



The role of personal values and personality traits in environmental concern of non-industrial private forest owners in Sweden

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ABSTRACT

Environmental benefits have become priority objectives for the management of forests, including for private forest owners in many countries. Understanding and promoting environmental-friendly private forest management requires a measure of environmental concern of forest owners and knowledge of factors that influence it. Such a measure allows to explore underlying motivations of forest owners to include environmental aspects in their forest management. This in turn helps in developing and implementing effective pro-environmental forestry policies. In this paper, we assess environmental concern in forest management of 226 non-industrial private forest (NIPF) owners in Sweden. In particular, we sought to achieve a two-fold objective: a) to quantitatively explore the content and dimensionality of the environmental concern construct of forestry owners and b) to identify the association between environmental concern of forest owners and their personal values and personality traits. A principal factor analysis resulted in a two-dimensional environmental concern construct encompassing: environmental strategy and environmental orientation. Hierarchical seemingly unrelated regressions (SUREG) showed that personal values and personality traits help to explain environmental concern in forest management of NIPF owners. A better understanding of environmental concern of forest owners and its relation with individuals' attributes will help in better designing, framing and targeting of tailor-made interventions to promote environmental considerations in forest management.

1. Introduction

Developing a green economy is high on the agenda of the European Union, reflecting the urgency felt to respond to the environmental challenges such as air and water pollution, soil erosion, climate change and increasing pressure on natural resources we currently face. Forest ecosystems and the forest sector can contribute significantly to greening the economy. As the Rovaniemi Action Plan for the Forest Sector in a Green Economy (RAP), adopted in 2013, already stated, “forests are already delivering renewable, environmentally friendly products and vital services to society, and there is great potential for even more” (UNECE/FAO, 2014). With the recent European Green Deal proposal, aiming at carbon neutrality and a healthy environment in the EU by 2050 (European Commission, 2019), the importance of the forest sector in this process is underlined again, as forests and the forest sector “are well positioned to play a strong role in reaching the objectives of the European Green Deal”

(CEPF, 2019). During the past decades, the environmental perspective had already become an integral part of the debate on forests, e.g. forests as important carbon sinks and for biodiversity conservation (Nordlund and Westin, 2011; Wolfslehner et al., 2020). However, in this Green Deal environmental considerations in forest management is considered to be more important than ever before. Hetemäki (2020), for example, observes that with the Green Deal the focus has shifted to protection and restoration of biodiversity and the improvement of carbon storage in forest ecosystems as priority objectives for the management of forests.

The provision of these environmental benefits in the EU is to a large extent in the hands of non-industrial private forest (NIPF) owners (Vedel et al., 2015; Haugen et al., 2016; Ugglå, 2018) as they own approximately half of the European forest land (Hirsch and Schmithüsen, 2010). NIPF owners refer to one or a small number of individuals who privately own a forest property (Andersson, 2010). The term *family forests* is also used for the same owner category. The scale and intensity of NIPF

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owners differs; for example, in size (varying from very small to very large forest holdings) and in terms of managing the forest under various management objectives (varying on a spectrum from purely timber oriented to no timber production at all) (Andersson, 2012). The term NIPF owners has been criticized for it does not focus on what these owners are, but instead on what they are not (Harrison et al., 2002; Fischer et al., 2010; Keskkitalo et al., 2017). However, it has also been regarded more precise than other terms often used, such as for example the term *small scale*, as NIPF owners may also relate to large forest holdings in terms of size, or *family forestry*, which might indicate a linkage to family which might not cover all ownership situations (Keskkitalo et al., 2017).

As Husa and Kosenius (2021) write, “the role of a non-industrial private forest (NIPF) owner as decision maker concerning the forestland is crucial when it comes to carbon sequestration, climate change adaptation and biodiversity protection”. In other words, the management choices of NIPF owners will have a large effect on the provision of forest ecosystem services (Gatto et al., 2019). Research has shown that these NIPF owners form a diverse and heterogeneous group of forest owners. This diversity has been the subject of extensive research in several European countries (see e.g. Boon et al., 2004; Hogl et al., 2005; Dhubbain et al., 2007; Hoogstra-Klein, 2016; Ficko et al., 2019). Not only the scale of NIPF ownership differs, varying from very small to very large forest holdings, but also factors as ownership history, gender, financial rationale, socio-economic situation, property characteristics, knowledge, and motivations and objectives for their ownership are important aspects. As Ficko et al. (2019) pointed out, the large amount of research shows how “perennial the problem of capturing the diversity of these people has been for decades”.

The diversity of NIPF owners might implicate differences in willingness to manage forests for environmental considerations. While many NIPF owners express a concern for monetary benefits and do harvest trees, many owners also own their forest partly for non-monetary uses, including purely environmental properties (Ficko et al., 2019; Eggers et al., 2014). Simultaneously delivering wood and non-provisional ecosystem services can be, however, an unresolved challenge (Triviño et al., 2015; Naumov et al., 2018; Lazdinis et al., 2019) and forest management practices are the outcome of individual preferences balancing productivity-profit considerations with environmental benefits. This has resulted in a heterogeneous mixture of forest management practices, from ‘sustained yield’ forestry (monetary primacy of timber production), ‘multi-purpose forestry’ (monetary primacy of timber production and other Ecosystem Services (ES)) to ‘ecosystem management’ (primacy of biodiversity conservation), or ‘carbon forestry’ (primacy of climate mitigation and adaptation) (Sotirov et al., 2017; Takala et al., 2017).

Research has shown that the extent to which environmental considerations are included in forest management are often linked to forest owner’s “greenness” and “environmental concern”. The research of Howley (2013) among Irish farm foresters, for example, observed that the level of concern for environmental issues significantly influenced their management practices. Nordlund and Westin (2011) concluded in their research that environmental values of Swedish forest owners influenced their environmental management positively and their monetary management negatively. Mitani and Lindhjem (2015) found in their research that a positive environmental attitude increases Norwegian forest owners’ probability of participating in biodiversity conservation.

Understanding and promoting environmental-friendly forest management among NIPF owners would, therefore, be facilitated by a measure of environmental concern of forest owners and knowledge about its antecedents, i.e. of factors that form environmental concern. It is acknowledged that human values are changing over time and these changes are assumed to affect strategic choices of forest owners (Ingemarson et al., 2006). In this regard, understanding underlying personal values and personality traits that determine individual forest

owners’ strategic motivations would be vital (Fischer et al., 2010; Ingemarson et al., 2006). In this paper, we therefore (1) quantitatively assess the empirical content and structure of environmental concern of NIPF owners in their forestry management and (2) explore environmental concern in more detail by investigating the role of personal values and personality traits in explaining environmental concern. These insights can help, among others, policy makers, NGOs, advisory bodies and consultants, to better target and frame environmental advice and improve communication with forest owners about environmental considerations in forest management.

This paper contributes to the scholarly debate in three ways. First, we provide a clear conceptualization of environmental concern as theoretical construct and measure its scale and dimensionality in private forestry setting using factor analysis. Most studies so far lack theoretical foundation and conceptual development (Fischer et al., 2010; Geiser and Crul, 1996; Aykol and Leonidou, 2015). Second, most of the existing studies focus on stated behaviour of NIPF owners (Meijer et al., 2015a; Meijer et al., 2015b; Shivan and Mehmood, 2010), and they do not enable us to identify whether environmental considerations are aimed at promoting financial interests or emerge due to intrinsic qualities. Our scale of environmental concern will allow us to assess the role of personal values and personality traits in environmental considerations in forest management strategies. Third, as research combining values and personality traits together and understanding how they jointly impact environment concern is limited (Parks and Guay, 2009; Marcus and Roy, 2019), this research will contribute to a more integrative view of the individual forest owner (Marcus and Roy, 2019).

Swedish NIPF owners were selected as a case study. With around half of the Swedish forestland owned by individual private forest owners, they form the largest category of forest owners in Sweden (Skogsstyrelsen/Swedish Forestry Agency, 2018). According to the Skogsstyrelsen/Swedish Forestry Agency (2018), there were 319, 649 NIPF owners (single owners) by 2017 of which 38% were women and 60% were men while no gender data were available for the remaining 2%. The number of management units owned by NIPF owners in 2017 were 224,888. Of these, 26% were owned fully by non-resident, 67% were locally owned and 7% were management units partly owned by non-resident. Management decisions are the responsibility of the individual forest owner who is encouraged to include environmental considerations in their management (Lidestav et al., 2015; Skogsvårdslagen/The Forestry Act/, 2020). Environmental measures that are enforced in a top-down way are often considered as an infringement to ownership rights. This is especially the case when these environmental measures interfere with timber production and the related income (Hertog et al., 2019). The Swedish private forestry, therefore, forms an excellent case to help understand private forest owners’ decisions in relation to environmental concern in forest management.

In what follows, we provide the theoretical framework of the study in Section 2. The research methodology is explained in Section 3. Section 4 presents the results. We end with discussions and conclusions in Section 5.

2. Theoretical background

The conceptualization of environmental concern varies and several meanings of the concept can be found in the literature (Stern et al., 1993; Dunlap and Jones, 2002; Takács-Sánta, 2007; Hirsh, 2010). In this study, we define environmental concern as “the attitudes of NIPF owners regarding the importance of environmental aspects in their forest management and planning”. As such, we consider environmental concern a latent theoretical construct, which cannot be measured directly. Latent constructs can, however, be assessed by use of measurement items (DeVellis, 2016). There are various approaches for measuring environmental concern of individuals. These range from subjective approaches based on self-report measures, to more objective approaches based on field observations with the help of informants,

trained observers, or technical devices as well as behavioral tasks in the laboratory (Lange and Dewitte, 2019).

In our case, we quantify environmental concern from measurement items based on self-reported responses of NIPF owners about their environmental attitudes and inclusion of environmental aspects in their forest management and planning. To correctly assess a latent construct it is important to classify the construct as being reflective or formative, i.e. if causality goes from the latent construct to the measurement items (reflective) or if measurement items define the construct (formative) (Rossiter, 2002). In our study, causality is assumed from the latent construct to the measurement items, similarly to work done by Hansson and Lagerkvist (2012) because environmental concern of NIPF owners are expected to influence their environmental attitudes and strategic choices in their forestry. This means that a reflective measurement model is used to empirically assess the structure and content of the latent construct: environmental concern (DeVellis, 2016; Jarvis et al., 2003; Hair et al., 2010).

Personality factors such as values and traits are crucial determinants of human-decision making (Ajzen, 1991; Hirsh, 2010; Soliño and Farizo, 2014). It is well documented that values, beliefs and attitudes influence forest management behaviour and decision making (Caprara et al., 2006; Meijer et al., 2015a; Mozzato et al., 2018; Nordlund and Westin, 2011). Moreover, with changes in human values, the personalities of individuals are assumed to become more important than their socio-demographics in influencing their choices in forest management (Ingemarson et al., 2006). Various studies suggest that NIPF owners have multiple objectives including both pecuniary and non-pecuniary motives (Eggers et al., 2014; Fischer et al., 2010; Ingemarson et al., 2006). Non-pecuniary motives are more likely to be related with individual personality differences than with the socio-economic groups individuals belong (Ingemarson et al., 2006). In a behavioral perspective, environmental concern of NIPF owners can be interpreted in light of personality factors. Personality is defined as a combination of dynamic, self-regulatory systems that arise and function over the life span of individuals in the course of personal adaptations (Caprara and Cervone, 2000). Personality systems direct affective, cognitive, and motivational processes, guiding people toward achieving individual and collective goals (Caprara and Cervone, 2000). Two dimensions of personality are personal values and personality traits (Caprara et al., 2006).

The focus of our research is on the association of personal values and personality traits with environmental concern of NIPF owners. The reason for this is that several studies (for example in psychology) indicate that personal values and personality traits might be important factors explaining environmental concern (see e.g. Hirsh, 2010; Parks and Guay, 2009; Parks-Leduc et al., 2015). Marcus and Roy (2019) also concluded in their research that personal values and personality traits have “distinct implications for ethical and sustainable management practice”. Moreover, they argue that it is important to assess values and personality together as this contributes to a more integrative view of the person (Marcus and Roy, 2019).

2.1. Personal values

Personal values belong to the most widely studied topics across the social sciences (Meglino and Ravlin, 1998; Marcus and Roy, 2019). Schwartz (1992, 2011) defined personal values as: i) beliefs; ii) being related to desired goals; iii) relating to several situations; iv) serving as standards which guide actions and/or evaluations; and v) being ordered according to their relative importance. Scholars studying value theory state that individuals share a common set of values, but the strength with which the different values are held differ per individual (Rokeach, 1973). Value orientations are also not mutually exclusive, i.e. individuals may hold to a certain degree several value orientations that, for example, could differ for the value object (such as the environment) (Stern and Dietz, 1994).

The literature distinguishes ten universal basic personal value

dimensions (Schwartz, 1992):

- (1) power, describing social status and prestige, control or dominance over people and resources.
- (2) achievement, describing personal success through demonstrating competence according to social standards.
- (3) hedonism, describing pleasure and sensuous gratification for oneself.
- (4) stimulation, describing excitement, novelty, and challenge in life.
- (5) independence (self-direction), describing independent thought and action—choosing, creating, exploring.
- (6) universalism, describing understanding, appreciation, tolerance, and protection for the welfare of all people and for nature.
- (7) benevolence, describing preservation and enhancement of the welfare of people with whom one is in frequent personal contact.
- (8) tradition, describing respect, commitment, and acceptance of the customs and ideas that traditional culture or religion provide the self.
- (9) conformity, describing restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms.
- (10) security, describing safety, harmony, and stability of society, of relationships, and of self.

The ten dimensions of personal values are interrelated in that they exist along a motivational continuum (Schwartz, 1992; Bardi and Schwartz, 2003).

Several studies have shown the link between individual values and environmental concern (Stern et al., 1995; Nordlund and Garvill, 2002; Schultz et al., 2005; Steg et al., 2011; Oreg and Katz-Gerro, 2006; Hansla et al., 2008; Hedlund, 2011). Studies have, for example, shown that individuals that more strongly adhere to a pro-social or biospheric value domain have higher environmental concern. Conversely, individuals who favor personal outcomes (such as wealth or power) have either a negative or insignificant link with environmental concern (Harring et al., 2017).

2.2. Personality traits

Whereas values represent a psychologically embedded construct within the motivational complex, personality traits refer to “enduring characteristics of the individual that summarize trans-situational consistencies in characteristic styles of responding to the environment” (Olver and Mooradian, 2003, p 110). Olver and Mooradian (2003) consider personality traits as: i) being associated with the biophysiological response system; ii) heritable; iii) immune to influence of the individual's parents and societal context; and iv) generally stable during the individual's adult life. The Five Factor Model (FFM, sometimes also called the “Big Five Model”) (John et al., 2008) is a frequently used model describing personality traits (Roccas et al., 2002; Soto et al., 2011). The model distinguishes five traits, which are considered to embody most of human personality:

- (1) neuroticism, describing the degree to which a person experiences the world as threatening and beyond his/her control.
- (2) openness to experience, describing the degree to which a person needs intellectual stimulation, change, and variety.
- (3) extraversion, describing the degree to which a person needs attention and social interaction.
- (4) agreeableness, describing the degree to which a person needs pleasant and harmonious relations with others.
- (5) conscientiousness, describing the degree to which a person is willing to comply with conventional rules, norms and standards.

The relation between specific personality traits and (a lack of) environmental concern has been studied in several studies (Hirsh, 2010;

Milfont and Sibley, 2012). Hirsh (2010), for example, found that higher levels of agreeableness and openness were related to greater environmental concern, with smaller positive relationships emerging with neuroticism and conscientiousness. Borden and Francis (1978) found that enthusiastic, extraverted, more conscientious and mature people showed a higher environmental concern. Pettus and Giles (1987) found that conscientious, self-confident and sincere people could be related to pro-environmental attitudes. Milfont and Sibley (2012) concluded that “individuals who are sympathetic, selfless, responsible, who score high on traits related to extraversion and conscientiousness, and the personality dimension of neuroticism, tend to be more environmentally engaged”.

Thus, regarding personal values, it is plausible to assume that environmental concern is impacted by the values held by the individual. Personal values characterize goals individuals consider desirable and as such they work as guiding principles of individuals (Roccas et al., 2002; Schwartz, 1992, 2011). Hence, we posit that personal values function to guide NIPF in the environmental concern they show in their forestry management and planning.

Personality refers to the intensity with which individuals undertake specific actions (Roccas et al., 2002) and individuals respond to their environments (Olver and Mooradian, 2003). We therefore assume that NIPF who differ in personality type will differ in their intensity of environmental concern in their forestry management and planning.

Thus, we formulate the following hypotheses:

- H1.** NIPF owners' personal value profiles significantly influence their environmental concern in forest management and planning.
- H2.** NIPF owners' personality traits significantly influence their environmental concern in forest management and planning.

3. Methods

In this section, we explain how we measured the variables included in the study and outline the data collection and analyses procedure. As explained in section 2, the main variables which form the basis of our analyses derive from the theoretical framework of the study.

3.1. Case and sampling procedure

The data for the study were collected through a survey conducted between June and August 2018 among NIPF owners in Sweden. The survey was part of a larger study on regulation of agricultural and forestry land acquisition in Sweden. NIPF owners own half of the productive forest area in Sweden (Eggers et al., 2014). Addresses of NIPF owners were obtained from a register of forestry owners held by Lantmäteriet, the Swedish mapping, cadastral and land registration authority. Only forestry holdings owned by physical persons were sampled. The sample was stratified so that larger holdings had a higher probability of being included for the survey. No holdings of less than 50 ha of forestry land were included in the sample. The reason was to focus on the NIPFs that are more likely to be economically dependent on their forest holding, thus excluding holdings that are more likely kept for hobby reasons and/or which are kept for country-style living preferences. A total of 1962 randomly selected unique forestry owners were contacted by regular mail and invited to participate in an online survey. After one reminder, a total of 226 usable surveys were collected, yielding a response rate of 11.5%. The reasons for the relatively low response rate could be that some of the respondents felt uncomfortable answering online questionnaires or that the questionnaire was considered too extensive in relation to their time.

Table 1 presents the descriptive statistics of the study sample. Most of the respondents were male (78%). In 2018, 61% of the forest owners were male in Sweden (Skogsstyrelsen/Swedish Forest Agency, 2018). The average age of the respondents was about 60 years and the average respondent had a high school forestry education. The average age of a Swedish forest owner was 61 years in 2018. The average household size

Table 1

Descriptive statistics of socio-economic characteristics of the study sample.

Variable	Mean (Standard deviation)
Gender (1 = male, 0 = female)	0.78 (0.41)
Age of respondent	60.59 (11.34)
Education level of respondent ^a	2.81 (1.66)
Household size (number)	2.45 (1.04)
Live at the forest holding (1 = yes, 0 = no)	0.67 (0.47)
Size of forest land in hectares	609.60 (1262.59)
Dependence on forest income ^b	3.56 (2.18)
Diversified forestry holding (1 = yes, 0 = no)	0.39 (0.49)
Certified forestry holding (1 = yes, 0 = no)	0.61 (0.49)

Note: ^a 0 = basic education; 1 = High school; 2 = High school forestry; 3 = University forestry; 4 = Other university education; 5 = Other schooling.

^b 0 = Not at all to 7 = Very much.

was two persons and the majority of the respondents live at their forest holding. The average household size in Sweden was 2.01. The average size of the forests in our sample was 610 ha, while the average forest size at the national level was 124.24 ha in 2018 (Skogsstyrelsen/Swedish Forest Agency, 2018). The minimum forest size was 23 ha and the maximum forest size was 19,500 ha.¹ The majority of the respondents own a single forest holding and most of the forest owners (61%) have their forest certified. Nationally, 41% of the total productive forest area of NIPF was under forest management certification in 2019 in Sweden (Statistics Sweden, 2020). Out of the sampled forest owners, 67% live at their forest holding.

3.2. Survey

In addition to data on respondents' demographic and socio-economic characteristics, the survey included questions related to considerations for environmental aspects (the environmental concern) in forest management and planning as well as questions related to respondents' personal values and personality traits.

Regarding environmental concern, the sampled forest owners were asked to self-report on measurement items intended to assess the importance of environmental aspects in their forest management and planning. The measurement items were five point Likert-scale statements to capture the degree of agreement of respondents about their environmental attitudes and various environmental aspects in their forest holding. The statements were adapted from Banerjee et al. (2003) and Leonidou et al. (2017). Respondents were asked to indicate the extent to which they agreed with the proposed statements. The beginning-point 1 refers to 'do not agree at all', the middle point 3 to 'neutral' and the end-point 5 refers to 'agree completely'. To minimize the risk of respondents taking the easy way out, no opt-out options (Do not know and do not want to answer) were included. Responses to such scales are regarded as measurement items of latent constructs of interest (DeVellis, 2016; Hair et al., 2010; Jarvis et al., 2003). The statements used in the survey are provided in Table 2.

Respondents may place different types of perceptions regarding the

¹ Note that we originally selected NIPF owners with no less than 50 ha of forest. However, the respondent with 23 ha was registered as owning 50 ha during the sample selection, but the respondent has sold part of the property and thus owns less than 50 ha when receiving the survey.

Table 2Descriptive statistics of measurement statements for environmental concern, $N = 226$.

Statement	Mean (SD)
At my forest holding, the environmental aspects are an important aspect in our strategic planning	3.45 (1.04)
At my forest holding, we think that reduced environmental impact is a quality factor	3.53 (1.01)
At my forest holding, we focus on merging environmental goals with other business goals	3.40 (1.01)
At my forest holding, we engage largely in developing products and processes that reduce environmental impact	3.11 (1.00)
At my forest holding, environmental considerations is a driving force that directs our business strategy	3.19 (1.02)
When we develop new products, we always take environmental impact into consideration	3.09 (0.95)
In my business we develop products and processes that minimize environmental impact	3.19 (1.02)

Note: The statements are 5-points Likert scale statements with the minimum scale 1 = 'do not agree at all'; 2 = 'Disagree a little'; 3 = 'neutral'; 4 = 'Agree a little'; 5 = 'agree completely'.

N refers to number of observations.

SD refers to standard deviation.

statements. However, our latent construct *environmental concern* considers how the environment is considered in relation to the management of the forestry holdings of NIPF owners, thus how they value environmental considerations together with other concerns in managing their forestry holdings. To account for possible systematic patterns regarding demographics and education level etc. in the environmental concern, we included these variables as covariates in the regression analysis and hence are controlled for.

We measured personal values based on a short version of Schwartz personality scale (Lindeman and Verkasalo, 2005). We asked NIPF owners to indicate the importance of each of the ten personal value dimensions as guiding principles in their life. The questions are posed in 9 point Likert-scale questions ranging from the starting-point 1 = "Totally against my principle" to the end-point 9 = "Very important" (see Appendix A1 for a full list of the questions).

Personality traits were measured from measurement items included in a short version of the Big Five Inventory (BFI) (John et al., 2008; Rammstedt and John, 2007; Soto et al., 2011). We included 11 items that can characterize an individual. The measurement items were posed to sampled NIPF owners as five point Likert-scale questions about the extent of agreement with which the items describe a respondent (ranging from 1 = Disagree strongly to 5 = Agree strongly). Appendix A2 provides a complete list of the exact questions (translated to English) asked to obtain the measurement items of personality traits in our survey.

3.3. Data analysis

The data analysis of this study has two parts. In the first part, we use exploratory factor analysis to measure the dimensions of environmental concern of NIPF owners. In the second part, we use hierarchical seemingly unrelated regression (SUREG) models to estimate the correlations between environmental concern of NIPF owners and their personal values and personality traits.

As explained earlier, environmental concern is a latent construct that cannot be observed and measured directly. A common indirect way of measuring latent constructs is through indicators (Flake et al., 2017). In our study, we developed the measurement indicators for environmental concern by asking sampled NIPF owners to self-report their degree of agreement regarding statements related to environmental aspects in their forestry (See Section 3.2). After developing the measurement indicators for the latent construct of interest, a first step is to determine the direction of causality implied between the measurement indicators and

the latent construct (Jarvis et al., 2003; Podsakoff et al., 2003; Rossiter, 2002). This will help in the choice of measurement model and type of scale development method to use in assessing the latent construct. Measurement models are categorized as reflective or formative. A reflective measurement model assumes direction of causality from the latent construct to the measurement indicators. This suggests that the latent construct leads to the type of responses to the measurement indicators. A formative measurement model assumes direction of causality goes from the measurement indicators to the latent construct. Jarvis et al. (2003) developed a set of decision criteria for assessing the direction of causality between measurement indicator and latent construct. Following this, we consider the environmental concern of forest owners a reflective construct. In particular, the environmental concern is assumed to guide forest owners management choices and thus cause the responses to the statements related to environmental aspects of forestry (the measurement indicators). This implies that a change in environmental concern is assumed to lead to changes in the measurement indicators and not the other way around. Furthermore, following the decision criteria by Jarvis et al. (2003) it is reasonable to assume that measurement indicators used here share a common theme, that the theoretical understanding of the latent construct remains unchanged if an indicator is dropped, that indicators can be expected to covary and that they share antecedents.

In addition, reflective measurement indicators covary with each other by construction, which is the case in the measurement statements of our study. Hence, our measurement model is reflective.

In the next step, we used exploratory factor analysis to obtain a scale measure of environmental concern of NIPF owners. The choice of factor analysis instead of principal component analysis is guided by our assumption that the latent construct, environmental concern, underlies the observed measurement indicators. The exploratory factor analysis was preferred to confirmatory factor analysis as the scale for measuring the latent construct environmental concern is not yet well established in the literature. The analyses were conducted using the software STATA 15. We tested the sampling adequacy of the measurement statements using Kaiser's overall measure of sampling adequacy (KMO) to assess their suitability for factor analysis. Having confirmed the adequacy of the factor solution according to these criteria, the reliability of the scales obtained was evaluated using Cronbach's alpha, item-to-item correlation and item-to-total correlation (Hair et al., 2010).

We analyzed the correlation between environmental concern and NIPF owners' personal values and personality traits in two steps. In the first step, we predicted the environmental concern score for each NIPF owner. In the second step, we estimated three hierarchical seemingly unrelated regression (SUREG) models to assess the association between environmental concern of NIPF owners and their personal values and personality traits. SUREG models consist of a set of equations having error terms that are correlated (Smith and Kohn, 2000). The advantage of SUREG models is that less observations are needed to obtain reliable estimates and hence are efficient. In Model 1, we predicted the environmental concern scores of forest owners from their demographic and socio-economic characteristics only. In Model 2, we added personal values to Model 1. In Model 3, we added personality traits to Model 2. This procedure enables us to assess whether there is a statistically significant improvement in the fit of the models with the inclusion of personality traits and personal values. In other words, the procedure helps us understand whether personal values and personality traits of forest owners statistically and significantly explain the variation in their environmental concern.

4. Results

In this section, we present the results of our analysis. First, we provide the results of the exploratory factor analysis. Then, we provide the results of the regressions about the correlation between environmental concern and personal values and personality traits of NIPF owners.

4.1. Environmental concern of NIPF owners

Table 2 provides the descriptive statistics of the measurement items of environmental concern of sampled respondents. The average score of each of the measurement items is greater than three. The sampling adequacy KMO statistic is 0.873 (greater than the threshold value of 0.5), which implies that our data is suited for factor analysis.

The exploratory factor analysis reduced the measurement statements into seven factors, reflecting the underlying construct of interest, i.e. environmental concern. The cumulative variance explained by the first two factors (unrotated) is 109%.² As shown in Appendix A3, the scree plot has a clear break at factor 2, showing that factors 1 and 2 can be retained. Even if the scree plot test may work well with strong factors, it is prone to subjectivity and ambiguity (Hayton et al., 2004). A commonly used method for factor retention decision is the eigenvalues rule. According to the rule, factors are retained if their eigenvalues are greater than 1. In our case, the eigenvalue of factor 1 is 3.87 while the eigenvalue for factor 2 is 0.41. However, we retained both factors 1 and 2 even if the eigenvalue of factor 2 is less than 1. This is because eigenvalues are just one of the criteria for factor retention. Even if the eigenvalues rule is the most commonly used method due to its theoretical basis and simplicity, there are a number of problems associated with this rule (See Hayton et al., 2004). Another method for factor retention decision is the parallel analysis (PA). Various studies show that that PA is the best method to determine how many factors to retain (Glorfeld, 1995; Thompson and Daniel, 1996; Ledesma and Valero-Mora, 2007). PA compares the observed eigenvalues extracted from the correlation matrix to be analyzed with those obtained from uncorrelated normal variables. The decision rule is a factor is retained if its eigenvalue extracted from the exploratory factor analysis (FA) is greater than the average eigenvalue in the PA column. In our case, the eigenvalues of the FA of factors 1 and 2 are greater than the eigenvalues of the PA (See Appendix A4). Alternatively, this can also be concluded from the graph in Appendix A4 where the dashed line for PA in the graph crosses the solid FA line before reaching the third component. Hence, we decided to retain factors 1 and 2 based on the PA. Because the factors are likely to be correlated with each other, oblique rotation was used to rotate the factor solution and facilitate interpretation of the factors (Hair et al., 2010). The decision about the number of relevant factors is guided by theory and the meanings of the factors. Factor loadings were considered significant if they were above the threshold level of 0.40, which represents statistical significance at the 5% level with a sample size of at least 200 observations (Hair et al., 2010).

Based on the exploratory factor analysis, we found two factors describing different dimensions of environmental concern (see Table 3). The first group, with high scores on statements 4–7, reflect pro-active environmental activities by NIPF owners. The second group, containing statements 1–3, reflects general considerations for environmental aspects by forest owners. These two elements perfectly fit the ideas of Banerjee et al. (2003), who distinguished two dimensions of environmental concern, i.e. environmental orientation (“the recognition by managers of the importance of environmental issues facing their firms”) and environmental strategy (“the extent to which environmental issues are integrated with a firm’s strategic plans”). Hence, we labeled the first group “environmental strategy” and the second group “environmental orientation”.

We tested the reliability of the measurement scales obtained from the factor analysis using item-to-total correlations, item-to-item correlations and Cronbach’s alpha. The item-to-total and item-to-item correlations

² When the cumulative variance of the current and preceding factors is greater than 100%, the subsequent factors in the factor solution will then have negative contribution to explaining the cumulative variance, i.e., will have negative variance (proportion) and hence the sum of the total variance (proportion) adds up to 100% (See Appendix Table A5).

Table 3
Factor solution of environmental concern construct.

Statement	Factor 1 Environmental strategy	Factor 2 Environmental orientation
1. At my forest holding, environmental aspects are an important aspect in our strategic planning.	0.1165	0.7078
2. At my forest holding, we think that reduced environmental impact is a quality factor.	-0.0785	0.6688
3. At my forest holding, we focus on merging environmental goals with other business goals.	0.2271	0.6513
4. At my forest holding, we engage largely in developing products and processes that reduce environmental impact.	0.5877	0.2559
5. At my forest holding, environmental considerations is a driving force that directs our business strategy.	0.5473	0.2960
6. When we develop new products, we always take environmental impact into consideration.	0.8672	0.0083
7. In my business we develop products and processes that minimize environmental impact.	0.7572	0.0436
Range of item-to-item Spearman correlation coefficients	0.531–0.713	0.523–0.670
Range of item-to-total Spearman correlation coefficients	0.839–0.898	0.801–0.870
Cronbach’s alpha	0.878	0.796

Note: Significant factor loadings in bold (i.e., greater than 0.4).

were all greater than the threshold values of 0.5 and 0.3 respectively for both factors 1 and 2 (Hair et al., 2010). The Cronbach’s alpha values for factors 1 and 2 were greater than the threshold value of 0.7 (Hair et al., 2010). These results suggest that the measurement scales are reliable.

4.2. Personal values and personality traits of NIPF owners

Table 4 provides an overview of the descriptive statistics of the personal values of the respondents. As the table shows, on average the sampled respondents scored the highest on the personal value of independence (independent thought and action - choosing, creating, exploring) while they score the lowest on the personal value of power (social status and prestige, control or dominance over people and resources), compared to the other personal values.

Table 5 presents the descriptive statistics of the personality traits of the respondents. The table shows that, in comparison to the other personality traits, on average the respondents scored the lowest on neuroticism (i.e., the trait explaining the degree to which a person experiences the world as threatening and beyond his/her control) and the

Table 4
Descriptive statistics of personal values (N = 202).

Personal values	Mean	SD
Conformity	6.406	1.794
Tradition	6.094	1.835
Benevolence	6.777	1.709
Universalism	5.792	1.905
Independence	7.331	1.394
Stimulation	6.425	1.741
Hedonism	6.301	1.655
Achievement	5.584	1.948
Power	4.163	2.150
Security	6.718	1.735

Note: The personal values are measured based on 9-point Likert scale statements about the importance of each of the ten personal value dimensions as guiding principles in the lives of the respondents, with the minimum scale 1 = “Totally against my principle” to the maximum scale 9 = “Very important”.

Table 5
Descriptive statistics of personality traits (N = 202).

Personality traits	Mean	SD
Extraversion	3.488	0.783
Agreeableness	3.718	0.560
Conscientiousness	3.990	0.792
Neuroticism	2.190	0.779
Openness	3.014	0.893

Note: The personal traits are obtained from 5-point Likert scale statements about the extent of agreement with which items included in a short version of the Big Five Inventory (BFI) describe a respondent (ranging from 1 = Disagree strongly to 5 = Agree strongly).

highest on conscientiousness (i.e., the trait explaining the degree to which a person is willing to comply with conventional rules, norms and standards).

We report the Spearman correlation coefficients between the factors (environmental strategy and environmental orientation) and the ten basic personal values dimensions and the Big Five personality traits scores in Table 6. The results show that environmental strategy of NIPF owners is positively and significantly associated with several personal value aspects (conformity, tradition, benevolence, universalism, independence, stimulation and security), but not significantly associated with personality traits at all. Environmental orientation is positively and significantly associated with certain personal values (benevolence, universalism, independence, and stimulation) and one personality trait (conscientiousness). It is important to note here that Table 6 presents correlations between the factors and personality aspects (values and traits) without controlling other factors such as demographic and socio-economic characteristics of NIPF owners. In the next section, we include demographic and socio-economic characteristics of NIPF owners as covariates in assessing the influence of personal values and personality traits on environmental concern.

4.3. Influence of personal values and personality traits on environmental concern of NIPF owners

Tables 7, 8 and 9 present the results of the hierarchical SUREG models for assessing the addition to model improvement of including personal values and personality traits of forest owners in predicting their environmental concern. In Model 1, we included only demographic and socio-economic characteristics to estimate the two factors, environmental strategy and environmental orientation. The results in Table 7 show that household size, dependence on forest income, having a

Table 6
Spearman rank correlation coefficients of factor scores with personal values and personal traits, N = 202.

Variables	Environmental strategy	Environmental orientation
PERSONAL VALUES		
Conformity	0.125*	0.030
Tradition	0.127*	0.034
Benevolence	0.235**	0.128*
Universalism	0.320***	0.255**
Independence	0.161**	0.205**
Stimulation	0.274**	0.173**
Hedonism	0.052	0.075
Achievement	0.084	0.048
Power	0.001	-0.013
Security	0.221**	0.059
PERSONAL TRAITS		
Extraversion	-0.036	0.075
Agreeableness	0.065	0.089
Conscientiousness	0.111	0.234**
Neuroticism	-0.034	-0.026
Openness	0.084	0.041

Note: *** p < 0.01, **p < 0.05, *p < 0.10.

Table 7
SUREG Model 1: Predicting environmental concern from demographic and socio-economic characteristics only (N = 204).

Variables	Environmental strategy	Environmental orientation
Gender (1 = male, 0 = female)	-0.134 (0.154)	-0.219 (0.145)
Age of respondent	0.008 (0.006)	-0.001 (0.006)
Education level of respondent	-0.006 (0.041)	0.093** (0.038)
Household size (number)	0.158** (0.066)	0.096 (0.062)
Live at the forest holding (1 = yes, 0 = no)	0.008 (0.144)	-0.076 (0.135)
Size of forest land in hectares	0.000 (0.000)	-2.11e-06 (0.000)
Dependence on forest income	0.075** (0.029)	0.053* (0.028)
Diversified forestry holding (1 = yes, 0 = no)	0.256** (0.123)	0.089 (0.116)
Certified forestry holding (1 = yes, 0 = no)	0.208* (0.124)	0.092 (0.117)
Model Chi² (df)	27.54 (9)	21.55 (9)
Model P-value	0.001	0.010
P-value of Wald test	0.001	0.010
R-sq	0.119	0.096

Note: **p < 0.05, *p < 0.10.

Table 8
SUREG Model 2: Predicting environmental concern from demographic and socio-economic characteristics and personal values (N = 204).

Variables	Environmental strategy	Environmental orientation
Demographic and socio economic variables	Yes	Yes
Conformity	-0.027 (0.057)	0.063 (0.057)
Tradition	0.000 (0.043)	-0.049 (0.044)
Benevolence	0.054 (0.049)	-0.082* (0.049)
Universalism	0.133*** (0.035)	0.117*** (0.035)
Independence	-0.028 (0.061)	0.153** (0.061)
Stimulation	0.085** (0.041)	-0.036 (0.041)
Hedonism	-0.085* (0.045)	-0.049 (0.046)
Achievement	-0.022 (0.035)	-0.023 (0.035)
Power	-0.010 (0.031)	-0.014 (0.031)
Security	0.017 (0.057)	0.012 (0.057)
Model Chi² (df)	76.00 (19)	50.27 (19)
Model P-value	0.000	0.000
P-value of Wald test	0.000	0.000
R-sq	0.295	0.216

Note: *** p < 0.01, **p < 0.05, *p < 0.10.

diversified forest holding (i.e. additional incomes from e.g. tourism, hunting, renting out of buildings, energy production etc.) and certified forest holding are positively related to environmental strategy. On the other hand, education level of forest owner and dependence on forest income are positively related with environmental orientation.

In Model 2, we added the ten basic personal values dimensions as explanatory variables to Model 1. The results in Table 8 show that the inclusion of personal values in Model 2 contributed significantly to the improvement of model prediction. The R-sqr increased in Model 2 and

Table 9
SUREG Model 3: Predicting environmental concern from demographic and socio-economic characteristics, personal values and personality traits (N = 204).

Variables	Environmental strategy	Environmental orientation
Demographic and socio economic variables	Yes	Yes
Conformity	-0.023 (0.058)	0.069 (0.057)
Tradition	0.011 (0.043)	-0.038 (0.043)
Benevolence	0.049 (0.049)	-0.085* (0.048)
Universalism	0.138*** (0.036)	0.123*** (0.035)
Independence	-0.034 (0.061)	0.146** (0.060)
Stimulation	0.089** (0.041)	-0.031 (0.041)
Hedonism	-0.097** (0.046)	-0.059 (0.045)
Achievement	-0.015 (0.035)	-0.011 (0.034)
Power	-0.007 (0.032)	-0.017 (0.031)
Security	-0.005 (0.059)	-0.026 (0.059)
Extraversion	0.014 (0.076)	0.015 (0.075)
Agreeableness	0.115 (0.107)	0.036 (0.106)
Conscientiousness	0.119 (0.075)	0.233*** (0.074)
Neuroticism	0.049 (0.076)	0.103 (0.075)
Openness	-0.022 (0.065)	-0.009 (0.064)
Model Chi² (df)	81.61 (24)	63.91 (24)
Model P-value	0.000	0.000
P-value of Wald test	0.000	0.000
R-sq	0.309	0.259

Note: *** p < 0.01, **p < 0.05, *p < 0.10.

the Wald test shows that the increase is statistically significant at 1% level of significance (P-value = 0.000 for both environmental strategy and environmental orientation). The results suggest that adding personal values as explanatory variables to a model with only demographic and socio-economic characteristics explain 29.5% of the variance in environmental strategy and 21.6% of the variance in environmental orientation. Regarding the specific dimensions of personal values, while universalism and stimulation are positively related with environmental strategy, hedonism has negative relation with environmental strategy. On the other hand, universalism and independence are positively related with environmental orientation, while benevolence has a marginal negative relation with environmental orientation.

Adding the Big five categories of personality traits in Model 3 further improved prediction significantly. The results in Table 9 show a statistically significant increase in R-sqr (P-values = 0.000). The inclusion of personality traits as additional explanatory variables in Model 3 explain 30.9% of the variance in environmental strategy and 25.9% of the variance in environmental orientation. The results of the Chi² test confirm these findings as the Chi² increases with the addition of personal values and personality traits to a model with only demographic and socio-economic characteristics. Hence, we find statistical support for our hypotheses regarding the significance of personal values and personality traits in explaining environmental concern of NIPF owners. Regarding the specific categories of personality traits, while there is no statistically significant relation between environmental strategy and the five personality traits, we find statistically significant positive relation between conscientiousness and environmental orientation.

4.4. Personal values versus personality traits

In Section 4.3, we showed that inclusion of personal values and personality traits improved model prediction of environmental concern over a model with only demographic and socio-economic characteristics. In this section, we assess which of the two personality aspects (values and traits) is stronger in predicting environmental concern. To assess this, we reverse the order of inclusion of the two facets of personality in the SUREG models by including personality traits before personal values to compare the resulting changes in the predictive power of the models. More specifically, we first include only demographic and socio-economic characteristics of NIPF owners in predicting their environmental concern (Model 1). Next, in Model 2 we add personality traits to Model 1. Finally, we add personal values to Model 2. The overall results in model improvement are shown in Table 10. The results show that adding personality traits to a model with only demographic and socio-economic characteristics increased the R-sqr from 11.9% and 9.6% for environmental strategy and environmental orientation respectively to around 18%. This increase in R-sqr is smaller compared to the increase in R-sqr we had when we added personal values to a model with only demographic and socio-economic characteristics (29.5% for environmental strategy and 21.65 for environmental orientation, see Table 8). These suggest that personal values are stronger than personality traits in predicting environmental concern.

5. Discussions and conclusions

This study explored environmental concern and examined the role of personal values and personality traits in predicting environmental concern of NIPF owners in Sweden. Despite being a case study of NIPFs in one single country, this paper provides new insights in the dimensions of environmental concern and its antecedents, and establishes a basis for further research on environmental concern of NIPFs, also in other countries.

5.1. Environmental concern

The results of this paper show that Swedish NIPF owners' average scores on each of the measurement items of environmental concern is greater than three. This indicates that, overall, there is some concern for environmental issues among these forest owners, although it seems not to be very high. This is in line with findings of, for example, Nordén et al.

Table 10
Evaluating alternative SUREG models: order of personal values and personality traits.

Model	Model Chi ² (df)	Model P-value	P-value of Wald test	R-sq
Model 1				
With demographic and socio-economic characteristics only				
Environmental strategy	27.54 (9)	0.001	0.001	0.119
Environmental orientation	21.55 (9)	0.010	0.010	0.096
Model 2				
Model 1 + personality traits				
Environmental strategy	40.25 (19)	0.000	0.000	0.181
Environmental orientation	40.42 (19)	0.000	0.000	0.182
Model 3				
Model 2 + personal values				
Environmental strategy	81.61 (24)	0.000	0.000	0.309
Environmental orientation	63.91 (24)	0.000	0.000	0.259

(2017) and Danley et al. (2021), who found that Swedish NIPF owners are strongly oriented at production. Danley et al. (2021) also concluded that “relying on volunteerism alone is unlikely to yield widespread and systematic improvements in forest and biodiversity protection (Löfmarck et al., 2017)”, and some sort of policy reform specific to NIPF owners needs to be considered in order to shift forest management to more environmental oriented management.

Our results show that such a shift best includes considering two dimensions of environmental concern. Based on the results from the factor analysis, we found a two-dimensional structure underlying the environmental concern of Swedish NIPF owners, (1) environmental orientation and (2) environmental strategy. While environmental orientation implies a general consideration of the environment in combination with other factors (such as economic benefits), environmental strategy takes the environment more explicitly and is more actively pro-environmental. As the results from our research show, the average scores of the Swedish NIPF owners differ on the two dimensions, with higher scores on environmental orientation than on environmental strategy. This shows that environmental aspects are better included in general forest management than in the commercial side of the forest holding. This is not a surprising outcome, considering that wood production is an important economic activity for Swedish NIPF owners. It, however, also shows that policy reform focused on changes in forest management might be best addressing the cost and revenue structure of NIPF owners. A tax-fund system, as explored by Bostedt et al. (2019), or a state-funded program similar to cost share programs that are common in the US, as suggested by Danley et al. (2021), would be in line with our findings, but one could also think of environmental oriented subsidies or wood price premiums. At the same time, the focus of this paper was on exploring environmental concern of Swedish NIPF owners in general and not their diversity in terms of environmental concern, which also means that our approach might not address all types of NIPF owners. A further exploration of this diversity and possible combinations of steering instruments influencing different behavioral logics might be an interesting avenue for further exploration.

This multi-dimensional nature of environmental concern has not been given attention in previous studies related to forest management, in which environmental concern is related to environmental consideration (Howley, 2013), to forest values, beliefs and attitudes (e.g., Eriksson, 2012) or to forest management strategies (e.g., Schlyter et al., 2009). Our approach further develops research on this topic and suggests a need for developing a standard scale for measuring environmental concern, based on both orientation and strategy. Such a scale helps, for example, in avoiding misconceptions of treating environmental concern as synonymous with environmental awareness or knowledge. It is, at the same time, important to note that our measure of environmental concern is based on a relatively limited number of statements related to environmental considerations in forest management, which might not provide a complete coverage of all aspects of environmental concern. Nevertheless, the two dimensions also reflect the outcomes of other studies, studying “corporate environmentalism” (such as Banerjee et al., 2003). Further research could, however, further explore the dimensions of environmental concern using a more elaborate scale (such as the one developed by Banerjee (2002) for “corporate environmentalism”).

5.2. Influence of personal values and personality traits on environmental concern

The results of our study show that we fail to reject both our hypotheses. The influence on personal values on environmental consideration in forest management decision-making is not new (see, e.g., Nordlund and Westin, 2011; Drescher et al., 2017; Koskela and Karpinen, 2021). However, the influence of personality traits in environmental concern in forest management has, however, so far not been topic of research. This study, therefore, highlights the importance to

include these traits in future research on this topic. Moreover, our analysis of the influence of personal values and personality traits on environmental concern shows that the combination of the two facets of personality significantly improved the prediction of environmental concern over a model with only socio-demographic characteristics. This means that both personal values and personality traits help in explaining environmental concern of NIPF owners in their forest management and planning and should be included in future models. This outcome confirms what Olver and Mooradian (2003) already promoted, i.e. integrative models that incorporate both “nature” (personality traits) and “nurture” (personal values) explanatory variables.

Furthermore, we found that personal values are stronger than personality traits in predicting environmental concern. This finding is in line with the findings of Caprara et al. (2006) who reported the primacy of values over traits in behaviors and choices that entail thoughtful weighing of alternatives, currently or in the past. This has also been reported in the works of Hansson et al. (2018) and Rocas et al. (2002) who postulated that values are likely to trump traits as predictors of behaviour that is under voluntary, intentional control.

Our analyses show that the influence of the dimensions of personal values and personality traits included in this study, vary significantly between the two dimensions of environmental concern. This again strengthens the outcome of this study that environmental concern exists out different dimensions. Only one variable (universalism) is influencing both environmental strategy and environmental orientation positively, indicating that this factor is of importance for both dimensions of environmental concern. This maybe not that surprising as the universalism value is of specific interest with regards to the relation between humans and nature as it focuses on aspects such as “unity with nature, the world of beauty and protecting the environment” (Karppinen and Korhonen, 2013). This corresponds to many other studies (Katz-Gerro et al., 2017) emphasizing the importance of universalism in explaining environmental concern. Several studies also showed the importance of benevolence in influencing environmental concern. Harring et al. (2017), for example, reported that while pro-social individuals were found to have high environmental concern, individuals who favor personal outcomes such as seeking pleasure, have negative or insignificant link with environmental concern. The result of benevolence being so important, second to universalism, is not illogical, considering that benevolence is the neighboring value of universalism; both are concepts concerned with the enhancement of others and transcendence of self-interest (Valkeapää, 2014). What our study, however, shows, is that benevolence is only of influence for a part of environmental concern, i.e. environmental orientation. Other variables we found significantly related to one of the two dimensions, are also in the literature reported to be related to environmental concern in general. Conscientiousness, for example, is positively correlated with environmental orientation. This finding is in line with the findings of Hirsh (2010), Borden and Francis (1978) and Milfont and Sibley (2012) who reported that more conscientious people tend to have a higher environmental concern. A possible explanation for this finding can be conscientious forest owners might be expected to strictly follow policy guidelines and social norms for appropriate environmentally friendly behaviour (Hirsh, 2010). Conscientiousness has also been linked to higher levels of social investment and prudent rule-adherence in general (Lodi-Smith and Roberts, 2007). However, none of these studies explicitly focus on the different dimensions of environmental concern, stressing again the need to further explore these dimensions. Our results suggest that various dimensions of environmental concern are differently linked with personal values and personality traits. It is, however, important to stress that our results regarding the associations between personal values and traits of NIPF owners and their environmental concern should be interpreted as correlations, not as causal effects.

5.3. Influence of other variables

Next to personal values and personality traits, several demographic and socio-economic variables are significantly related to the two factors, but interestingly enough, the differences between the factors are large. Environmental strategy is significantly and positively related to the variables household size, dependence on forest income and having a diversified and certified forest holding. Educational level of forest owners and dependence on forest income are significantly and positively related to environmental orientation.

The influence of several of these variables on environmental concern in forest management was already topic of research in other studies. Uliczka et al. (2004), for example, already found that educational level was an important factor in NIPF's attitudes toward biodiversity conservation in Sweden. Studies among forest owners in other countries also show education to be a positive predictor of the likelihood of forest owners to participate in conservation activities (Van Herzele and Van Gossum, 2009), in certification programs (Thompson et al., 2010), in voluntary biodiversity conservation programs (Mitani and Lindhjem, 2015), and manage their land for carbon sequestration (Thompson and Hansen, 2012). This study, however, shows that the influence of these demographic and socio-economic variables may be different from what expected, i.e. influencing different facets of environmental concern or influencing the two facets of environmental concern differently. As this is the first study to combine personal values, personality traits, demographic and socio-economic in forest owner research, we call for further research to explore these different relations in more detail.

5.4. Implications of our results

Our results have implications for forest management practice and research. First, our results regarding the two dimensions of environmental concern imply that both dimensions need to be considered in assessing environmental concern in forest management. Emphasizing environmental orientation without due regard for environmental strategy might lead to "green washing". Second, growing concern about current pressing global challenges such as climate change has made the importance of research on social and behavioral aspects of environmental problems evident (Cruz and Manata). As outlined in the EU New Green Deal, the forest sector can play a significant role in addressing environmental challenges (European Commission, 2019). Studies have documented that efforts to alter individuals' environmental considerations through interventions often have not been successful (Cruz and Manata, 2020; Fransson and Garling). In this regard, Fransson and Gärling (1999) suggested that a necessary condition to improve the outcome of such interventions may be an increase in environmental concern and information about the causes and effects of environmental considerations. However, measuring environmental concern is a difficult endeavour (Cruz and Manata, 2020). Our study aimed at assessing environmental concern in the context of NIPF owners in Sweden and highlighted the role of taking into account personalities of NIPF owners in improving the efficacy of interventions aimed at promoting environmental considerations in forest management. Our results suggest that the individual personalities (personal values and personality traits) of forest owners, rather than their demographic and socio-economic characteristics alone are vital in shaping their environmental concern. Third, our finding that personal values are stronger than personality traits in predicting environmental concern suggests that environmental concern in forest management is a voluntary behaviour under the control of forest owners and hence can be influenced by interventions. Personal values are formed and influenced strongly by the environment of individuals, while personality traits are mostly considered to be endogenous variables (Olver and Mooradian, 2003). This has often also been the reason that these personality factors were not considered of relevance for policy change and interventions (Bleidorn et al., 2019). Bleidorn et al. (2019), however, argue that despite that personality traits

are indeed relatively stable in nature, these traits can and do change throughout the life span. They, therefore, also argue that personality claims "are ideal targets for interventions". These interventions, however, require substantial shifts in the way they should be conducted and evaluated. Further research in this respect seems to be important, considering not only interventions in terms of influencing personal values, but also and especially personality traits. Besides, future research could compare NIPF owners with industrial private forest owners with regard to their environmental concern. Another interesting research avenue could be the use of panel or time series data for assessing the effects of time variant factors such as market conditions on environmental concern. Further research could make use of quasi-experimental designs and econometric methods of causal analysis to tease out the effects of various forest management interventions on environmental concern of NIPF owners and assess the relative importance of potential factors that can influence environmental concern.

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CRedit authorship contribution statement

Mohammed B. Degnet: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Helena Hansson:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition, Project administration. **Marjanke A. Hoogstra-Klein:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Anders Roos:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.forpol.2022.102767>.

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