Forest Policy and Economics 144 (2022) 102839

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

# Common preferences of European small-scale forest owners towards contract-based management

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ARTICLE INFO

*Keywords:*
Choice experiment
Ecosystem services
Forest policy
Incentives
Private forest owners

ABSTRACT

The societal demands on forest management are becoming increasingly diverse, which will be reflected in decisions made by forest owners. We examined the willingness of private forest owners in Austria, Finland, Germany, Slovenia, and Sweden to participate in a contract-based payment scheme in which they were asked to apply a specific management strategy to promote either timber production or environmental goals. The preferences for the contract-based management and associated consequences in terms of profitability, biodiversity, carbon stock, and climate change-induced damages were addressed within a choice experiment. A majority of respondents across all countries agreed to participate in a payment scheme to promote environmental goals, while schemes purely targeted to increase wood production were found less attractive. Forest owners liked improvements in profitability and environmental attributes and disliked deterioration of these attributes. Differences among countries were found in the level of expected contract payments, and commonalities were found with respect to preferences towards environmental goals, including biodiversity and carbon stocks. Hence, new policies to target European forest subsidy to promote the provision of environmental goals would likely be acceptable.

## 1. Introduction

The demands on and challenges for forest management in Europe are becoming increasingly diverse, which will be reflected in the decisions made by forest owners. For example, the new EU Forest Strategy for 2030 emphasises, among other things, the development of new wood-based materials and products (European Commission, 2021), and renewable energy policies call for increased energy use of biomass (European Commission, 2018). This increased the motivation to enlarge the supply of sustainable renewable materials and energy, commonly referred to as 'wood mobilization', by increasing harvest area and intensifying forest harvesting in Europe (Lawrence, 2018). At the same time, there are goals to increase forest protection to halt biodiversity loss and reverse the degradation of ecosystems (European Commission, 2020) and to use the EU's forested area for carbon storage and sequestration to achieve climate neutrality (European Commission, 2019). Achieving these environmental goals will likely require less intensive, nature-based forest management practices (Trivino et al., 2017). Also, climate change brings challenges for forest management in the form of more frequent extreme weather events such as drought, snow, and windthrows, resulting in large-scale pest attacks, disease infestations, and forest fires across Europe (Seidl et al., 2014), with far-reaching consequences for the economic value of forest management (Hanewinkel et al., 2013; IPCC, 2021).

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https://doi.org/10.1016/j.forpol.2022.102839
Received 11 March 2022; Received in revised form 2 September 2022; Accepted 5 September 2022
Available online 14 September 2022

In Europe, nearly 50% of forests are privately owned, and 59% of the private holdings are regarded as small-scale forest owners managing forests of fewer than 100 ha (Hirsch et al., 2007). They form a heterogeneous group in terms of their motivations and goals for their ownership and preferences for forest management (Ficko et al., 2019; Pröbstl-Haider et al., 2017). The forest ownership and forest owners' goals are changing due to the increasing urbanisation of lifestyles, the exit from agriculture, and changing values in society (Dominguez and Shannon, 2011; Weiss et al., 2019). A growing number of forest owners are inactive in managing their forest, which has increased the political concern about underutilised and unmanaged forest lands (Wilkes-Allemann et al., 2021). The reason for the apparent inactivity may be that forest owners presume a higher environmental benefit of forests from less intensively managed forests over modest financial benefits from timber production on small forest lots (Lawrence, 2018). Forest owners may therefore be willing to practice adapted management strategies to provide multiple ecosystem services as public goods that are increasingly demanded in Europe (Winkel, 2017).

National Forest Acts give forest owners a substantial operating space on how to manage their forests, but their decisions can be influenced by various policy instruments like regulations or subsidies. There is no formal common forest policy for European countries, although communalities are sought in the Ministerial Conference on the Protection of Forests in Europe, Forest Europe (https://foresteurope.org/). Some elements of forest management are subsidised through the European Agricultural Fund for Rural Development (EAFRD) (European Commission, 2013) and various country-specific funding schemes. The diverse subsidy systems are designed to achieve multiple objectives, from improving resource efficiency to enhancing ecosystem conservation (Quiroga et al., 2019; Haeler et al., manuscript). Based on economic theory, subsides should be used to correct market failures or unacceptable income distribution. However, justification for the current forest subsidies is typically ad hoc and country-specific, while a more knowledge-based and policy-coherent incentive system might be required to meet the various demands on forests by European societies in the future.

Contract-based forest management is one possible option for a new incentive system that could be introduced in the future to encourage forest owners to adopt a certain management behaviour. In this type of system, forest owners are asked to practice a specific type of forest management strategy and receive compensation for doing so, according to the terms of the contract. To develop an efficient and feasible payment system, information is needed on forest owners' preferences and their willingness to participate in the system (Sarvasova et al., 2018). It is particularly important to know the forest owners' willingness to accept (WTA) (i.e., how much compensation they require for participating in a scheme).

Several studies have investigated the willingness of private forest owners to participate in contract-based payment schemes related to, for example, biodiversity conservation (Mitani and Lindhjem, 2015), carbon sequestration (Smith et al., 2016), climate change adaptation (Mostegl et al., 2019), landscape conservation (Mäntymaa et al., 2018), and reduction of risks from invasive pests and diseases (Sheremet et al., 2018). Previous studies have focused on individual countries, whereas our study considers five countries across a wide range of European forest types and reveals both general and heterogeneous patterns in forest owners' preferences across countries.

In this study, we examined the willingness of private forest owners to participate in a hypothetical contract-based incentive scheme that requires them to use a 'timber oriented' or a 'nature oriented' management strategy by using a choice experiment (CE) method. In addition, we considered preferences of forest owners for potential consequences of the management strategies. This payment scheme was elaborated earlier by Juutinen et al. (2021), focusing on Finnish private forest owners. In this study, we extended and adapted the previous analysis by considering private forest owners from five European countries: Austria, Finland, Germany, Slovenia, and Sweden. Our objective was to investigate and understand the differences in forest owners' preferences between countries to provide input to the development of new policies for forest management in Europe. In particular, we 1) investigated the preferences of European private forest owners for contract-based management and associated varying outcomes in terms of profitability, biodiversity, carbon stock, and probability of climate change-induced forest damage; 2) assessed private forest owners' compensation requirements; and 3) examined how individual-specific variables are associated with the preferences of private forest owners.

## 2. Materials and methods

### 2.1. Characteristics of forest owners by countries

Forests and forest owners in the five studied countries are different in many respects (Table 1). The share of forest area from total land area ranges between 48 and 86% in four of the five countries, which exceeds the average 35% forest area share in Europe (Forest Europe, 2020). Germany has the lowest forest area share and together with Sweden also the smallest share of forests managed by private forest owners (Table 1). In contrast, forests in Austria and Slovenia are managed predominantly by private owners. The number of private forest owners and in particular of small-scale private forest owners varies from 140,000 owners in Austria and to estimated 1.8 Mill owners in Germany. The average size of forest holdings varies from 2.4 and 2.6 ha per owner/holdings in Germany and Slovenia, respectively, up to 30 in Finland and 34.5 ha in Sweden.

### 2.2. Survey design

The questionnaire was developed in cooperation with researchers from Austria, Finland, Germany, Slovenia, and Sweden (see Juutinen et al., 2021 for details), and the same questionnaire was used in each country to allow comparison of the results. Along with the CE, the questionnaire included questions about the socio-economic status of respondents, forest holding, and forest owner management practices (see Supplement).

In the CE, respondents were told that they could enter a 15-year management contract with a local authority. The principal idea of the proposed contract-based management schemes was that the government would offer forest owners monetary incentives to undertake the specified management strategies to promote bioeconomy development (timber oriented) or to safeguard biodiversity and mitigate climate change (nature oriented). Respondents were presented with choice sets that described the potential payment schemes (see Fig. 1). Each choice set consisted of alternatives A, B, and C. Alternative A stayed unchanged in all choice sets and was the reference (status quo), in which the attribute levels were fixed at the current level, 'conventional management' as management strategy, and additional subsidy was zero. The alternatives B and C represented contract-based management schemes, where the two management strategies 'timber oriented' and 'nature oriented' and the other attribute levels varied between the choice sets. Respondents were asked to imagine that they have a 50-year spruce-dominated forest stand and consider choosing alternative A, B, or C for this hypothetical stand in order to ensure that they make a decision about a similar stand.

We used country-specific descriptions for the management strategies because the forest management strategies differ among the studied countries (Table 2). The specific management actions used in the management strategies for the hypothetical stand were described to the respondents before the choice tasks (Supplement).

The attributes of profitability, biodiversity, carbon stock, and climate change-induced damage were used to characterise the potential long-term consequences of management strategies. The fifth attribute was the additional financial subsidy. The respondents were presented with

**Table 1**
Overview of forest areas and small-scale private forest ownership in the five investigated EU countries.

| | Austria[2,3] | Finland[4,5] | Germany[6,7,8,9] | Slovenia[10,11] | Sweden[12] |
|---|---|---|---|---|---|
| Forest area, Mill ha (share of total area) | 4.02 (48%) | 26.3 (86%) | 11.5 (32%) | 1.2 (58%) | 28 (68%) |
| Forest area privately owned, Mill ha (share of total forest area) | 3.1 (80%) | 13.9 (53%) | 5.5 (48%) | 0.91 (76%) | 11.3 (48%) |
| No private forest owners/holdings | 140,000 | 396,000 | 1,800,000 | 320,000 | 227,500 |
| No of small forest owners/holdings <200 ha | 138,000 | 392,000 | 3.8 Mill ha[13] | 233,000 | 216,000 |
| Average size of holdings | 19.7 ha | 30 ha | 3 ha | 2.6 ha | 34.3 ha |
| Male (share of forest owners)[1] | 0.30 | 0.75 | – | 0.51 | 0.61 |

[1] Živojinović et al. (2015).
[2] Statistik Austria (2016).
[3] Toscani and Sekot (2017).
[4] Natural Resources Institute Finland (2021).
[5] Karppinen et al. (2020).
[6] NFI (2012).
[7] Feil et al. (2018).
[8] Hennig (2018).
[9] Koch and Maier (2015).
[10] Pezdevšek Malovrh et al. (2015).
[11] Skudnik et al. (2021).
[12] Swedish Forest Agency database (2022).
[13] Estimates of the number of small-scale forest owners/holding are not available for Germany, instead the approximate total size of this owner category is given.

| CHOICE SET 1 | Alternative A | Alternative B | Alternative C |
|---|---|---|---|
| **Management strategy** | Conventional management (no contract) | Nature Oriented (15-year contract) | Timber Oriented (15-year contract) |
| **Profitability** (without additional subsidy) | Current level | Decrease 20% | Current level |
| **Biodiversity** | Current level | Increase | Decrease |
| **Carbon stock** | Current level | Current level | Decrease |
| **Probability of climate change induced damages** | Current level | Increase | Decrease |
| **Additional subsidy** (lump sum payment, €/hectare) | 0 | 300 | 750 |
| **My choice is:** | ◯ | ◯ | ◯ |

**Fig. 1.** An example of one choice set. Each respondent received six of such choice sets (Supplement).

written descriptions of the attributes before being presented with the choice tasks (Supplement). The aim was to make sure that the respondents had sufficient information for their choices and to prevent hypothetical bias. The attributes and their levels used to describe the contract-based management schemes in the CE are shown in Table 3.

Using prior information from the pilot survey, we created a Bayesian efficient design optimised for D-efficiency for the multinomial logit (MNL) model to generate the choice sets presented to the respondents (Juutinen et al., 2021). The design was estimated with restrictions. Under the timber-oriented management strategy, biodiversity and carbon stock were not allowed to increase. Under the nature-oriented management strategy, biodiversity and carbon stock were not allowed to decrease. These restrictions were based on the results of previous studies (Trivino et al., 2017), but they also were used due to need for making the CE applicable to different types of forest owners and different countries. The resulting design consisted of 36 choice sets, divided further into six groups. Each respondent received six choice sets. The six versions of the questionnaire were distributed randomly among the respondents.

### 2.3. Data collection

The data were collected in 2020 in each participating country using different methods which depended on the availability of national forest owner registers. Austria and Germany do not possess nationwide registers of forest owners and thus we had to use other means to reach the aspired target group and size.

In *Austria*, the survey was outsourced to a private market research company. Costumers of regular market surveys were asked whether they own small-scale forests (<200 ha) and if they want to participate. The survey was kept open until the minimum targeted sample size, 300 respondents, was reached. Hence, the response rate was not recorded.

The survey data in *Finland* were collected through a nationwide questionnaire sent by mail to a random sample of 3000 family forest owners with at least two hectares of forestry land. Individual owners and those with a spouse, private partnership, or heirs were collectively considered to belong to the sample of family forest owners. The sample was derived from the Finnish Forest Centre's nationwide forest owner register. Of the 3000 addresses, 39 were not valid, giving a net sample of

**Table 2**
Management strategy descriptions by countries.

| | Conventional Management | Timber Oriented | Nature Oriented |
|---|---|---|---|
| Austria | Rotation forestry: tree planting or natural regeneration.<br>Thinning (1–3 during a rotation).<br>Clearcutting (max. 0.5 ha according to the forest act) or selection cuttings. | Intensive rotation forestry: high thinning intensity aiming to optimise stand density for tree growth.<br>Spruce-dominated forests with highly productive coniferous trees for species mix. | Continuous cover forestry: harvests are done by selection cuttings, and trees are naturally regenerated.<br>Increased number of retention trees.<br>Not removing dead trees for the benefit of biodiversity.<br>Favouring or active reforestation of deciduous trees in the stand; aim is that at least 10% of the stand timber volume consists of 'less valued' deciduous trees. |
| Finland | Rotation forestry: soil preparation, natural regeneration by seed trees or artificial seeding or tree planting, tending of seedling stands, pre-commercial thinning, thinning (1–3 during a rotation), and clearcutting | Intensive rotation forestry: no or at maximum one thinning, regeneration/clearcutting is done earlier (at stand age 40–70 years, depending on site characteristics and region) than usual.<br>After clearcutting, soil preparation followed by tree planting.<br>Tending of saplings and pre-commercial thinning.<br>Fertilisation when applicable. | Continuous cover forestry: harvests are done by selection cuttings, and trees are naturally regenerated.<br>Increased number of retention trees and amount of dead wood left in forest.<br>Favouring deciduous trees in the stand; aim is that at least 10% of the stand timber volume consists of 'less valued' deciduous trees, such as aspen, alder, or rowan. |
| Germany | Continuous cover forestry: harvests are done by selection cuttings, trees are preferably naturally regenerated, and thinnings are applied in long regular intervals. | Continuous cover forestry: intensive management with increase in frequency of timber fellings and harvest amounts.<br>Increase of regeneration with highly productive species, including non-native species.<br>Reducing rotation periods for all tree species.<br>Reduce timber stock per hectare.<br>Maintain status quo of nature conservation. | Continuous cover forestry: active conversion, changing tree species composition towards mixed/ broadleaved species. Regeneration with tree species of the potential natural forest vegetation (increase in share of deciduous species).<br>Increase in timber stock, especially in old stands.<br>Increase in forest set-aside areas and dead wood. |
| Slovenia | Continuous cover forestry including the use of a forest management system that aims to provide all forest functions. Small-scale forest management with emphasis on natural forest regeneration. The main measures are protection and thinning of young trees, regular thinning (1–3 times during the rotation period), introduction of stands for regeneration, and final felling of trees when natural regeneration has become established in gaps. | Continuous cover forestry with the main focus on more intensive timber production, including measures as soil preparation for regeneration, natural regeneration with additional plantings or completely artificial regeneration, regular thinning of young forests and more frequent thinning at older development phases (every 10 to 15 years), protection of young trees from game browsing (fences or stables), shorter rotation period, and increased use of new technologies for felling and harvesting (harvesters, forwarders …). | Continuous cover forestry with the main focus on conservation of nature and thus on preserving biodiversity and protecting natural heritage, as well as providing ecological and social functions through adapted forest management. This includes the preservation of existing and new forest areas without logging interventions (ecocells), leaving old standing trees as habitat trees and increasing the amount of deadwood, promoting rare deciduous tree species (> 10% wood stock) and supporting bearing tree species, abandoning existing forest roads (without building new ones), expanding forest reserves, extending the rotation period, low-intensity logging and harvesting with only occasional use of chainsaws and manual or tractor harvesting. |
| Sweden | Rotation forestry: soil preparation, natural regeneration by seed trees or artificial seeding or tree planting, tending of seedling stands, pre-commercial thinning, thinning (1–3 during a rotation), and clearcutting | Intensive rotation forestry: no or at maximum one thinning, regeneration/ clearcutting is done earlier (at stand age 40–70 years, depending on site characteristics and region) than usual.<br>After clearcutting, soil preparation followed by tree planting with genetically improved plants.<br>Tending of saplings and pre-commercial thinning.<br>Fertilisation when applicable. | Continuous cover forestry: harvests are done by selection cuttings or using shelterwood system, and trees are naturally regenerated.<br>Increased number of retention trees and amount of dead wood left in forest.<br>Favouring deciduous trees in the stand; aim is that at least 10% of the stand timber volume consists of 'less valued' deciduous trees, such as aspen, alder, or rowan. |

2961. The response rate was 31.8%.

In *Germany*, the survey was set up as an online survey, using the tool LimeSurvey. It was advertised at forest owner conferences, in forest magazines, and via social media. In total, 307 respondents filled out the questionnaire.

The *Slovenian* survey was conducted by the Slovenian Forestry Institute. A printed letter with an invitation to participate in the online survey was sent out to 2000 random addresses of forest owners. Out of total sample 85 addresses were not valid. Some forest owners asked for a printed questionnaire. Since the response rate was low (7.4%) and many respondents quit the survey before entering all the responses, the online survey was supplemented by 217 personal interviews, giving a total of 359 responses.

In *Sweden*, the survey was conducted in-house at the University of Agriculture in Umeå. The Swedish Forest Agency provided addresses of a random sample of 2000 forest owners with holdings of 5 ha or larger. Some owners had sold their holding, were deceased, or did not have a correct address. These were removed, and the net sample consisted of 1921 owners. A printed questionnaire was distributed by mail, and a reminder was sent three weeks later to those who had not responded. The response rate was 34.0%.

## 2.4. Model specification

We analysed the five data sets using the Error Components MNL model for panel data (Train, 2009).[1] This model specification is well suited for our data analysis as it allows repeated choices by each sampled forest owner and correlation among the non-status quo alternatives. In this case, the utility function $U_{jit}$ for individual *i* of alternative *j* in choice situation *t* is specified as (Economic Software, Inc., 2020):

[1] In contrast to Juutinen et al. (2021), who used mixed logit model specifications in preference and willingness-to-pay spaces, we employed an error component approach to account for preference heterogeneity (Scarpa et al., 2007). The latter is not that complex and, therefore, more suitable for smaller data sets used in this study.

**Table 3**
Attributes used to describe the contract-based management schemes.

| Attributes | Levels | Variable names[b] |
|---|---|---|
| Management strategy | Nature oriented | NatureOrien |
| | Timber oriented | (reference level) |
| Profitability | Decrease 20% | ProfitDecre |
| | Current level | (reference level) |
| | Increase 20% | ProfitIncre |
| Biodiversity | Decrease | BiodivDecre |
| | Current level | (reference level) |
| | Increase | BiodivIncre |
| Carbon stock | Decrease | CarbonDecre |
| | Current level | (reference level) |
| | Increase | CarbonIncre |
| Probability of climate change-induced damage | Increase | DamageIncre |
| | Current level | (reference level) |
| | Decrease | DamageDecre |
| Additional subsidy[a] | 400, 700, 1000, 1300, 1600, 2000 (€/ha) | Subsidy |

[a] A lump sum payment for a 15-year contract.
[b] Variables were dummy coded for the analysis, except that the additional subsidy was treated as a continuous variable.

$$U_{jit} = \alpha_{jt} + \boldsymbol{\beta}' \boldsymbol{x}_{jit} + \varepsilon_{jit} + \mu_j E_{ji}, j = 1, \ldots, J_n, t = 1, \ldots, T_n$$

where $\alpha_{jt}$is the alternative-specific constant (ASC), $\boldsymbol{\beta}$ is the parameter vector (i.e., a taste or preference parameter) for attributes, $\boldsymbol{x}_{jit}$ is the vector for observed values of attributes, and $\varepsilon_{jit}$ is the individual specific random term (i.e., a panel structure). The error component $E_{nj}$ refers to alternative-specific random individual effects, whereas $\mu_j$ is the standard deviation which is made explicit by assuming $\text{Var}[E_{ji}] = 1$, the means are assumed to equal zero. In our model, the ASC was coded as 'one' for the contract-based alternatives B and C ($\alpha_j = 1$) and 'zero' for the reference alternative A ($\alpha_j = 0$). The ASC captures the influence of different confounded factors. Preference for ASC reflects preference for one of the alternatives B or C and therefore participation in the proposed contract-based management schemes (i.e., a positive coefficient indicates a tendency to select the contract-based alternatives, and a negative coefficient indicates a tendency to select the reference alternative). In addition, notice that a constant term of model captures the influence of the reference level of a dummy coded variable. Therefore, the ASC also reflects preferences for reference levels of dummy coded attributes (Table 2), particularly the timber-oriented management strategy. The error component was specified to account for substitution patterns between the contract alternatives B and C (Espinosa-Goded et al., 2010).

Assuming the type I extreme value distribution of the error term ($\varepsilon_{jit}$) leads to the following expression of the (conditional) probability to choose the alternative $j$:

$$Pr(y_{it} = \text{j}) = \frac{exp\left(\alpha_{jt} + \boldsymbol{\beta}' \boldsymbol{x}_{jit} + \mu_j E_{ji}\right)}{\sum_q exp\left(\alpha_{qt} + \boldsymbol{\beta}' \boldsymbol{x}_{qit} + \mu_q E_{ni}\right)}$$

where $y_{it}$ is the index of the choice made. In this study, preference heterogeneity was investigated by interacting individual specific characteristics with the ASC and attributes.

## 3. Results

### 3.1. Protest responses and characteristics of respondents

The pre-examination of the CE revealed that some respondents did not respond to any choice sets. In addition, some respondents always selected the reference alternative A in the choice sets. Based on a specific follow-up question (Supplement), they did not all truly consider it as the best alternative in the choice set, but many of these respondents revealed some other reasons for their choices: 'I did not find the contract-based alternatives B and C realistic', 'I do not want to make management contracts', and 'Other:__'. We interpreted that the first two other reasons were representing protest and invariant responses, which do not reflect the respondent's actual valuation of the forest management alternatives per se; therefore, we removed them from the data sets before CE analysis. The number of responses available for the CE analysis by countries is shown in Table 4. There were significant differences in the number of responses across the countries. In the data sets used in the analysis, the number of respondents who always selected the reference alternative varied between 6.2% (Germany) and 29.6% (Sweden).

**Table 4**
Number of responses by countries.

| | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| All responses (not accounting for item-non-responses for choice sets) | 300 | 942 | 307 | 359 | 644 |
| Responses to choice sets (accounting for item-non-responses for choice sets) | 300 | 893 | 223 | 269 | 605 |
| Responses to choice sets excluding protest and invariant responses | 241 | 715 | 179 | 192 | 494 |

The characteristics of respondents by countries, including the variables that were used to investigate preference heterogeneity in the analysis, are presented in Table 5. Recall that the sampling and data collection method varied between the countries. Therefore, the respondents represent themselves and are not assumed to represent all forest owners in the five countries. Their preferences for the considered contract-based forest management schemes, however, provide essential insight into the current and possible future behaviour of private forest owners in Europe and the potential to steer those forests in the direction set by the New EU Forest Strategy. Regarding representativeness, large holdings and male forest owners were over-represented in our data sets (cf. Tables 1 and 5).

### 3.2. Choice analysis

We found that profit increase (ProfitIncre), biodiversity increase (BiodivIncre), carbon stock increase (CarbonIncre), decrease of climate change-induced damage (DamageDecre), and additional subsidies (Subsidy) improve the utility of forest owners (Table 6).[2] The 'counterparts' of these variables — ProfitDecre, BiodivDecre, CarbonDecre,

[2] Another way of interpretation is that those variables in Table 5 with negative coefficients decrease and those with positive coefficients increase the probability of accepting the proposed contract.

**Table 5**
Characteristics of forest owner respondents by countries (means).

| | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| *Socio-economic variables* | | | | | |
| Male (proportion) | 0.85 | 0.77 | 0.89 | 0.71 | 0.78 |
| Age (years) | 49.8 | 63.5 | 49.1 | 52.6 | 64.5 |
| University education (proportion) | 0.13 | 0.32 | 0.47 | 0.38 | 0.41 |
| *Forest holding related variables* | | | | | |
| Duration of forest ownership (years) | 21.5 | 27.1 | 17.7 | 17.7 | 27.6 |
| Time spent on management (days) | 34.4 | 24.4 | 32.0 | 21.1 | 33.1 |
| Size of holding (ha) | 29.1 | 56.5 | 43.2 | 14.4 | 95.0 |
| Forest certification (proportion) | 0.41 | 0.55 | 0.43 | 0.13 | 0.38 |

**Table 6**
Estimation results by countries (coefficients, standard errors in parentheses).

| | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| ASC[a] | −0.33490 (0.29923) | −1.99447*** (0.18492) | 0.95325*** (0.32653) | −0.26807 (0.33376) | −0.88174*** (0.22833) |
| NatureOrien | 0.41088** (0.17196) | 0.97481*** (0.11352) | 0.62906*** (0.21764) | 0.47872** (0.18722) | 0.36126*** (0.12499) |
| ProfitDecre | −0.21381* (0.12823) | −0.60431*** (0.08186) | −0.34196*** (0.12412) | −0.07732 (0.12036) | −0.65842*** (0.08313) |
| ProfitIncre | 0.19974* (0.11961) | 0.61100*** (0.07390) | 0.30119** (0.13134) | 0.25754** (0.12579) | 0.42813*** (0.08981) |
| BiodivDecre | −0.12721 (0.13292) | −0.60166*** (0.09892) | −0.63022*** (0.15213) | −0.33940** (0.15507) | −0.19206* (0.09971) |
| BiodivIncre | 0.29796*** (0.10955) | 0.40018*** (0.07019) | 0.43692*** (0.13758) | 0.23184* (0.12780) | 0.30673*** (0.07973) |
| CarbonDecre | −0.23125* (0.11907) | −0.55806*** (0.08953) | −0.08905 (0.12733) | −0.18711 (0.15149) | −0.355575*** (0.09408) |
| CarbonIncre | 0.34614*** (0.10964) | 0.23737*** (0.07444) | 0.30493*** (0.11737) | −0.02575 (0.14044) | 0.26811*** (0.07755) |
| DamageIncre | −0.20723** (0.10315) | −0.61219*** (0.06790) | −0.42127*** (0.11519) | −0.39924*** (0.10803) | −0.53434*** (0.07862) |
| DamageDecre | 0.03014 (0.10108) | 0.18120*** (0.06749) | 0.20800* (0.10852) | 0.08319 (0.11306) | 0.13477* (0.07862) |
| Subsidy | 0.46079*** (0.06648) | 0.48079*** (0.04923) | 0.52403*** (0.09091) | 0.29592*** (0.07790) | 0.24849*** (0.05209) |
| Sigma[b] | 3.53898*** (0.33236) | 3.59630*** (0.19203) | 2.51895*** (0.29113) | 3.08004*** (0.3166) | 3.89432*** (0.26831) |
| Log likelihood | −1588.59 | −3048.50 | −889.28 | −980.97 | −2213.87 |
| Pseudo $R^2$ | 0.23 | 0.34 | 0.22 | 0.21 | 0.30 |
| AIC | 2461.6 | 6121.0 | 1802.6 | 1986.0 | 4451.7 |
| No of choices | 1446 | 4180 | 1039 | 1127 | 2863 |
| No of groups | 241 | 715 | 182 | 192 | 494 |

Notes: Variables with positive coefficients are interpreted as improving utility or welfare, while negative coefficients are interpreted to impair utility of forest owners. [a] Coded as one for the contract alternatives B and C and zero for the no-contract alternative A. [b] Mean coefficient and standard error for standard deviations of latent random effects (i.e., error components). *, **, and *** significant at 10%, 5%, and 1% levels, respectively.

and DamageIncre — were negative and therefore impair utility. Regarding these variables, the estimation results were qualitatively quite similar between countries. The exception was Slovenia, where the sign of the coefficient for carbon stock increase (CarbonIncre) was negative, but the coefficient was not statistically significant.

Recall the ASC was coded to equal 'one' for the contract alternatives (B, C) and 'zero' for the reference no-contract alternative (A). Hence, the negative coefficients for ASC in all countries, except Germany, indicate that in these countries the no-contract alternative with the conventional management is preferred over the contract-based management schemes. The negative coefficients for ASC may also indicate a possible dislike for the timber-oriented (TimberOrien) strategy. The nature-oriented (NatureOrien) strategy was preferred (positive coefficients) relative to the timber-oriented strategy, which was the omitted level for the dummy coded forest management strategy attribute. Importantly, the error component specification (sigma) is also significantly different from zero, indicating heterogeneity across respondents in preferences for the contract alternatives B and C compared with the reference alternative A.

### 3.3. Marginal willingness to accept (WTA) the scheme

The average marginal WTAs of attribute levels with standard errors by countries are shown in Fig. 2.[3] For example, Swedish forest owners were asking on average 2885 €/ha compensation for entering the payment scheme (ASC) instead of continuing current forest management without a forest management contract. Their claim for compensation was 1182 €/ha lower when the contract involved the nature-oriented (NatureOrien) instead of the timber-oriented (TimberOrien) management strategy. The other results shown in Fig. 2 can be interpreted accordingly.

The absolute values of marginal WTAs were overall the highest in Sweden and the lowest in Austria. In Finland and Sweden, the WTA for ASC was relatively high, meaning that forest owners asked for an average high compensation to accept a 15-year contact in which they had to apply the timber-oriented strategy (profitability, biodiversity, carbon stock, and probability of climate change-induced damage remain at the current level). In Germany, forest owners did not ask for any compensation for the contract (with other conditions remaining at the current level) as the WTAs for ASC and the nature-oriented strategy were both negative. In the other Central European countries, the compensation claim for the contract was relatively low and not significant. The WTA for the nature-oriented strategy was negative in all countries. Hence, in a situation with unchanged profitability, the forest owners were asking for lower compensations for a contract of the nature-oriented strategy in contrast to a contact of the timber-oriented strategy.

There were statistically significant differences between countries in these results. According to the Poe test (Poe et al., 2005), Finland had significantly higher WTA for the ASC than the other countries, excluding Sweden (at 10% level or less). Sweden had higher WTA for the ASC than the other countries, excluding Finland and Slovenia. Germany had lower WTA for the ASC than the other countries. Austria had significantly different WTA for the ASC than all the other countries. The differences in WTA for the nature-oriented strategy between the countries were not significant, expect that Austria had a significantly different value than

[3] The marginal WTA values were calculated using the estimation results shown in Table 5. The mean values and standard errors were calculated by the WALD command, which applies the Krinsky and Robb method in NLOGIT 6 (Economic Software, Inc., 2020).

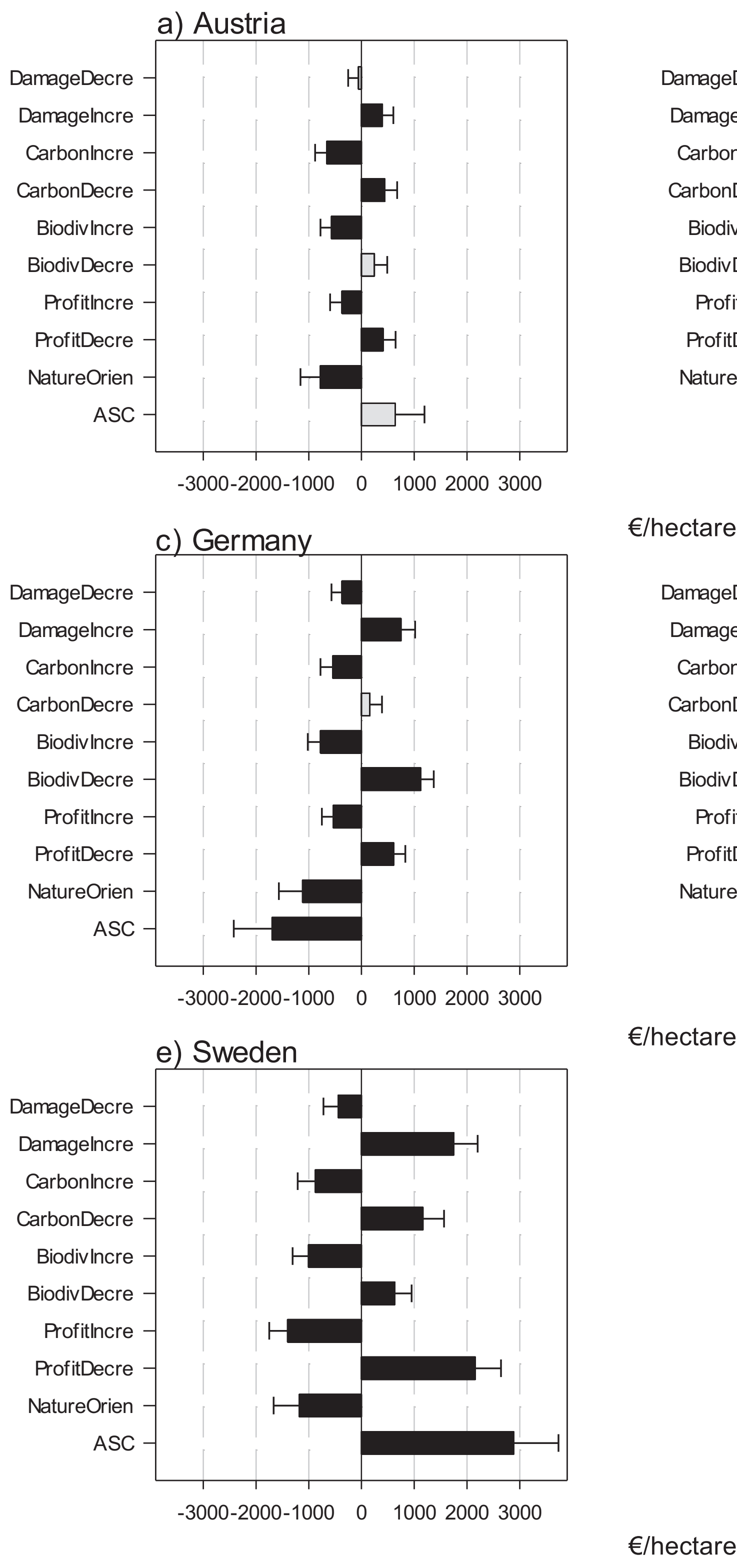


**Fig. 2.** Marginal willingness-to-accept (WTA) values by countries (purchasing power parity adjusted). A positive WTA indicates compensation claim; a negative WTA can be interpreted as willingness to pay a certain amount. The bars show mean values with standard errors. WTAs that are not statistically significant at the 10% level are denoted by bars with light grey.

Finland.

The WTAs for profitability varied between the countries. In Sweden, the profit decrease (ProfitDecre) had the highest (positive) WTA. Hence, profitability was relatively the most important attribute. Interestingly, the absolute value of WTA for profit decrease was clearly larger than the WTA for profit increase (ProfitIncre) in Sweden. In the other countries, the WTAs for profit decrease and increase were rather similar. Finland and Sweden had significantly different WTA for the profit decrease than the other countries. Additionally, Sweden had a different value than Finland. Regarding the profit increase, Austria and Germany had significantly different values than Finland and Sweden.

There were also differences in the WTAs for other attributes between the countries, but the pattern of differences was not that clear. The increase of probability of climate change-induced damage (DamageIncre) had a relatively high value of WTA in Sweden, Slovenia, and Finland. In Austria, the carbon stock was regarded as the most important attribute. In Sweden, decrease of carbon stock (CarbonDecre) had the second highest value. In contrast, decrease of biodiversity (BiodivDecre) was considered as the second most important in Finland, Germany, and Slovenia. The results showed that the deterioration of the environment (BiodivDecre, etc.) had a higher WTA (in absolute value) than the improvement in many countries. Regarding the improvement of environment quality, the increase of biodiversity (BiodivIncre) was typically considered as the relatively most important aspect of forest management.

Considering the biodiversity increase and the decrease of probability of climate change-induced damage, the differences in WTA between the countries were not significant. Austria had significantly different WTA for the biodiversity decrease than Finland, Germany, and Slovenia. Austria and Germany had different WTA for the carbon stock decrease than Finland and Sweden. Regarding the carbon stock increase, Sweden had significantly different WTA than Finland and Slovenia. Austria had different WTA for the increase of probability of climate change-induced damages than the other countries, excluding Germany, and Sweden had different values than Finland and Germany.

### 3.4. Individually specific factors explaining forest owners' preferences

We examined how individually specific variables were associated with respondents' preferences. The variables studied were divided into two groups: the socioeconomic characteristics of the forest owners (gender [MALE], age [AGE], university education [UNIV]), and the forest holding-related variables (duration of ownership [DURA], self-activity [WORK], size of holding [HA], forest certification [CERT]).[4] Each variable group was analysed separately. We created and tested all interaction terms between the explanatory variables and the attribute variables but only included significant interaction terms in the final models (Tables 7 and 8).

The results did not show a uniform pattern since significant factors differed between countries. However, similarities were also found between the countries. Regarding the socio-economic variables (Table 7), older respondents were less likely to choose a contract alternative compared with other respondents (Austria, Finland, and Sweden), as the coefficient of the interaction term between ASC and age was negative. In contrast, respondents with a university education were more likely to choose a contract alternative (Austria, Finland, and Slovenia). In Germany, the influence of university education on the ASC, however, was the opposite.

Regarding variables related to forest holding (Table 8), respondents who had owned their forest holding for a longer time (DURA) were less willing to choose a contract alternative (Finland, Slovenia, Sweden) and gave less weight to an additional subsidy (Finland, Germany, Slovenia). In addition, forest owners who own a larger forest area (HA) were more negative about the decrease of profit (Austria, Finland, Sweden) than were other forest owners.

## 4. Discussion

### 4.1. Overview of forest owners' preferences for contract-based management

The majority of respondents selected a contract-based alternative at least once. They were willing to participate in the proposed payment schemes if the subsidy was high enough and other attributes at acceptable levels. There was, however, a tendency to select the reference alternative, which represented the current management strategy without any contract but also captured the influence of timber-oriented management strategy. The tendency to select the current management was expected because the forest management contract limits the decision-making of forest owners. In general, respondents prefer the current situation and do not want to change, as has been observed in previous studies on the status quo bias in CEs (Meyerhoff and Liebe, 2008).

Interestingly, there was no tendency to select the reference alternative in Germany. There are many possible explanations for this finding, but this may be because the considered forest management strategies were not the same in content but varied from country to country (Table 1). In Germany, all three management strategies were variants of continuous cover forestry, which is the required legal standard and hence relatively similar, which made it easier to change from conventional to timber-oriented or nature-oriented strategy. In addition, Feil et al. (2018) found that in Germany only about 8% of forest owners used their forest for income generation, and most forest owners supported and planned an increase in nature protection measures even if timber utilisation or recreation functions would decrease in return, whereas only 10–15% preferred to maintain the status quo forestry. In the past, nature protection measures in Germany have been implemented voluntarily in (mostly) public forests or by regulatory instruments in all forest ownership types. Therefore, forest owners might be dismissive of regulatory approaches and have a favourable attitude towards contract-based management (Seintsch et al., 2018). Moreover, since 2018 forest owners in Germany have experienced unprecedented disturbances in their forests, which were widely perceived and discussed in media and throughout the society. Thus, the respondents may have considered the current way of managing their forests too risky, preferring alternative contract-based forest management strategies to the current management strategy.

However, when comparing the results between the countries, it should be borne in mind that the studied samples were not representative. In addition, forest owners had different preferences for the contract alternatives within countries. For example, highly educated and older forest owners preferred the contract alternatives differently than others, as will be discussed later. In Germany, the sample included a relatively high proportion of highly educated respondents, and the average age of respondents was lower than in other countries, which contributes to explaining their higher willingness to change management strategy.

The general pattern of forest owners' preferences for the considered attributes was similar in all countries. Forest owners preferred the nature-oriented strategy to the timber-oriented strategy, and they liked the improvements of profitability and environmental attributes and disliked deterioration of these attributes. These results are consistent with the findings of previous studies showing that forest owners increasingly rely on a wide range of ecosystem services, not just timber, to manage their forests (Urquhart and Courtney, 2011; Häyrinen et al., 2017; Ficko et al., 2019).

### 4.2. Forest owners' compensation requirements

There were clear differences between countries in terms of WTAs. The Nordic countries Finland and Sweden had higher WTAs (in absolute values) than the three central European countries. In particular, the forest owners were asking for a high compensation for accepting a 15-year contract in the Nordic countries.[5] This outcome may reflect the

[4] The variables were selected based on findings of previous studies (see, e.g., Juutinen et al., 2020 and references therein).

[5] Juutinen et al. (2021) showed that the compensation requirement of the Finnish forest owners is at the same level as the actual payments paid in the ongoing Finnish conservation programme for a 10-year contract.

**Table 7**
Gender (MALE), age (AGE), and university education (UNIV) as explanatory variables by countries (coefficients, standard errors in parentheses).

| Interactions | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| ASC*AGE | −0.04806* (0.02511) | −0.05378*** (0.01480) | – | – | −0.07374*** (0.01874) |
| ASC*UNIV | 1.40649* (0.74979) | 1.05678*** (0.35402) | −0.91891* (0.54680) | 1.10948* (0.64449) | – |
| NatureOrien*MALE | – | −0.60440*** (0.17636) | – | – | – |
| NatureOrien*AGE | – | – | – | −0.02137*** (0.00794) | – |
| NatureOrien*UNIV | – | – | – | – | 1.14677*** (0.18717) |
| ProfitDecre*AGE | – | – | – | – | 0.01537** (0.00696) |
| ProfitDecre*UNIV | – | – | −0.42281* (0.22782) | – | −0.44167** (0.14813) |
| ProfitIncre*MALE | – | – | – | 0.51625** (0.21649) | 0.40279** (0.15969) |
| ProfitIncre*AGE | – | −0.02459*** (0.00511) | – | – | – |
| ProfitIncre*UNIV | | – | – | 0.41227* (0.21366) | – |
| BiodivDecre*MALE | – | 0.58754** (0.22866) | – | – | – |
| BiodivIncre*AGE | – | 0.34805*** (0.12329) | – | – | – |
| BiodivIncre*UNIV | – | – | 0.37139* (0.22600) | 0.63462*** (0.22305) | – |
| CarbonIncre*MALE | – | – | – | – | −0.33634* (0.17754) |
| CarbonIncre*AGE | – | 0.00897* (0.00538) | 0.01722** (0.00680) | – | – |
| CarbonIncre*UNIV | – | 0.34448*** (0.12910) | – | – | – |
| DamageIncre*AGE | – | 0.01170* (0.00529) | – | – | – |
| DamageDecre*MALE | – | −0.64787*** (0.15572) | – | – | – |
| DamageDecre*UNIV | – | – | 0.36336** (0.17594) | – | – |
| Subsidy*MALE | – | 0.24301** (0.10426) | – | – | – |
| Subsidy*AGE | – | −0.01195*** (0.00421) | – | – | – |
| Subsidy*UNIV | – | – | 0.44703*** (0.17016) | 0.32496** (0.15691) | – |

Notes: Includes only estimation results of the interaction terms. Full estimation results are shown in Table A1 in the appendix. *, **, and *** significant at the 10%, 5%, and 1% levels, respectively. Mark '-' denotes a non-significant interaction term that was not included in the final model.

**Table 8**
Duration of ownership (DURA), self-activity (WORK), size of holding (HA), and forest certification (CERT) as explanatory variables by countries (coefficients, standard errors in parentheses).

| Interactions | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| ASC*DURA | – | −0.02180** (0.01108) | – | −0.04878* (0.02557) | −0.02519* (0.01362) |
| ASC*WORK | – | −0.00784* (0.00427) | – | – | −0.01159* (0.00666) |
| ASC*CERT | – | – | – | – | 1.13034** (0.48938) |
| NatureOrien*DURA | – | – | – | – | −0.01910*** (0.00585) |
| NatureOrien*WORK | – | – | – | – | −0.01185*** (0.00236) |
| NatureOrien*HA | – | −0.00176*** (0.00039) | – | – | – |
| ProfitDecre*HA | −0.00495** (0.00222) | −0.00357*** (0.00077) | – | – | −0.00167*** (0.00051) |
| ProfitIncre*DURA | – | −0.01168*** (0.00406) | – | – | – |
| ProfitIncre*WORK | – | – | – | – | 0.0490* (0.00285) |
| ProfitIncre*CERT | – | 0.41953*** (0.14203) | – | – | – |
| BiodivDecre*CERT | – | 0.38487** (0.17161) | – | – | – |
| BiodvIncre*WORK | −0.00931*** (0.00309) | – | −0.00762** (0.00368) | – | – |
| BiodivIncre*CERT | – | – | – | 0.95383*** (0.32488) | −0.3249** (0.14266) |
| DamageIncre*DURA | – | – | 0.01939*** (0.00639) | 0.01260** (0.00588) | – |
| Subsidy*DURA | – | −0.00747** (0.0323) | −0.01136** (0.00453) | −0.01260** (0.00588) | – |
| Subsidy*WORK | – | – | – | – | 0.00530** (0.00208) |
| Subsidy*CERT | 0.32311*** (0.12037) | 0.23322*** (0.09776) | – | – | −0.27255 (0.10448) |

Notes: Includes only estimation results of the interaction terms. Full estimation results are shown in Table A2 in the appendix. *, **, and *** significant at the 10%, 5%, and 1% levels, respectively. Mark '-' denotes a non-significant interaction term that was not included in the final model.

fact that conventional rotational forestry has a long tradition in the Nordic countries, and therefore some forest owners may not be willing to adopt new management strategies with any subsidy. In contrast, forests are mainly multifunctionally managed in the central European tradition (e.g., Borrass et al., 2017), and forest owners may not be so strongly committed to the conventional management strategy. Another explanation could be the already experienced forest disturbances in Central Europe (Nagel et al., 2017; Schuldt et al., 2020), which hit owners in Slovenia, Germany, and Austria harder than owners in Nordic countries. The immediate experience of extreme forest loss and the connected turmoil at national timber markets may have initiated a rethinking of conventional management strategies (Seidl et al., 2016; Mostegl et al., 2019).

The marginal WTA values of the attributes reflect their relative importance to forest owners. Interestingly, Swedish forest owners asked for a higher compensation claim to accept a decrease of profitability than for a decrease of biodiversity and carbon stock and for an increase of probability of climate change-induced damages, whereas in Finland the compensation claims of these attributes were at the same level. Finnish forest owners therefore seem to be more concerned about the potential deterioration of the environment than Swedish forest owners. Finland has had a payment scheme in place for a long time, where forest owners can receive compensation for the temporary protection of forests (Juutinen et al., 2008), which may have raised forest owners' awareness of environmental issues.

There are also differences among the Central European countries. Carbon stocks had the highest importance in Austria, while they were less important in Germany and not even significant in Slovenia. In Germany, biodiversity had the highest importance, while in Slovenia the increase of the probability of climate change-induced damages was of highest concern. We assume that such differences reflect ongoing societal debates among national forest communities, which have a slightly different focus. For example, the role of forests and wood products has been widely discussed among Austrian foresters and the wider Austrian community (i.e., Braun et al., 2016; Jandl et al., 2018), while the German forest community was more involved in biodiversity research, as shown within a recent review (Oettel and Lapin, 2021) where the highest number of studies on biodiversity and forest management originated from Germany. Slovenian forest owners, on the other hand, have had the worst forest damages in recent years by events that are connected to climate change (sleet, windthrow, drought, and bark beetle infestations) (Seidl et al., 2017; de Groot et al., 2018).

### 4.3. Factors explaining preferences

The explanatory variable analysis showed that many factors were significant in explaining respondents' preferences, as has been observed previously in studies on forest owners' management decisions (Kline et al., 2000; Matta et al., 2009; Khanal et al., 2017). The factors explaining preferences were typically country-specific, but several similarities were also found across the countries. Generally, older forest owners were less willing and highly educated forest owners were more willing to participate in the proposed payment scheme in many countries. Previous studies have similarly shown that young forest owners are more willing to use new forest management strategies (Juutinen et al., 2020), older forest owners are less active in forest harvesting (Joshi and Mehmood, 2011; Aquilar et al., 2017), and high education of forest owners may be negatively correlated with timber harvesting (Joshi and Mehmood, 2011) and use of intensive forest management strategies (Juutinen et al., 2020).

Previous studies have shown that forest owners' past experiences of forest management practices influence their management decisions: forest owners tend to use the same management practices in the future that they have used in the past (Aquilar et al., 2017; Juutinen et al., 2020; Husa and Kosenius, 2021). Similarly, we found that respondents who have owned their forest holding for a longer time were less willing to participate in the proposed payment schemes. In addition, we found that forest owners who own a larger forest area were particularly negative about a potential decrease of profit, probably because their forest profits are significant to their overall income, while forest profits may not have an important economic function for small-scale forest owners (Mostegl et al., 2019). However, according to Quiroga et al. (2019), forest owners' affinity to subsides is not associated to the size of forest holding and has more to do with the time allocated to forest activities.

### 4.4. Challenges related to multi-country comparison and survey strategies

To our knowledge, the present analysis is one of the first studies which assesses the preferences of small-scale forest owners among countries using a common CE. Challenges for such a country comparison lie in different forest ecosystems and management activities, as well as different forest owner structures and the accessibility of forest owner registers and data. To overcome the differed understanding of management strategies in relation to forest ecosystems and management traditions, the management strategies were named according to their common management objectives, i.e. timber-oriented, nature-oriented or conventional. In each country, however, the strategies were described using country-specific management activities in order to enable participants to compare their own activities with the given alternatives. Thus, although the management activities of the same strategy cannot be fully compared across countries, forest owners should be able to indicate their preferences relative to the typical country-specific management.

The attributes and their levels should be described in CE as accurately as possible so that the respondents understand them in the same way (Johnston, 2022). We however decided to use qualitative CE attribute levels "decreasing" and "increasing" relative to current level, which means that the interpretation of absolute WTA values must be done with caution. The reason for choosing qualitative attribute levels was that they could be applied and understood in the different countries. Nevertheless, respondents may have perceived the changes in attributes differently, which in turn may have increased the preference heterogeneity among respondents (see also Juutinen et al., 2021). Also, if the respondents were uncertain about the change in attribute levels, they may have ended up choosing the current situation as there was no "I don't know" alternative in the choice sets. In fact, we also tested quantitative attribute level descriptions, but the non-precise descriptions were easier to understand by the focus group members (Juutinen et al., 2021).

The survey strategies had to be adapted to the conditions of each country and hence it was not possible to ensure that the collected data was always representative. Also, we could not fully evaluate the representativeness of our data as there was no census data available on forest owners for each country. We found, however, that large holdings and male forest owners were overrepresented in our case as has been found also in previous studies (Danley, 2018; Koivula and Sivonen, 2022). Based on previous studies (Chetri et al., 2018; Koivula and Sivonen, 2022), it is also likely that highly educated were overrepresented. The different survey strategies might also have affected country-specific compensations and factors relationships: for example, the lower age and higher education among German respondents could be caused by the entirely online census.

## 5. Conclusions

Our results suggest that many forest owners would be willing to participate in a payment scheme targeted to promote environmental goals, but a scheme purely targeted to promote wood mobilization may be less attractive. There are differences in the forest owners' preferences for the contract-based management and associated impacts both within and between countries, but there are also commonalities. To some extent, the preference heterogeneity is associated with the same individual-specific factors in the studied countries. In particular, the preferences are similar in terms of environmental goals in the sense that forest owners like improvements in biodiversity and carbon stock and dislike deterioration of these attributes in each studied country.

In the light of forest owners' preferences, it appears that a European forest subsidy system clearly promoting the provision of environmental goals (i.e., public goods) would be acceptable in the future. However, it is challenging to develop a common system that is flexible enough to be applied in different European countries where forest practices and strategies as well as current subsidy systems differ (Feliciano et al., 2017; Mason et al., 2021). It seems anyway that the Central European forest owners would be willing to participate in a new payment scheme with a lower compensation than forest owners of Nordic countries. Climate change-related forest disturbances have been significant in Central Europe, which is probably why forest owners there are more willing to change their forest management strategies. Importantly, however, some forest owners are currently not willing to change their management strategies, and therefore education and communication campaigns may be necessary along with new payment schemes to engage European forest owners in active forest management to promote the provision of environmental goals in their forests (Wilkes-Allemann et al., 2021).

## CRediT authorship contribution statement

**Artti Juutinen:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Elena Haeler:** Writing – original draft, Data curation, Writing – review & editing. **Robert Jandl:** Conceptualization, Data curation, Writing – original draft. **Katharina Kuhlmey:** Conceptualization, Data curation, Writing – original draft. **Mikko Kurttila:** Conceptualization, Data curation, Writing – original draft. **Raisa Mäkipää:** Conceptualization, Writing – original draft. **Tähti Pohjanmies:** Writing – original draft. **Lydia Rosenkranz:** Writing – original draft. **Mitja Skudnik:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing. **Matevž Triplat:** Conceptualization, Data curation, Writing – original draft. **Anne Tolvanen:** Conceptualization, Writing – original draft, Writing – review & editing. **Urša Vilhar:** Conceptualization, Writing – original draft, Writing – review & editing. **Kerstin Westin:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing. **Silvio Schueler:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision.

## 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.

## Data availability

The authors do not have permission to share data.

## Acknowledgements

This study (ValoFOR project) was supported under the umbrella of ERA-NET ForestValue by the Federal Ministry for Sustainability and Tourism, Austria (BMNT); the Ministry of Agriculture and Forestry Finland (MMM); theAcademy of Finland (AKA, project no. 326375); the Innovation Funding Agency Business Finland (Business Finland); the Ministry of the Environment in Finland (YM); the Federal Ministry of Food and Agriculture, Germany (BMEL); the German Agency for Renewable Resources (FNR); the German Federal Office for Agriculture and Food (BLE); the Ministry of Education, Science and Sport, Slovenia (MISZ); the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS); the Swedish Energy Agency (SWEA); the Swedish Governmental Agency for Innovation Systems (Vinnova); and the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773324.

## Appendix A. Appendix

**Table A1**
Gender (MALE), age (AGE), and university education (UNIV) as explanatory variables by countries (coefficients, standard errors in parentheses): full estimation results excluding interactions.

| | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| ASC[a] | 1.85749 (1.31674) | 1.11341 (0.97951) | 1.40017*** (0.44317) | −0.55918 (0.37744) | 3.75135*** (1.26124) |
| NatureOrien | 0.4133** (0.17193) | 1.47648*** (0.17942) | 0.67990*** (0.23087) | 1.70994*** (0.44575) | −0.06008 (0.17149) |
| ProfitDecre | −0.20481 (0.12894) | −0.59206*** (0.08511) | −0.19527 (0.15216) | −0.12745 (0.12709) | −1.44724*** (0.46564) |
| ProfitIncre | 0.20513* (0.11994) | 2.17846*** (0.32536) | 0.31630** (0.14301) | −0.35370 (0.24172) | 0.10747 (0.15615) |
| BiodivDecre | −0.13488 (0.13342) | −1.11929*** (0.27569) | −0.65578*** (0.15830) | −0.33212** (0.16319) | −0.29490*** (0.11227) |
| BiodivIncre | 0.30169*** (0.10980) | 0.27563*** (0.08562) | 0.28497* (0.17118) | −0.10724 (0.17344) | 0.34362*** (0.09054) |
| CarbonDecre | −0.23756** (0.11955) | −0.59900*** (0.09320) | −0.08996 (0.13206) | −0.17761 (0.15661) | −0.37771*** (0.10686) |
| CarbonIncre | 0.34425*** (0.10978) | −0.45755 (0.34960) | −0.52677 (0.35820) | −0.09936 (0.15279) | 0.56291*** (0.15419) |
| DamageIncre | −0.21333** (0.10335) | −1.37688*** (0.33842) | −0.47114*** (0.11791) | −0.44870*** (0.12063) | −0.64929*** (0.08495) |
| DamageDecre | 0.02782 (0.10239) | 0.67598*** (0.14335) | −0.04669 (0.13778) | 0.07978 (0.11997) | 0.12909 (0.09245) |
| Subsidy | 0.46252** (0.06658) | 1.07042*** (0.28294) | 0.333678*** (0.11620) | 0.14702 (0.09463) | 0.30203*** (0.06266) |
| Sigma[b] | 3.44916*** (0.32399) | 3.40810*** (0.18248) | 2.62737*** (0.30100) | 2.84461*** (0.32194) | 3.76948*** (0.28969) |
| Interactions: see Table 7 | | | | | |
| Log likelihood | −1209.12 | −2820.77 | −816.05 | −913.38 | −1795.99 |
| Pseudo $R^2$ | 0.24 | 0.35 | 0.24 | 0.22 | 0.32 |
| AIC | 2446.2 | 5689.5 | 1668.1 | 1862.8 | 3628.0 |
| No of choices | 1446 | 4180 | 1029 | 1127 | 2863 |
| No of groups | 241 | 715 | 179 | 192 | 494 |

Notes: Variables with positive coefficients are interpreted as improving utility or welfare, while negative coefficients are interpreted to impair utility of forest owners. [a] Coded as one for the contract alternatives B and C and zero for the no-contract alternative A. [b] Mean coefficient and standard error for standard deviations of latent random effects (i.e., error components). *, **, and *** significant at 10%, 5%, and 1% levels, respectively.

**Table A2**
Duration of ownership (DURA), self-activity (WORK), size of holding (HA), and forest certification (CERT) as explanatory variables by countries (coefficients, standard errors in parentheses) full estimation results excluding interactions.

| | Austria | Finland | Germany | Slovenia | Sweden |
|---|---|---|---|---|---|
| ASC[a] | −0.34745 (0.30976) | −1.03868*** (0.35669) | 0.81987** (0.34559) | 0.56665 (0.55673) | −0.19659 (0.46630) |
| NatureOrien | 0.42951** (0.17487) | 1.07659*** (0.12186) | 1.07178*** (0.28266) | 0.48822*** (0.18770) | 1.25197*** (0.21991) |
| ProfitDecre | −0.06737 (0.15182) | −0.45086*** (0.09855) | −0.37437** (0.13182) | −0.07859 (0.12665) | −0.55734*** (0.10239) |
| ProfitIncre | 0.19114 (0.12251) | 0.65444*** (0.14368) | 0.31037** (0.13182) | 0.25025** (0.12665) | 0.30241** (0.12378) |
| BiodivDecre | −0.12049 (0.13506) | −0.85355*** (0.15794) | −0.66253*** (0.16097) | −0.34082** (0.15861) | −0.20759* (0.10242) |
| BiodivIncre | 0.55180*** (0.15552) | 0.42264*** (0.07415) | 0.69478*** (0.18049) | 0.11266 (0.13466) | 0.43239*** (0.09854) |
| CarbonDecre | −0.22682* (0.12265) | −0.60640*** (0.09572) | −0.07404 (0.13693) | −0.19333 (0.15476) | −0.39479*** (0.09854) |
| CarbonIncre | 0.37627*** (0.11115) | 0.23056*** (0.08009) | 0.32282*** (0.12464) | −0.05252 (0.14516) | 0.30489*** (0.08273) |
| DamageIncre | −0.21045** (0.10416) | −0.67185*** (0.07292) | −0.79954*** (0.16205) | −0.69562*** (0.17495) | −0.60035*** (0.07899) |
| DamageDecre | 0.04121 (0.10384) | 0.20010*** (0.07235) | 0.20279* (0.11399) | −0.09106* (0.411311) | 0.13107 (0.08688) |
| Subsidy | 0.33829*** (0.08949) | 0.53234*** (0.10187) | 0.75522*** (0.14571) | 0.50445*** (0.13071) | 0.24623*** (0.08299) |
| Sigma[b] | 3.63041*** (0.34868) | 3.43154*** (0.19054) | 2.50616*** (0.27622) | 2.98352*** (0.31152) | 3.80736*** (0.28012) |
| Interactions: see Table 8 | | | | | |
| Log likelihood | −1194.07 | −2710.10 | −811.58 | −959.66 | −1925.05 |
| Pseudo $R^2$ | 0.24 | 0.33 | 0.23 | 0.21 | 0.30 |
| AIC | 2418.1 | 5462.2 | 1655.2 | 1951.3 | 3894.1 |
| No of choices | 1446 | 4180 | 1029 | 1127 | 2863 |
| No of groups | 241 | 715 | 179 | 192 | 494 |

Notes: Variables with positive coefficients are interpreted as improving utility or welfare, while negative coefficients are interpreted to impair utility of forest owners. [a] Coded as one for the contract alternatives B and C and zero for the no-contract alternative A. [b] Mean coefficient and standard error for standard deviations of latent random effects (i.e., error components). *, **, and *** significant at 10%, 5%, and 1% levels, respectively.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2022.102839.

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