruuskanen, T. Forest owners decision support in voluntary biodiversity-protection projects.	2008	Silva Fennica	Finland	Mixed methods	Several methods
Layton, D. F., & Siikamäki, J. Payments for ecosystem services programs: predicting landowner enrolment and opportunity cost using a beta-binomial model.	2009	Environ Resource Eco	Finland	Survey	Econometric model
Lienhoop, N., & Brouwer, R. Agri-environmental policy valuation: Farmers' contract design preferences for afforestation schemes.	2015	Land Use Policy	Germany	Several methods	Experimental design
Lindhjem, H., & Mitani, Y. Forest owners' willingness to accept compensation for voluntary conservation: A contingent valuation approach.	2012	Journal of Forest Economics	Norway	Survey	Econometric model
Lindhjem, H., Grimsrud, K., Navrud, S., & Kolle, S. O. The social benefits and costs of preserving forest biodiversity and ecosystem services.	2015	Journal of Environmental Economics and Policy	Norway	Survey	Econometric model
MacDonald, H., McKenney, D. W., Pedlar, J. H., Hope, E. S., McLaven, K., & Perry, S. Adoption influences in Ontario's 50 Million Tree Program.	2018	The Forestry Chronicle	Canada	Several methods	Statistical analysis

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Author Title	Year	Journal	Country	Data	Analysis method
Mayer, A. L., & Tikka, P. M. Biodiversity conservation incentive programs for privately owned forests.	2006	Environmental Science & Policy	Austria, Finland, Sweden, US	Use of Administrative Sources	Comparative study
Mitani, Y., & Lindhjem, H. Forest owners' participation in voluntary biodiversity conservation: what does it take to forgo forestry for eternity?.	2015	Land Economics	Norway	Survey	Econometric model
Mäntymaa, E., Juutinen, A., Mönkkönen, M., & Svento, R. Participation and compensation claims in voluntary forest conservation: A case of privately owned forests in Finland.	2009	Forest Policy and Economics	Finland	Several methods	Econometric model
Mönkkönen, M., Ylisirniö, A. L., & Hämäläinen, T. Ecological efficiency of voluntary conservation of boreal-forest biodiversity.	2009	Conservation Biology	Finland	Several methods	Statistics, Modelling
Nielsen, A. S. E., Jacobsen, J. B., & Strange, N. Landowner participation in forest conservation programs: A revealed approach using register, spatial and contract data.	2018	Journal of Forest Economics	Denmark	Several methods	Statistics, Modelling
Nielsen, A. S. E., Strange, N., Bruun, H. H., & Jacobsen, J. B. Effects of preference heterogeneity among landowners on spatial conservation prioritization.	2017	Conservation Biology	Denmark	Several methods	Statistical analysis
Paloniemi, R., & Tikka, P. M. Ecological and social aspects of biodiversity conservation on private lands.	2008	Environmental science and policy	Finland	Several methods	Several methods
Paloniemi, R., & Vilja, V. Changing ecological and cultural states and preferences of nature conservation policy: The case of nature values trade in South-Western Finland.	2009	Journal of Rural Studies	Finland	Several methods	Content Analysis
Primmer, E., Paloniemi, R., Similä, J., & Tainio, A. Forest owner perceptions of institutions and voluntary contracting for biodiversity conservation: not crowding out but staying out.	2014	Ecological Economics	Finland	Survey	Statistical analysis
Salomaa, A., Paloniemi, R., Hujala, T., Rantala, S., Arponen, A., & Niemelä, J. The use of knowledge in evidence-informed voluntary conservation of Finnish forests.	2016	Forest Policy and Economics	Finland	Focus groups	Content Analysis
Siikamäki, J., & Layton, D. F. Potential cost-effectiveness of incentive payment programs for the protection of non-industrial private forests.	2007	Land Economics	Finland	Survey	Several methods
Tikka, P. M. Conservation contracts in habitat protection in southern Finland.	2003	Environmental Science & Policy	Finland	Several methods	Comparative study
Vainio, A., & Paloniemi, R. Forest owners and power: A Foucauldian study on Finnish forest policy.	2012	Forest Policy and Economics	Finland	Interviews	Discourse analysis
Vainio, A., & Paloniemi, R. Adapting to the gender order: Voluntary conservation by forest owners in Finland.	2013	Land Use Policy	Finland	Several methods	Several methods
Vainio, A., Paloniemi, R., & Hujala, T. How are forest owners' objectives and social networks related to successful conservation?.	2018	Journal of Rural Studies	Finland	Survey	Statistical analysis
Widman, U. Shared responsibility for forest protection?.	2015	Forest Policy and Economics	Sweden	Several methods	Several methods
Widman, U. Exploring the role of public–private partnerships in forest protection.	2016	Sustainability	Sweden	Several methods	Policy analysis
Widman, U., & Bjärstig, T. Protecting forests' social values through partnerships.	2017	Scandinavian Journal of Forest Research	Sweden	Several methods	No info

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