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Effects of Policy Measures and Moderating Factors on Climate Change Adaptation Among Private Forest Owners in Sweden

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ABSTRACT

Threats associated with climate change may damage forests. To encourage adaptation in countries with a lot of privately owned forest, policy measures directed at private forest owners may be implemented. By means of policy scenarios, the present study examined the effects of two hypothetical policies: an advice and an economic incentive, on climate change adaptation among private forest owners in Sweden ($n = 753$ and $n = 729$). Both policies strengthened the intention to adapt although results also revealed that individual variables (i.e., forest values) and a contextual variable (i.e., being in an encouraging social risk management context) were important for the owners' response. Production forest values and social risk management context furthermore moderated the effect of policy on intention to adapt, suggesting that the economic incentive was mainly more effective than the advice among owners with strong production values and among owners in less encouraging social risk management contexts.

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Climate change adaptation; ecological values; forest risk management; policy measures; production values; social risk management context

Introduction

The health of forests is threatened by various stressors including biotic disturbances, such as pest and disease outbreaks, and abiotic disturbances, including fire and wind storm (Trumbore, Brando, and Hartmann 2015). Forests have always been subject to damages although with a changing climate damages may increase (Lindner et al. 2010; Keenan 2015). Adaptation to climate change concerns adjusting to real or expected climatic stimuli or consequences thereof in both the ecosystem and the socioeconomic system (e.g., economic and technological developments, infrastructure, knowledge, institutions) (Lindner et al. 2010; Intergovernmental Panel on Climate Change [IPCC] 2011). Since trees have a long life-span, forests do not quickly adapt to a changing climate. However, it is possible to, in the long term, adapt, for instance, using more broadleaves and fewer coniferous trees, more mixed forests, and changing the rotation length and thinning schedule (Fuhrer et al. 2006; Bouriaud et al. 2015).

The implementation of aligned and nonconflicting policies can be considered key to a successful climate change adaptation in the forest sector (Keenan 2015). To inform

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policymakers, a bottom-up perspective clarifying the target groups' evaluations of and responses to policies is needed. In countries where a large share of the forest is owned by individual private forest owners, also labeled family forest owners or non-industrial private forest owners (e.g., in the United States, Finland, Germany, Sweden), adaptation to climate change requires the involvement of a large group of often heterogeneous individuals with different sociodemographic characteristics and objectives for owning forest (Ní Dhubháin et al. 2007). Although, for example, forestry experts and professionals have been found to display concern for climate change (Williamson, Parkins, and McFarlane 2005; Yousefpour and Hanewinkel 2015), studies suggest that among actors in the forest sector climate change is considered uncertain and generally not among the most urgent issues (Grotta et al. 2013; Eriksson 2014; Lawrence and Marzano 2014). To learn more about responses to climate change policy measures, the present study examined intention to adapt to climate change in response to hypothetical policy scenarios (i.e., an advice versus an economic incentive) among individual private forest owners in Sweden.

Approaches to Promote Behavioral Change

In the environmental domain, two overall approaches have been identified to promote individuals' behavioral change: (1) informational measures and (2) structural changes of the behavioral choice situation (e.g., changes in the physical context, economic incentives/disincentives) (Steg and Vlek 2009). Without actually improving any of the choice alternatives, informational measures are expected to change perceptions, motivations, knowledge, and/or norms to achieve a change in behavior. In contrast, structural changes attempt to make the desired behavioral choice more attractive (or alternatives less attractive) by means of a real contextual change. Because people are different however, it is not very surprising that informational measures that match the needs of the target group, that is tailored measures, tend to be more effective (Abrahamse et al. 2005; Bostrom, Böhm, and O'Connor 2013). In line with this reasoning, there is a need to understand how different individuals respond to different types of behavioral change measures.

Potential Moderators of the Policy–Behavior Relationship

Various individual factors including, for example, values and attitudes, but also contextual factors such as the physical and social setting, are important for how individuals' act in relation to the environment and natural resources (Stern 2000). There is furthermore evidence suggesting that both individual and contextual factors may act as moderators indicating that the influence of policy on behavior is dependent on these factors (Figure 1).

The cognitive hierarchy model stipulates that cognitions about a topic are hierarchically ordered and the more general cognitions, including basic values and general beliefs are the foundation for more specific beliefs and attitudes (McFarlane and Boxall 2003). Basic values are preferred end states or specific modes of conduct (e.g., freedom, protecting the environment) and transcending situations these values act as general guiding principles in people's lives (Schwartz 1992). General forest beliefs, or forest values, are more specific and reflect the reasons why humans value forests, including the value of forests for humans (e.g., production) and for the biosphere (Manning, Valliere, and Minteer 1999; McFarlane and Boxall 2003). Studies have shown that to what extent forest owners value the forest for production, ecology or recreation has implications for attitudes and management

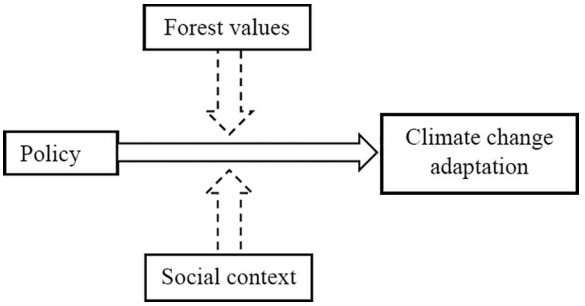

Figure 1. The influence of policy on climate change adaptation, with forest values and the social context acting as moderators.

(Nordlund and Westin 2011; Põllumäe, Korjus, and Paluots 2014). In addition, the response to informational measures has been found to be dependent on people's values. For example, informational messages tailored to fit with the target groups' values (i.e., a value match) have been found to increase the acceptability of a policy to a greater extent compared to when there is a value mismatch (Nilsson et al. 2016; see also Bolderdijk et al. 2013). Because responses to policies may depend on people's values, these internal cognitions may be said to act as moderators of the policy–behavior relationship.

Even when management decisions are the result of an individual's reasoning however, the social context is likely to also play a role (Ruseva, Evans, and Fischer 2014; Sagor and Becker 2014; Truelove, Carrico, and Thabrew 2015). The social context contains information regarding which behaviors are approved or not approved of (i.e., injunctive social norms) and which behaviors are typically performed (i.e., descriptive social norms) (Cialdini, Reno, and Kallgren 1990). In addition, support from others (e.g., emotional, appraisal, informational, or instrumental support) are potentially important for an individuals' actions (Stroebe and Stroebe 1996). Situational cues, such as descriptive social norms, can thus support, or counteract, an individual's internal motivation to act (Steg et al. 2014). When a certain behavior is not supported by the social context, more forceful policy measures may be needed to achieve a behavioral change (e.g., incentives or contextual changes rather than information). Hence, the social context may also act as a moderator of the policy–behavior relationship (Steg and Vlek 2009).

Climate Change Adaptation Among Individual Private Forest Owners

Private forest owners vary in the extent to which they believe that climate change will have an impact on their forest (Blennow et al. 2012; Bisonette et al. 2017). Although the uncertainty associated with climate change is often highlighted by the owners, an increase in the risk for drought, wind, flooding, insects, and fungi, but also increased tree growth have been acknowledged (Blennow 2012; Eriksson 2014). Climate change adaptation among private forest owners has involved increasing diversity in tree species composition (e.g., more mixed forest and more broadleaves), as well as varying the rotation length and silvicultural treatments. However, the share of owners stating that they have taken measures to adapt to climate change vary greatly between countries (e.g., 20% in Sweden, but approximately 50% in Portugal and Germany) (Blennow et al. 2012; see also Blennow 2012; van Gameren and Zaccai 2015; Bisonette et al. 2017). Studies suggest that both policy (financial

incentives) and sociocognitive factors (e.g., personal beliefs) are important for climate change adaptation (Blennow et al. 2012; van Gameren and Zaccai 2015). However, more systematic examinations of the effects of climate change policy measures are lacking.

The Study Context

In Sweden, forest covers almost 70% of the land area and coniferous trees, mainly Norway Spruce and Scots Pine, are the dominating tree species (Swedish Forest Agency [SFA] 2014). The forest is an important economic asset in Sweden being among the countries in the European Union with the largest production of roundwood and sawnwood in 2013 (Eurostat 2015). Approximately, 50% of the forest is owned by almost 330,000 individual private forest owners (SFA 2014). Main causes of damage to forests include wind, insects, fungi, browsing animals, and heavy wet snow. Climate change is furthermore expected to lead to increased risk of damage from fungi, insects, spring frost, and wind (Statens Offentliga Utredningar [SOU] 2007). Risk-spreading has been promoted as a way to adapt to climate change mainly by promoting diversity in management with respect to both tree species composition and management strategy (Eriksson et al. 2016).

In the Swedish forest policy, the environmental and production objectives are equally important (Swedish Gov. Bill 2007/08: 108). Information and advice are the most important instruments to fulfill the goals of the forest policy although regulations and financial instruments are used as well (Johansson and Keskitalo 2014). The Swedish Forestry Act offers forest owners a large degree of freedom; however, the forestry sector has a responsibility to do even more than the regulations demand (i.e., "freedom under responsibility"). In this context, it is important to learn more about how policies can be used to influence the management behaviors of private forest owners.

The Present Study

The aim of the present study is to examine climate change adaptation among individual private forest owners in Sweden in response to two hypothetical policy scenarios attempting to encourage adaptation. Methodological insights from environmental psychology were utilized to enable a systematic examination of adaptation (Steg and Vlek 2009; Steg et al. 2014). The study was conducted by means of a questionnaire with an experimental setup. Half of the respondents were asked to state their intention to adapt if they received advice to do so by the Swedish Forest Agency (SFA), and the other half were asked to consider whether they would adapt if an economic incentive was implemented. Climate change adaptation was explored in terms of risk-spreading in management including incremental changes (e.g., increasing the share of mixed forests) as well as transformational changes (e.g., the use of new tree species) (cf. Pinkard et al. 2015). Although a strong intention does not mean that this management will be carried out in the future, intention has been identified as a direct antecedent of behavior (Ajzen 1991). Since this study aimed to compare the effects of policies when the owners had been randomly assigned to assess one of the two policies, intention (using specific behavioral indicators) was considered a good enough proxy for future behavior.

Hypotheses depicting main effects of policy measure, forest values, and social risk management context on adaptation intentions were developed, but also hypotheses stipulating that responses to policy measures were dependent on individual and contextual variables

(i.e., the effect of moderators). Hypothesis 1 (H1) stipulates a main effect of policy on adaptation intentions. Since the structural measure actually changes the context and makes adaptation more favorable, the economic incentive was expected to have a larger impact on intentions than advice. Furthermore, since both forest values and the social context have been found to be important for management (Kueper, Sagor, and Becker 2013; Põllumäe, Korjus, and Paluots 2014), main effects of production values, ecological values, and social risk management context were expected. More specifically, adaptation intentions were expected to be stronger among owners with stronger production values (Hypothesis 2, H2), stronger ecological values (Hypothesis 3, H3), and among those part of a more encouraging social risk management context (Hypothesis 4, H4).

Furthermore, forest values and the social risk management context may act as moderators (Steg and Vlek 2009; Nilsson et al 2016). Since the economic incentive can be considered more in line with the interests of the owners emphasizing production values (i.e., a value match) (Nilsson et al. 2016), the economic incentive was expected to be particularly influential on owners with stronger production values but have a lesser impact on owners with stronger ecological values. Hypothesis 5 (H5) thus stipulates an interaction between policy and production values and Hypothesis 6 (H6) an interaction between policy and ecological values. Furthermore, since owners in less encouraging social contexts may be in need of more forceful changes, the economic incentive was expected to have a larger effect on owners in a less encouraging social risk management context. Hypothesis 7 (H7) accordingly stipulates an interaction between policy and the social risk management context. Although the main dependent variable in the present study was intention to adapt in response to policy, to enable comparisons past adaptation was also examined. In addition, the main hypotheses were analyzed while controlling for different owner categories as well as past adaptation to verify the results on different types of forest owners and those already involved in adaptation.

Methods

Respondents

The analyses are based on results from a postal questionnaire of a randomly selected sample of individual private forest owners in Sweden, 20–80 years, owning more than 5 ha of forest land. The study was conducted by Statistics Sweden in the autumn of 2014. After two reminders, the response rate was 50% ($n = 1482$).

Questionnaire

The questions analyzed in this study were part of a longer questionnaire although only the questions relevant for this study are described here. Theory and previous research were utilized when preparing the questionnaire and forest damage experts at the SFA, as well as private forest owners, provided further insights. Information about the region where the forest estate/s were located, north, middle, or south (corresponding to the organizational setup of the SFA) was taken from the property register at Statistics Sweden. In the questionnaire, several background questions were asked including gender, age, whether they were resident or non-resident owner, and the size of forest holding/s.

Forest values: The owners' responded to how important they believed production (e.g., timber or biofuel) and biodiversity (diversity in plant and animal life) were as follows: (1)

in their own forest and (2) in the Swedish forest in general, on a seven-point scale (1 = not at all important, 7 = very important). Index variables were created by calculating the means of the two items for production values and ecological values, respectively.

Social risk management context: Six items were utilized to create an index variable of the social risk management context, ranging from less to more encouraging. One item reflected how often the owner had collaborated with other forest owners to deal with forest risks (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always). In addition, two items measured descriptive norms in terms of the extent to which other forest owners were perceived to strive to prevent forest risks, and the extent to which the SFA was perceived to strive to encourage forest owners to prevent forest risks (1 = not at all, 5 = to a great extent), and three items assessed social support, that is, the extent to which they perceived it to be possible to receive support from other private forest owners, forest owners' associations, and the SFA when handling forest risks (1 = not at all, 5 = to a great extent). The means of the six items were used as an indicator of social risk management context.

Past climate change adaptation: Before the policy scenarios were described, respondents indicated how often they had previously used the five management strategies depicted in Table 1 on a five-point scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always). These were subsequently summarized into an index variable on a scale from 5 to 25.

Change intention and intention to adapt in response to policy: Intention to adapt was assessed in response to advice in half of the sample (randomly selected) ($n = 753$) and in response to an economic incentive in the other half of the sample ($n = 729$). After a general introduction including a description of risk-spreading as a way to adapt to climate change, the advice scenario included a description of how the SFA provided the owner with the advice to use risk-spreading to prevent damages on their forest. In contrast, the scenario of the economic incentive described how the SFA provided the owner with 70% of the additional cost compared to more traditional management if they were to implement strategies that contribute to risk-spreading to prevent damages on their forest. The owners in both groups were first asked to indicate how likely it would be that they would change their forest management if the policy (advice or economic incentive) was implemented on a five-point scale (1 = not at all likely, 5 = very likely) (i.e., change intention). Subsequently, they stated how likely it would be that they would use the five strategies described in Table 1 in the future if the policy was implemented on a five-point scale (1 = not at all likely, 5 = very likely). The means of the five items were combined into an index variable reflecting the intention to adapt in response to policy.

Analyses

Climate change adaptation was initially examined by exploring change intention and the intention to adapt in response to the two policy measures, as well as the level of past adaptation. Bivariate correlations using Pearson were subsequently utilized to explore relations between the study variables. The hypotheses were examined by means of an ANCOVA, including the main effects of policy (factor), production values, ecological values, and social risk management context (covariates), as well as the three interaction terms between policy and the individual and contextual variables. To interpret the significant interaction effects, results were displayed in line charts after splitting the sample

at the mean (e.g., creating groups with weak versus strong production values). In an additional ANCOVA (placed in the Appendix), gender, age, residency, size of forest holding, region, and past adaptation were controlled for.

Results

The Sample

In the sample, 25% were women, and mean age was 61 years (SD = 11.4). The size of forest holdings was on average 96.3 ha (SD = 191.9) and about half of the respondents (47.2%) were resident owners. A larger share of the owners owned forest in the south region (42.2%) and an almost equal share of the owners owned forest in the north and middle regions (28.3 and 28.9%, respectively). The sample was fairly representative for the population of forest owners in the property register although it did contain slightly more men and owners older than 60 years (for more details, see Eriksson 2017b). The two groups of owners evaluating the different policies were furthermore equivalent regarding gender distribution, age, region, residency, and size of forest holdings.

Climate Change Adaptation

Both the advice and the economic incentive strengthened the intention to use different adaptation strategies, and site-adapted forestry was the strategy that would be most likely used (Tables 1 and 2). However, whereas the intention to increase the share of new tree species was stronger for the group evaluating the economic incentive compared to the advice, no differences were found for the other strategies, change intention, and the index variable of overall intention to adapt in response to policy. Past adaptation was generally not very frequent, but comparable to intentions, site-adapted forestry was the most commonly used strategy.

Bivariate Correlations

The bivariate correlation between past adaptation and intention to adapt in response to policy was positive, but not particularly strong (Table 2). Both measures of adaptation, however, displayed similar correlations with forest values and the social risk management

Table 1. Past adaptation and intention to adapt to climate change in response to policy, advice, and economic incentive, respectively.

	Past adaptation[a] ($n = 1482$)	Intention to adapt in response to advice[b] ($n = 753$)	Intention to adapt in response to economic incentive[b] ($n = 729$)
	M (SD)	*M* (SD)	*M* (SD)
Change intention	—	3.17 (1.12)	3.27 (1.26)
Increase/d the share of mixed stand	2.58 (1.20)	3.18 (1.17)	3.17 (1.21)
Increase/d the share of deciduous stand	2.46 (1.17)	3.01 (1.20)	3.07 (1.24)
Increase/d the share of new tree species (e.g., European larch)	1.42 (0.85)	2.21 (1.21)	2.40 (1.32)**
Always implement/ed site-adapted forestry	2.81 (1.32)	3.76 (1.11)	3.76 (1.12)
Increase/d the variation in felling age and thinning program	2.14 (1.09)	3.23 (1.09)	3.25 (1.15)

[a]Scale 1–5 (never, seldom, sometimes, often, always).
[b]Scale 1–5 (not at all likely, very likely).
**$p < 0.01$.

Table 2. Internal reliability (α), means, standard deviations, and bivariate correlations between past adaptation, intention to adapt in response to policy, ecological values, production values, and social risk management context.

	Past adaptation	Intention to adapt in response to policy	Ecological values	Production values	Social risk management context
Past adaptation[a]	11.32 (4.27)				
Intention to adapt in response to policy[b]	0.36***	$\alpha = 0.77$, 3.08 (0.85) $\alpha = 0.81$, 3.13 (0.92)			
Ecological values[c]	0.14***	0.23***	$\alpha = 0.90$, 4.94 (1.64)		
Production values[c]	0.20***	0.23***	0.28***	$\alpha = 0.81$, 5.92 (1.37)	
Social risk management context[d]	0.30***	0.31***	0.20***	0.23***	$\alpha = 0.76$, 2.70 (0.78)

Note. Intention to adapt in response to policy, upper row advice: $n = 753$, lower row incentive: $n = 729$.
[a]Scale 5–25 (ranging from never to always).
[b]Scale 1–5 (ranging from not at all likely to very likely).
[c]Scale 1–7 (ranging from not at all important to very important values).
[d]Scale 1–5 (ranging from weak to strong social risk management context).
***$p < 0.001$.

context although the association between ecological values and past adaptation was slightly weaker than between ecological values and intention to adapt in response to policy.

Predictors of Intention to Adapt in Response to Policy

The ANCOVA revealed that in line with the descriptive analysis, policy measure was not a significant predictor of intention to adapt to climate change, contradicting H1(Table 3). However, in line with H2, H3, and H4 production values, ecological values, and social risk management context had significant effects on intention to adapt in response to policy. In addition, two of the interaction effects were significant, between policy measure and production values and between policy measure and social risk management context, thus supporting H5 and H7, but not H6. The interactions are displayed in Figure 2 suggesting that the economic incentive was mainly more effective than the advice among owners with strong production values and among owners in a less encouraging social risk management context. The effect sizes were generally small but for social risk management context it was moderate. In the second ANCOVA (available in the Appendix), past adaptation, region, and age were also significant predictors (reflecting a stronger intention among those already engaged in adaptation, among owners in the south region, and among younger owners), and the adjusted R^2 increased from 13.5 to 23.3. However, the hypothesized predictors remained significant, thus indicating that the results are valid in different owner categories.

Table 3. Results from the ANCOVA of intention to adapt in response to policy by policy measure, production values, ecological values, the social risk management context, and interaction terms.

	Df	*F*	Partial η^2	*p* values
Policy (advice)	1	1.189	0.001	0.276
Production values	1	18.761	0.014	0.000
Ecological values	1	31.851	0.023	0.000
Social risk management context	1	82.817	0.058	0.000
Policy × production values	1	4.330	0.003	0.038
Policy × ecological values	1	0.532	0.000	0.466
Policy × social risk management context	1	10.814	0.008	0.001

Adj. $R^2 = 0.135$.

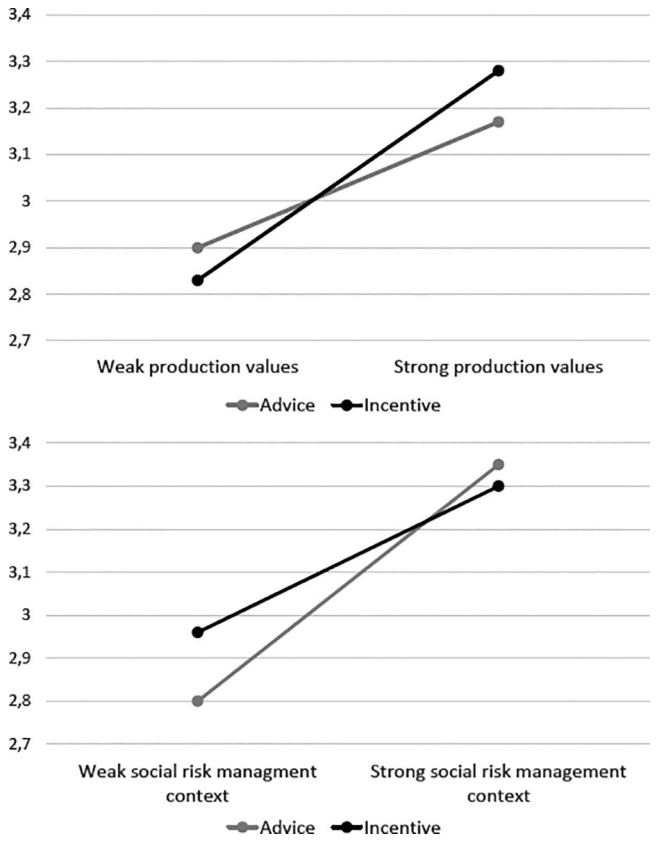

Figure 2. Illustration of the significant interaction effects: Upper panel: intention to adapt in response to policy as a function of policy measure and production values. Lower panel: intention to adapt in response to policy as a function of policy measure and the social risk management context. Five-point scale (1 = not at all likely, 5 = very likely).

Discussion and Conclusion

Different policy measures can be employed to encourage climate change adaptation in a forest context. While an economic incentive attempts to make climate change adaptation more attractive, advice from an authority could potentially increase knowledge and make the owners feel that they can in fact do something (i.e., creating a more positive view on coping). Both policies can furthermore signal that this is the right way to respond to climate change thus comprising a normative pressure (cf. Steg and Vlek 2009). Although the present study does not provide exact estimates of how much different policies would influence adaptation, results indicate that both advice and economic incentives can strengthen the intention to change forest management and accordingly influence adaptation behaviors (cf. van Gameren and Zaccai 2015). The considerable economic incentive examined in this study did, however, not strengthen the overall intention to adapt more than the advice, in contrast to Hypothesis 1. The relatively strong impact of advice in this context may be linked to the fact that advice is appreciated and has a long tradition in the forest sector in Sweden (Johansson and Keskitalo 2014; Eriksson 2017a). Because it is not

plausible to reach the whole target group with an advice in a real-world setting; however, this effect may have been overestimated.

This study furthermore suggests that it is important to consider both individual and contextual factors when implementing policy measures directed at forest owners, thus highlighting the role of tailoring in a forest context. The significant main effects of forest values and social risk management context on adaptation intentions (in line with Hypotheses 2–4) indicate that different policies, in this case, an advice and an economic incentive, are more likely to be effective among owners with stronger internal motives to adapt and when the social context encourages risk management. Adding to previous studies of the link between forest values and forest management in general (Nordlund and Westin 2011), the present study revealed links between forest values and climate change adaptation more specifically. Whereas ecological values have been found to be important for behaviors mitigating environmental problems (Nordlund and Garvill 2002), both ecological and production values were significant drivers of climate change adaptation in response to policy in this study. Since mitigation and adaptation behaviors may be determined by slightly different factors however (Haden et al. 2012; Brügger, Morton, and Dessai 2015), and climate change adaptation is likely needed also to maintain forest production in the future, this result is reasonable. Notably, though, since the impact on the forest may be different depending on how the strategy is implemented (e.g., striving toward diversification versus extensively planting only a few new production species) (cf. Hengeveld et al. 2014), whether the owner is motivated by production or ecological values may still lead to diverse effects on the forest. Contrary to Blennow et al. (2016) who found only marginal support for the importance of value profiles for belief in the local effects of climate change among forest owners in Sweden (environmentalists displayed a stronger belief) and no such connection among owners in Germany, the present study suggests that the importance of forest values for responses to climate change cannot be ruled out. Nevertheless, an encouraging social context may be even more important than forest values for climate change adaptation. The emphasis on understanding the role of local social factors, such as personal relationships (Guillén, Wallin, and Brukas 2015), exchange between peers (Kueper, Sagor, and Becker 2013), and more or less formal social networks (Ruseva, Evans, and Fischer 2014) has increased recently. Although social ties may provide valuable information, support, and norms for appropriate management, informal social ties can encourage any management option and thus act either as significant facilitators, or barriers, of climate change adaptation.

The present study furthermore revealed significant interactions in support of Hypotheses 5 and 7. More specifically, the economic incentive was found to be more effective than the advice only among owners with strong production values and among owners in contexts where risk management is not encouraged. In other words, results suggest that the advice is more, or at least equally effective, as the incentive among owners with weak production values and among owners in an encouraging social risk management context. Perhaps are economic incentives most useful when attempting to boost the use of strategies that are currently not perceived as viable options at all. In the present study, the owners had rarely attempted to increase the share of new tree species before (a transformational adaptation strategy, cf. Pinkard et al. 2015) and the economic incentive strengthened the intention more than the advice did. Because of high costs associated with implementation, the cost-effectiveness of economic incentives can nevertheless be questioned. Overall, policy measures undoubtedly need to be evaluated, not only in terms of, for example,

effectiveness and cost-effectiveness, but also in terms of acceptability among forest owners and the general public to ensure they are legitimate. In addition, the institutional capacity to govern the implementation needs to be assessed (Cusack et al. 2014).

The results from the present study may furthermore be considered in relation to the potential need for targeting sub-groups of owners to increase adaptation (Bostrom, Böhm, and O'Connor 2013). Because owners with weak production values, and those in less supportive risk management contexts, displayed lower adaptation levels in the past (see Table 2 for bivariate correlations), these groups of owners are likely to need interventions the most. Although this study suggests that the effect of the examined policy measures on these owners would be of a smaller magnitude, doing something is probably better than doing nothing. Future research may aid in revealing what type of intervention these low adaptation owners would respond to, including both traditional policy measures such as economic incentives and disincentives, but also for example whether encouraging collaboration in social networks where risk management occurs would in itself promote adaptation.

When interpreting the results, there are limitations to consider. Although the sample and the population displayed comparable sociodemographic profiles, forest owners less involved in making forest management decisions, for example allowing forestry advisors to plan for their forest, are presumably under-represented in the sample (cf. Eriksson 2017b). The dependent measure in this study may furthermore be questioned on the grounds that it may not fully reflect actual adaptation in the future. Although there were commonalities between the measure of intention to adapt and past adaptation there were also differences (e.g., the strategies implemented in the past were generally also expected to be implemented in the future, and the two index measures displayed similar correlations with the examined predictor variables, but the correlation between the two index measures was weak). These results are consistent with the fact that the measures represent to some extent different things: adaptation in the past versus adaptation in a partly changed policy context in the future. Since the present study compared the effect of policies in two independent groups, intention to adapt in response to policy was considered a good enough measure. Although several of the effects in this study were significant, particularly the interaction effects had small effect sizes. Since the interactions are theoretically justified, and helps to clarify the nonsignificant main effect of policy measure; however, they should be considered.

According to Bouriaud et al. (2015) and Lindner et al. (2010), a lot of privately owned forests is a potential barrier to climate change adaptation in forestry. One reason for not adapting may be that the owners do not perceive climate change to be an urgent issue (Blennow 2012; Blennow et al. 2012). Since practical knowledge based on past experiences is generally important in forestry, and changes in forest management may thus often be gradual, change in response to an upcoming threat, such as climate change, may be hard to achieve (Lidskog and Sjödin 2014). Despite this rather grave outlook, the owners in the present study were willing to make changes in response to the examined policies. Since results further revealed that internal drivers as well as the context were found to be important for responses to policy even when different structural factors, for example residency and size of forest holding, were controlled for, implications for governance may be discussed. By means of collaborations with forest owner associations and via their own outreach channels, the responsible agency may, for example, strive to create a more encouraging social context where adaptation is the norm rather than the exception. In

addition, by highlighting different reasons for adaptation, it is possible to convince more owners of the value of adaptation. Although structural changes may be required, they should be carefully selected, perhaps mainly considered when transformational changes are necessary. In sum, by drawing on environmental psychology regarding both theory and methods (Clayton et al. 2016), this study reveals individual level motives and barriers, and highlights the potential need for tailoring. This micro-level analysis is an important complement to macro-level analyses of policies in this context (Keenan 2015).

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Appendix

Table A1. Results from the ANCOVA of intention to adapt in response to policy by policy measure, production values, ecological values, the social risk management context, and interaction terms, while controlling for gender, age, residency, size of forest holding, region, and past adaptation.

	df	*F*	Partial η^2	*p* values
Policy (advice)	1	1.074	0.001	0.300
Production values	1	5.100	0.004	0.024
Ecological values	1	30.158	0.023	0.000
Social risk management context	1	42.972	0.032	0.000
Policy × production values	1	4.474	0.004	0.035
Policy × ecological values	1	0.218	0.000	0.641
Policy × social risk management context	1	12.136	0.010	0.001
Gender	1	0.821	0.001	0.365
Age	1	16.723	0.013	0.000
Residency (resident owners)	1	0.542	0.000	0.462
Size of forest holding (large-scale owners)	1	3.184	0.003	0.075
Region (south)	1	9.064	0.007	0.003
Past adaptation	1	93.511	0.069	0.000

Note. Dummy coding of gender: women = 1, men = 0, residency: resident owner = 1, non-resident owner = 0, size of forest holding: 50 ha or more = 1, <50 ha = 0, region: south = 1, north and middle = 0.
Adj. $R^2 = 0.233$.