Public Perceptions and Acceptance of Intensive Forestry in Sweden

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Abstract The use of intensive forestry on part of the forested area in Sweden increases the production of forest biomass and enables an increased use of such biomass to mitigate climate change. However, with increasing conflicting interests in forests and forestry, the success of such a strategy depends on the public acceptance. In this paper, the results of a mail survey show that although a majority of the general public in Sweden supports measures to increase forest growth, they oppose the use of intensive forestry practices such as the cultivation of exotic tree species, clones, and forest fertilization. The acceptance of such practices is mainly influenced by the perceptions of their environmental consequences. Public acceptance was highest for forest fertilization, whereas clone cultivation was the least accepted practice.

Keywords Intensive forestry · Acceptance · Perceptions · General public · Sweden

INTRODUCTION

Implementation of intensive forestry practices such as the cultivation of exotic tree species, cultivation of clones, and forest fertilization on part of the forested land area in Sweden increases forest growth and enables a greater use of forest biomass to substitute more fossil energy intensive materials and fuels. This may support the government policies to reduce oil dependency, increase the reliance on renewable energy sources, and mitigate climate change (Larsson et al. 2009). However, the use of intensive forestry may also affect other valuable functions of the forest (Larsson et al. 2009) and involve trade-offs with ecological sustainability (Colombo et al. 2012). Environmental risks associated with the introduction of exotic trees

include self-dispersal of the species to new environments, the spread of pathogens and pests to native systems and ecosystems and changes to ecosystem processes, structures, and biodiversity (Engelmark et al. 2001). The risks of clone cultivation include susceptibility to fungi or insect attacks (Bishir and Roberds 1999) and decreased biodiversity (Carnus et al. 2003). Fertilizing may lead to altered species composition, acidification, and nutrient leakage (Gustafsson et al. 2009).

An important stakeholder group in national issues of forests and forestry is the general public. The relationship of the general public to the forest works on several levels. The public may visit the forest for e.g., recreational or rehabilitation purposes. Forests also produce a number of ecosystem functions (e.g., clean water, biodiversity) that can be considered common-pool resources (Sandström et al. 2011). Further, forestry and its related industries are important to the national economy. Approximately 55 % of Sweden's land area is covered by boreal forest of which most is used for timber production (Swedish Forest Agency 2010). Sweden's present forest policy and management emphasizes production and environmental protection as parallel goals (Sandström et al. 2011). However, the Swedish forest sector is increasingly affected by global trends of changing energy systems, climate politics, governance systems, and land use systems (Beland and Westholm 2011) and an increased competition between different functions (e.g., economic, environmental, recreational) of the forest is predicted (Sandström et al. 2011). Given that any forest policy influences various forest functions, and that forest policy in a democratic society such as Sweden, at least in theory, is influenced by public opinion, it is of interest to understand what the public acceptance of intensive forestry is, and what factors it may depend on. Incorporating the public opinion in the forest

policy may result in greater acceptance of forest practices and policies (Pappila and Pölönen 2012) and reduce risk of activist behavior (McFarlane and Hunt 2006). The implications of the public acceptance of intensive forestry are vast, since public policies may change the behavior of many people and organizations (Stern 2000).

Little is known about the public acceptance of intensive forestry practices. Swedish forestry has long favored fast-growing indigenous conifers and the use of exotics has been limited. A predicted timber shortage led to the large-scale introduction of the North-American Lodgepole pine in the 1970s. However, environmental concerns and problems with pathogens and tree instability led to increased restrictions and in 2001, approximately 3 % of the productive forest land was covered in Lodgepole pines (Engelmark et al. 2001). One study from 1989 suggest that such forest stands might be perceived as less natural than stands of indigenous tree species, but not less suitable for recreation (Kardell and Wallsten 1989). Forest fertilization has been used in Swedish forestry since the 1950s, mostly in large-scale forestry. The use of fertilizers peaked in the 1970s, after which reports and public debates regarding environmental effects such as eutrophication, acidification, and reduced biodiversity contributed to increasing restrictions and a decrease in forest fertilization (Lindkvist et al. 2011). Although modern methods of fertilizing are developed to minimize negative effects to the environment, public perceptions based on such previous experience may remain (Lindkvist et al. 2011, 2012). The cultivation of clones is used on a smaller scale, primarily in southern Sweden (Simonsen et al. 2010), but both public and forestry experience with clones is limited.

Studies of public attitudes towards forestry suggest that the general public in Nordic countries, compared to the one in other European countries, has a close relationship to and positive image of forests and forestry (ECORYS 2009). However, although the public may accept economic uses of the forest, environmental aspects such as the protection of biodiversity are perceived to be more important (Manning et al. 1999; ECORYS 2009; Eriksson 2012). The public generally favor forest management that emphasizes multiple uses of the forest rather than one that benefits a single constituency (Manning et al. 1999; Ribe 2006). There also seem to be a growing public awareness that the future of the forest is linked to broader issues of climate change and energy transition (ECORYS 2009; Beland and Westholm 2012). A majority of European citizens believe that growing trees can help mitigate climate change (ECORYS 2009).

Swedish and international studies on public preferences for forest management options suggest that it may depend on a multifold of factors, including region, urbanity, gender, age, and experience with forestry (Elands et al. 2004;

Gundersen and Frivold 2008; ECORYS 2009; Clement and Cheng 2011). Some forest studies have linked preferences or forest management attitudes to cognitive aspects such as values and beliefs (e.g., Manning et al. 1999; Ford et al. 2009; Clement and Cheng 2011). For example, investigating the linkage between value orientation, beliefs about consequences of clearfelling, and acceptance of clearfelling, Ford et al. (2009) concluded that values and beliefs are important underlying factors in social acceptability judgments. In relation to this, interviews of different stakeholders regarding intensive forestry in Sweden indicate that negative perceptions formed in past conflicts over the intensification of forestry may remain (Lindkvist et al. 2012).

The aim of this study is to understand if the general public of Sweden accepts the use of exotic tree species, forest fertilization, and clones in Swedish forestry, and how perceptions influence the acceptance of such intensive forestry practices. Following Rogers' (2003) diffusion of innovations theory, we test if the public acceptance depends on the perceived need to increase forest growth, the perceptions of current forest management, and the perceptions of the intensive forestry practices. The purpose of this study is not to conclude whether or not intensive forestry should be implemented in Sweden, but to understand the public attitude towards such a strategy. Although our study uses data gathered from a survey of the general public in Sweden and has direct implications for forest management in Sweden, it also has international relevance. Public perceptions of forests and forestry in boreal forest countries (e.g., other Nordic countries, Canada, USA) have many similarities (e.g., Gundersen and Frivold 2008; ECORYS 2009). Additionally, the adoption of intensive forestry in Sweden could influence the adoption of such practices in other boreal forest countries that have similar forestry. International interest in silvicultural treatments such as fertilization and species selection to mitigate climate change has recently increased (Grayston 2007).

MATERIALS AND METHODS

Theoretical Framework

The theory of the diffusion of innovations (Rogers 2003) is a widely used framework to understand the adoption of an idea, practice or object that is perceived as new by potential adopters. Because the intensive forestry practices of this study are limited by regulatory restrictions in Sweden they are expected to be unfamiliar to the majority of Swedish people. Therefore, following the definition by Rogers (2003), the intensive forestry practices are innovations. The general public may not be directly involved in adopting

Fig. 1 Overview of the theoretical framework of the study

intensive forestry practices, but they may express their opinions about the adoption of such innovations. In other words, the degree to which the public accepts (favors or opposes) intensive forestry practices can be interpreted as the adoption of the idea that intensive forestry is used by a forest owner or society. This is a type of non-activist, environmentally significant behavior (Stern 2000) which, whether the public accepts intensive forestry or not, has implications for forest policy and management.

The diffusion of innovations theory (Rogers 2003) suggests that the adoption of an innovation is not a single act, but a process that occurs over time. In this “innovation–decision process” potential adopters go through five different stages while deciding about adopting an innovation. The process is initiated by a set of prior conditions, among which is perceived needs or problems. If existing conditions are satisfactory, and potential adopters do not perceive a need for change, the innovation may not be adopted. In the knowledge or awareness stage, the potential adopter learns about the existence of the innovation and may seek further understanding of what it is. This stage is influenced by personal characteristics, socioeconomic factors, and access to change agents like mass media. In the following persuasion or evaluation stage, the individual form a negative or positive attitude towards the innovation. Here, the degree of uncertainty about the innovation and the social reinforcement from others may affect the individual’s opinions and beliefs about the innovation. In the decision stage the individual chooses to adopt or reject the innovation. The implementation stage occurs when the innovation is actually used, and in the final confirmation stage the adopter either continues or discontinues use of the innovation (Rogers 2003).

In the persuasion or evaluation stage of the innovation–decision process, potential adopters evaluate the attributes associated with the innovation. An important attribute is the relative advantage, or the degree to which the innovation is perceived to be better compared to other options or compared to what it replaces (Rogers 2003). Innovations that are perceived to be better are more likely to be adopted. Perceptions are here referred to as the evaluative beliefs about attributes of the innovation, i.e., the innovation-specific beliefs or the way the innovation is understood. This notion corresponds to the generally accepted understanding (see, for example, Ajzen and Fishbein 1980;

Vaske and Donnelly 1999) that beliefs about a phenomena or behavior (e.g., outcome expectancies of adopting an intensive forestry practice) are important antecedents to the attitude or behavior towards the phenomena (e.g., acceptance of intensive forestry practices).

Following the innovation–decision process as described by Rogers (2003) important elements for the public acceptance of intensive forestry practices is the perceived need for intensive forestry and perceived advantages or disadvantages of implementing such practices. An individual who perceives a need to increase forest growth may be more accepting of intensive forestry than one who does not. Further, an intensive forestry practice with more perceived advantages is more likely to be accepted than one with fewer perceived advantages. Such advantages or disadvantages may be perceived in relation to the current forest management as well as in relation to alternative intensive forestry practices. Therefore, the acceptance of an intensive forestry practice may depend on the perceptions of the current forest management as well as of the intensive forestry practice. An overview of the theoretical framework of the study can be seen in Fig. 1.

Questionnaire Survey

A mail-in questionnaire was used to investigate public perceptions and acceptance of intensive forestry practices in Sweden. This approach enabled screening the public acceptance and perception at a point of time irrespective of knowledge level or group membership. Questionnaire surveys is a cost-efficient and widely adopted method to gather responses in a standardized way (Dillman et al. 2009) that may capture also the opinion of the silent majority that may be less inclined to participate in focus group discussions or in-depth interviews (Clement and Cheng 2011).

In January 2010, questionnaires were sent to a random sample of 3000 individuals drawn from the Swedish population register (Statliga Personadressregistret, SPAR). The sample was proportionally stratified based on geographical regions (the eight Nomenclature of Territorial Units for Statistics, NUTS2 regions of Sweden) and included individuals with ages 18 and older with Swedish addresses and social security numbers. Two reminders, spaced 2 weeks apart, were sent to sampled individuals after the

Table 1 Variables and adjacent questionnaire questions included in analysis

Variable	Representative questionnaire question	Range of answers
Acceptance of (intensive forestry practice) ^a	Do you favor or oppose to increase forest growth by (intensive forestry practice) ^a ...	1 = Completely oppose 5 = Completely favor
Perceived need to increase forest growth	Do you think measures should be taken to increase forest growth in already managed Swedish forests?	0 = No 1 = Yes
Perceptions of current forest management	How well is Swedish forestry currently managed with respect to... ^b	1 = Very poorly managed 5 = Very well managed
Perceptions of (intensive forestry practice) ^a	How do you think (intensive forestry practice) ^a would impact... ^b	1 = Very negative impact 5 = Very positive impact

^a Cultivating exotics, fertilizing, and cultivating clones, respectively

^b Forest growth, timber supply, pulpwood supply, bio-energy supply, profitability, public benefits, landscape scenery, berry/mushroom picking, hunting, recreation/outdoor activities, cultural environment, value of forest for coming generations, soil nutrients, biodiversity, the climate, reindeer keeping, nitrogen leakage

questionnaire was dispatched. The second reminder included an additional copy of the questionnaire. The questionnaire was in Swedish and covered (a) the respondent's relationship to the forest and forestry (e.g., if visited forest for leisure), (b) questions about increasing forest growth and the impact of cultivating exotic tree species, fertilizing, and cultivating clones, and (c) background questions (e.g., age, gender, forest ownership). Most questions included five-point Likert-type scale responses, where extreme responses were named based on the question. An overview of the variables and questions relevant to this study is shown in Table 1.

Non-response Bias

Nine-hundred seventy-one questionnaires were completed and returned. This 32 % response rate is somewhat lower than that of previous surveys such as Clement and Cheng (2011) and Eriksson (2012). The possible reasons for the non-participation of the targeted individuals include disinterest in the survey topic, survey fatigue, and the length and complexity of the questions. The topic of the survey was likely uninteresting to individuals with little connection to the forest.

The mean age of respondents was 55 years, ranging from 19 to 93. To assess the presence of unit non-response bias, the composition of respondents was first compared to the Swedish population at large with respect to age, gender, and geographical regions (Table 2). No significant non-response bias was found except that, compared to the Swedish population at large, older respondents were overrepresented. The presence of non-response bias was further investigated by comparing one-third of the respondents to another third with respect to the variables included in the analysis. No significant differences were found.

Analysis

The perceptions of the current forest management and of the intensive forestry practices were measured using respondents' ratings of current forest management and of the intensive forestry practices with respect to 20 different consequences of forest management (e.g., timber supply, biodiversity) (Table 1). A confirmatory factor analysis was performed on the respondents' ratings of current forest management with respect to these consequences. The purpose was to reveal if the consequences could be grouped according to underlying dimensions (factors) related to economic, recreational, and environmental consequences of forest management. Such dimensions have proved valid in previous studies of forest-related attitudes (e.g., Ford et al. 2009; Eriksson 2012) and reduced the number of variables included in the following regression analysis. Because many respondents did not rate, or answered "do not know" about, current forest management, only three consequences per factor were included in the factor analysis (see Fig. 2).¹

The factor analysis confirmed that there were economic, environmental, and recreational factors to how respondents perceived current Swedish forest management with respect to various consequences. A numerical value representing the mean ratings of the included consequences was created for each factor, to be included as a variable in the following regression analyses. Such values were also created to

¹ Although the model Chi square (χ^2) should be non-significant, it was significant ($\chi^2 = 42.242$, $p = 0.009$, $N = 266$, $df = 23$). However, the χ^2 was less than two times the model's degrees of freedom, which roughly indicates a good model fit (Tabachnick and Fidell 2006). The goodness-of-fit indices (Schreiber et al. 2006) also indicated a good model fit (the normed fit index, incremental fit index, Tucker–Lewis index and comparative fit index were greater than 0.95 and the root mean square error of approximation was less than 0.06).

Table 2 Distribution of population and respondents within categories of background variables

Categories	Population (%) ^a	Respondents (%)
Age groups ^b		
18–34	27	14
35–44	17	14
45–54	16	16
55–64	16	22
65 and above	23	34
Gender		
Men	49	52
Women	51	48
Geographical region		
Eastern Sweden	38	37
Stockholm	21	17
Östra Mellansverige	17	20
Southern Sweden	44	43
Småland med öarna	9	10
Sydsverige	15	13
Västsverige	20	19
Northern Sweden	19	20
Norra Mellansverige	9	11
Mellersta Norrland	4	4
Övre Norrland	5	6

^a Data collected through Statistics Sweden (2011)

^b Because of few (5 %) respondents aged 24 or younger, respondents aged 18–34 were kept in one group. 65 is the common retirement age of Sweden

represent the perceptions of the intensive forestry practices (respectively) with respect to economic, recreational, and environmental consequences. Because the perceptions of the intensive forestry practices were measured with respect to the same consequences of forest management included in the factor analysis for the current forest management, we did not conduct individual factor analyses for the perceptions of the intensive forestry practices. The nonparametric Wilcoxon signed-rank test ($p \leq 0.05$), which is suitable for comparing responses within the same group of respondents (Pallant 2010), was used to test if the rating of current forest management differed significantly with respect to the economic, recreational, and environmental consequences. This test was also used to detect if the rating of the three intensive forestry practices differed significantly with respect to the different consequences.

Regressions

Ordinary least square regression analyses, commonly used to explain influence of perceptions on acceptance (e.g., Ribe 2006), were used to estimate the influence of the perceived need to increase forest growth and of the perceptions about current forest management and the intensive forestry practices, on the acceptance of intensive forestry. Previous research indicated that it was important to control for the effects of socio-demographic variables, including age, gender, geographical region, urban or rural residence, and forest ownership. Because the reasons for accepting a

Fig. 2 Modeled confirmatory factor analysis (with standardized estimates) of the perceptions of the current forest management. The factors represent economic (ECO), recreational (REC), and environmental (ENV) consequences of forest management

practice may differ between practices, analyses were conducted individually for each intensive forestry practice.

Missing Answers

Many respondents could not be included in the regressions because they failed to rate, or answered “do not know” when asked to rate, the consequences of current forest management and intensive forestry practices. The non-parametric Mann–Whitney U test was used ($p \leq 0.05$) to assess possible item non-response bias and determine if there were differences in the response patterns (e.g., perceptions of fertilizing) and age between the respondents included in the regressions and the remaining respondents. The test converts the response scores to ranks and evaluates if they differ significantly between two distinct groups of respondents and is suitable for testing differences between independent samples of ordinal or continuous data (Pallant 2010). Possible relationships between being included in the regressions and nominal variables included in the analysis (perceived need to increase forest growth and socio-demographic variables, excluding age) were examined using cross tabulations, in which χ^2 tests for independence ($p \leq 0.05$) determined if they were statistically significant.

RESULTS

A majority (81 % of $n = 842$) of respondents thought that measures should be taken to increase forest growth in Sweden. A larger proportion of respondents opposed, rather than favored, to increase forest growth through the intensive forestry practices (Fig. 3). The greatest opposition concerned cultivating clones, whereas fertilization encountered the least opposition.

Respondents rated the current forest management as significantly better with respect to economic than recreational consequences, and also as better with respect to recreational than environmental consequences, of the forest management. The consequences of fertilizing were more

Fig. 3 Acceptance (1 = Completely oppose, 5 = Completely favor) of increasing forest growth through the use of intensive forestry practices

Fig. 4 Mean perceptions of the intensive forestry practices (1 = Very negative impact, 5 = Very positive impact) with respect to economic (ECO), recreational (REC), and environmental (ENV) consequences of forest management

positively rated than those of cultivating exotics or clones (Fig. 4). The consequences of clone cultivation were rated most negatively. With respect to economic consequences, fertilizing was rated more positive than exotics, and exotics were rated more positive than clones. There were no significant differences between the ratings of fertilizing and exotics with respect to recreational or environmental consequences, but those consequences were rated more negative with clone cultivation than with the other practices.

Regressions of the Acceptance of Intensive Forestry Practices

Table 3 presents the results of the regressions for the acceptance of fertilizing, cultivating exotics, and cultivating clones. All regressions were significant according to the F statistics and there were no signs of heteroscedasticity or multicollinearity. The coefficient for a particular predictor represents the change in the acceptance of an intensive forestry practice associated with a one-unit change in the predictor variable, holding all other predictors constant (Tabachnick and Fidell 2006).

The perceived need to take measures to increase forest growth had a significant, positive influence on the acceptance of all three intensive forestry practices. For all practices, the acceptance was also significantly influenced by the perceived economic and environmental consequences. The more positive the perceptions of an intensive forestry practice were with respect to these consequences, the greater the acceptance of the practice. The acceptance of exotics was also influenced by the perceived recreational consequences of the practice. The more favorably respondents perceived the recreational consequences of cultivating exotics the more they accepted them. The respondents' perceptions of current forest management did not influence the acceptance of the intensive forestry practices. Neither did gender or urban/rural residence. Geographical region and forest ownership had a significant influence on the acceptance of exotics. Respondents in southern or eastern Sweden accepted exotics to greater extent than northern

Table 3 Results of ordinary least square regressions of the acceptance of the intensive forestry practices. The coefficient for a particular predictor represents the change in the acceptance of the intensive forestry practice associated with a one-unit change in the predictor, all other predictors held constant (Tabachnick and Fidell 2006)

Predictors	Acceptance of ... ^a		
	Fertilizing (<i>n</i> = 361)	Cultivating exotics (<i>n</i> = 337)	Cultivating clones (<i>n</i> = 317)
Perceived need ^a	0.154***	0.099*	0.140**
Current forest management ECO ^b	−0.034	−0.007	0.051
Current forest management REC ^b	0.104	−0.005	0.019
Current forest management ENV ^b	−0.013	−0.018	−0.010
Intensive forestry practice ECO ^c	0.169***	0.202***	0.143**
Intensive forestry practice REC ^c	0.032	0.133*	0.039
Intensive forestry practice ENV ^c	0.401***	0.379***	0.481***
Forest ownership ^d	0.022	0.131**	0.068
Gender ^e	0.031	0.013	−0.009
Urban or rural living ^f	−0.048	0.035	−0.007
Age ^g	−0.027	−0.030	−0.128**
Geographical region ^h	0.006	−0.118*	−0.063
Adjusted <i>R</i> ²	0.354***	0.405***	0.441***

*R*², the squared multiple correlation, is the proportion of variation in the acceptance of the intensive forestry practice predictable from the best linear combination of the predictors. Adjusted *R*² considers the magnitude of chance fluctuations due to the sample size (Tabachnick and Fidell 2006)

Asterisks indicate the significance of the explanatory power of the predictor variables at * *p* ≤ 0.05, ** *p* ≤ 0.01, *** *p* ≤ 0.001

^a See variable captions in Table 1

^b Mean rated consequences of the current forest management with respect to the ECO, REC, and ENV factors in Fig. 2

^c Mean rated consequences of practice with respect to the ECO, REC, and ENV factors in Fig. 2

^d 1 = No, 2 = Yes

^e 0 = Man, 1 = Woman

^f 1 = Urban residence (Stockholm, Gothenburg, or Malmo region), 2 = Rural residence

^g 1 = 18–34, 2 = 34–44, 3 = 45–54, 4 = 55–64, 5 = 65 or older

^h 0 = Southern or Eastern Sweden, 1 = Northern Sweden

respondents did. Forest owners were more likely to accept exotics than non-owners were. The acceptance of clones was significantly influenced by age; younger respondents were more likely to accept clones than older ones.

The regressions explained approximately 40 % of the variance in the acceptance of the intensive forestry practices. For example, 44 % of the variability (adjusted *R*²) in the acceptance of clone cultivation was explained by the perceived need to increase forest growth, the perceived economic and environmental consequences, and the age of the respondent. In all regressions, the perceived environmental consequences of the intensive forestry practice explained the most variance in the acceptance, followed by the perceived economic consequences.

Comparison of Respondents

There was no significant difference in the rated acceptance of intensive forestry practices between the respondents included in the regressions and the remaining (i.e., excluded) respondents (Table 4). However, compared to the

remaining respondents, a significantly smaller proportion of the regression respondents perceived a need to increase forest growth. This pattern was reflected in all three regressions. Moreover, the respondents included in the regressions were more negative towards the economic and recreational consequences of current forest management than the remaining respondents were (Table 4). This was also true for respondents included in the regression for clones regarding their perceptions the environmental consequences of current forest management. The regression respondents did not differ from remaining respondents in their beliefs about the economic or recreational consequences of the practices. However, the respondents included in the regressions for exotics and clones were more positive towards the environmental consequences of those practices than the remaining respondents were.

In the regressions, male respondents were overrepresented (~59 % males) and urban residents were underrepresented (~18 % metropolitans), compared to the excluded respondents (~48 % males, ~28 % urban residents). The regression respondents also included a greater

Table 4 Response patterns of respondents included (Incl.) in the regressions versus the remaining respondents (Excl.) with respect to the acceptance of the intensive forestry practices, the perceptions of the current forest management and the perceptions of intensive forestry practices

Mean ^a	Regression equation for the acceptance of...					
	Fertilizing		Cultivating exotics		Cultivating clones	
	Incl. (n)	Excl. (n)	Incl. (n)	Excl. (n)	Incl. (n)	Excl. (n)
Acceptance	2.76 (361)	2.70 (514)	2.40 (337)	2.42 (535)	2.08 (317)	2.13 (562)
Current forest management ECO	3.44 (361)*	3.69 (121)	3.44 (337)*	3.65 (145)	3.42 (317)*	3.66 (165)
Current forest management REC	3.34 (361)*	3.51 (350)	3.35 (337)*	3.49 (374)	3.33 (317)*	3.50 (394)
Current forest management ENV	2.99 (361)	3.00 (248)	2.99 (337)	3.01 (272)	2.96 (317)*	3.04 (292)
Intensive forestry practice ECO	3.78 (361)	3.77 (271)	3.40 (337)	3.39 (220)	3.17 (317)	3.07 (216)
Intensive forestry practice REC	2.82 (361)	2.86 (298)	2.81 (337)	2.78 (285)	2.59 (317)	2.40 (252)
Intensive forestry practice ENV	2.72 (361)	2.63 (288)	2.70 (337)*	2.55 (276)	2.44 (317)*	2.18 (271)

An asterisk indicates a Mann–Whitney *U* test found the respondents included in the regression provided a significantly different rating of the variable than the remaining respondents ($p \leq 0.05$)

^a See variable captions in Table 3

proportion of forest owners (~15 %) compared to the remaining respondents (~10 %). There were no significant differences between the respondents included in the regressions and the remaining respondents with respect to the mean age or geographical region.

DISCUSSION

The elements of diffusion of innovation theory included in this study elucidated some important antecedents for the acceptance of intensive forestry practices in Sweden. The results showed that a perceived need to increase forest growth influenced the acceptance of cultivating exotic tree species, fertilizing the forest, and cultivating clones. Respondents who perceived that there was a need to increase forest growth were more likely to accept these intensive forestry practices. Moreover, a practice that was more positively evaluated and thus having greater perceived relative advantage was more likely to be accepted. Forest fertilization was perceived to perform better and therefore was more acceptable to the general public than the cultivation of exotics or clones.

Although a majority of respondents to this survey accepted that measures be taken to increase forest growth, very few accepted intensive forestry practices. One of the main reasons is that the public perceives these practices to be associated with environmental risks. An additional reason may be that the public does not perceive such practices as economically beneficial. One way of influencing the acceptance of intensive forestry practices may hence be to increase the awareness of the need for such measures along with their environmental and economic implications. The stronger relationship between acceptance of intensive forestry practices and perceived environmental

consequences, rather than economic consequences, supports earlier results (e.g., Manning et al. 1999; ECORYS 2009; Eriksson 2012) that the public perceives environmental protection as more important than the material benefits of the forest. The results of our survey also corroborates earlier conclusions that the public perceives current forest management as favoring economic rather than recreational or environmental functions of the forest (Eriksson 2012).

Contrary to other findings such as Clement and Cheng (2011) our results showed no significant effect of gender on the acceptance of intensive forestry practices. Because of the larger representation of male respondents in the regressions a comparison of the variables included in the analysis was made with respect to gender. No significant differences were found. The regressions also included larger proportions of forest owners and rural residents than there were among remaining respondents. A possible reason may be that these respondents are more familiar with forests and forestry and, therefore, could answer the questions better. That forest owners were more accepting of exotics than non-owners were may relate to that forest owners are more likely to emphasize production values and express weaker environmental concerns (Eriksson 2012). This difference between forest owners and non-owners may explain why the regression respondents were more positive towards the environmental consequences of exotics and clones than the remaining respondents were. However, this is not conclusive considering these respondents did not differ from other respondents in the acceptance of intensive forestry. In speculation, the acceptance of intensive forestry among respondents included in the regressions (encompassing more forest owners) may be more influenced by perceived economic consequences of intensive forestry, than the acceptance of intensive forestry

among remaining respondents (putting less emphasis on such values).

The greater acceptance of the cultivation of exotics in southern Sweden than in the more forestry-dependent north may relate to the greater variety of tree species in the south. This regional difference is consistent with earlier results (e.g., Elands et al. 2004) that attitudes towards forests and forestry vary between regions. Consistent with studies indicating the importance of recreational aspects (e.g., Eriksson 2012), the acceptance of exotics was influenced by the perceived recreational consequences. This study could not assess why such perceptions did not influence the acceptance of fertilization or clone cultivation. The larger number of responses regarding recreational consequences of current forest management, compared to those regarding economic or environmental consequences, indicate a larger familiarity with such concepts among the general public. The public's more positive assessment of fertilizing may relate to higher familiarity with fertilization than with the cultivation of exotics and clones, as indicated by the larger number of respondents in the regression for fertilizing.

Our survey likely attracted respondents interested in forestry and forest issues. However, the large number of missing and “do not know” responses indicates that the awareness of intensive forestry practices is scant and the perceptions illustrated here may not be well informed. A limitation of this study is that we did not analyze how respondent's knowledge about intensive forestry practices might have influenced their perceptions and acceptance of such practices. In future studies, it may be of interest to investigate respondent's knowledge because it is an important element in the adoption of an innovation (Rogers 2003). Further, the included variables only explained part of the acceptance of intensive forestry and there are more variables and complexity to the theory of the diffusion of innovations than accounted for here. In addition to knowledge, future studies could benefit from studying the potential influence of change agents (e.g., mass media) for the acceptance of intensive forestry. This would increase the understanding of which agents have most influence on the public acceptance. It is also possible that the acceptance of intensive forestry depend on more contextual variables than were included in this study (e.g., on which and how much forest land the respondents imagined intensive forestry to be implemented). Neither did we look into the reasons for a perceived need to increase forest growth (e.g., if forest growth should be increased to increase the available biomass or to increase the amount of land set aside for the protection of biodiversity).

Although understanding the acceptance of the public as a whole is of interest for policy makers, the public encompass

a diversity of forest values and beliefs that may react to a forest policy in different ways (Eriksson 2012). Therefore, future studies on the acceptance of intensive forestry could also benefit from investigating the influence of other attitudinal factors, e.g., value orientations, environmental concerns, and social norms, which have been related to forest preferences in previous studies (e.g., Vaske and Donnelly 1999; Ford et al. 2009). Stern (2000) noted that general environmental concerns may have an important influence on non-activist environmentally significant behavior, such as the acceptance of intensive forestry. Furthermore, studies using visual stimuli, such as pictures of forest stands where intensive forestry is implemented, might provide a deeper understanding about attitudes towards intensive forestry practices. Most studies of acceptance or preferences for forest alternatives involve evaluating visual quality (Ford et al. 2009). Visualization tools may also be an effective method to increase public awareness about the possible impact of climate change and a forest policy involving intensive forestry (Sheppard 2005).

CONCLUSION

Public acceptance of measures that increase forest growth in Sweden is substantial. However, a majority of Swedish people have a very limited understanding of intensive forestry practices and oppose the cultivation of exotic tree species and clones and the use of forest fertilization. Independent from the perceptions of the current forest management, this opposition is related to perceptions of the environmental and economic consequences of the intensive forestry practices. The largest opposition is directed at the cultivation of clones, whereas forest fertilization encounters the least opposition. Greater acceptance of intensive forestry practices will require more positive perceptions about the environmental and economic consequences of intensive forestry practices along with a perceived societal need to increase forest growth.

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