Norwegian University of Life Sciences
School of Economics and Business

Philosophiae Doctor (PhD)
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Valuing Ecosystem Services to Inform Land Use Policies in Norway - Methodological Issues and Applications of Stated Preference Methods

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Table of Contents

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List of papers

Paper 1. **Iversen, E. K.**, Lindhjem, H., Jacobsen, J. B., & Grimsrud, K. (2021). Moving (back) to greener pastures? Social benefits and costs of climate forest planting in Norway. *Land Use Policy, 107,* 104390. DOI: 10.1016/j.landusepol.2019.104390

Paper 2. **Iversen, E. K.**, Lindhjem, H., Grimsrud, K., & Navrud, S. (2022). Mountains of trouble: Accounting for environmental costs in local benefit-driven tourism development, *Tourism Management*, submitted.

Paper 3. **Iversen, E. K.** & Dugstad, A. (2022) Spatial Dimensions in Stated Preference: The Role of Place Attachment, *Land Use Policy*, submitted.

Paper 4. **Iversen, E.K.**, Grimsrud, K., Mitani, Y. & Lindhjem, H. (2022) Altruist Talk May (also) Be Cheap: Revealed Versus Stated Altruism as a Predictor in Stated Preference Studies. *Environmental and Resource Economics.* DOI: 10.1007/s10640-022-00704-y

1 Introduction

1.1 Motivation

I have two key motivations for this thesis. The first motivation is to value ecosystem services (ES) to help inform land use policies using stated preference (SP) methods. The second motivation is to help to improve the validity and use of SP estimates by refining our understanding of preference formation and heterogeneity.

ES, meaning the "the benefits people obtain from ecosystem", are grouped into supporting services, regulating services (e.g., carbon sequestration), provisioning services (e.g., timber) and cultural services (Millennium ecosystem assessment, 2005). Cultural ES include various services directly benefitting humans, such as landscape aesthetics, sense of place and experience of nature and wildlife through recreation and tourism (Daniel et al., 2012). The total economic value (TEV) of ES includes use values that stem from peoples' direct consumption and experience of nature and nonuse values that arise when individuals value nature for reasons such as altruism toward others and future generations (Iversen et al., 2022).

Most ES are nonexcludable in consumption. The land and provisioning services such as food products and timber are excludable and therefore sold and valued in markets while regulating and cultural ES are almost impossible to parcel out and sell to consumers. Nonexcludability hinders efficient allocation of resources and causes an inherent underprovision of ES in the market economy. The lack of market signals may also distort public decision-making. The costs of reducing the value of ES often remain unknown and overlooked in land use decisions (Bateman et al., 2013).

An underappreciation of ES has put global biodiversity under severe pressure. Land use changes are the most critical threat globally (IPBES, 2019) and in Norway (The Norwegian Biodiversity Information Centre, 2021). In Norway, tourism development and decline in agricultural production are important factors behind land use change and biodiversity loss (Rørholt & Steinnes, 2020; The Norwegian Biodiversity Information Centre, 2021).

SP methods, including Contingent valuation (CV) and Choice experiments (CE), are the available tools for estimating changes in TEV of a marginal change in quality or quantity of ES (Bateman et al., 2002). SP methods have become increasingly popular over the past two decades due to their ability to measure nonuse values (De Valck &

Rolfe, 2018). Although SP methods are critical in measuring the TEV of ES, the methods have attracted controversy (Bishop, 2018). One main criticism is that SP methods use surveys and hypothetical markets to elicit preferences. As Scott (1965) asserted over fifty years ago: "ask a hypothetical question, and you will get a hypothetical answer". Another related criticism was voiced by Kahneman & Knetsch (1992), who argued that CV studies invite a "purchase of moral satisfaction", implying that SP values are inflated by the "warm glow" of giving. In the aftermath of the Exxon Valdez oil spill Natural Resource Damage Assessment, there was a heated debate concerning the adequacy of SP methods to value public goods and capture nonuse values (Kling et al., 2012). Since then, researchers have focused on improving the validity and reliability of SP. Bishop & Boyle (2019) highlight the development of consequential question formats and incentive-compatible designs as remarkable methodological improvements. They argue that the substantial body of methodological research has provided the SP methods with sufficient reliability and validity to inform and shape public policy. However, improvements are still being made (Bishop & Boyle, 2019).

Informed policy should consider the change in use and nonuse values of change in ES across affected populations (Johnston et al., 2017). Both use and nonuse values are subject to preference heterogeneity, including spatial heterogeneity. Psychological concepts such as attachments, attitudes, and feelings are not much studied in SP (Faccioli et al., 2020) and may help improve our understanding of the interaction between human and ecological systems across the spatial dimension.

There are two main objectives of this thesis:

1) To inform spatial planning and enhance cost-benefit analysis (CBA) as a decision support tool by applying SP methods to value nonmarket impacts of ES from selected land use changes in Norway.
2) To improve our understanding of how psychological factors such as altruism, place attachment, and the spatial context affect households' valuation of nonmarket ES in SP studies.

The first objective of this thesis is to apply SP methods to monetise the nonmarket impacts in ES from selected land use changes and include their economic value ES in CBA, along with economic impacts on market goods and market ES. In this way, SP methods can inform and help improve policies affecting land use in Norway.

I address two land use policies affecting the market and nonmarket values of ES. In the first paper, we question whether the Norwegian government should

implement a national afforestation program for greenhouse gas sequestration on recently abandoned semi-natural pastureland. The program has positive climate effects but also impacts landscape aesthetics and biodiversity. In the second paper, we study the national implications of local tourism and land management. Building recreational homes yield substantial economic benefits to local communities but also affects ES and imposes externalities on those who benefit from these, including people outside the destination.

The second objective of this thesis is to improve our understanding of how psychological factors, such as altruism and place attachment, shape households' valuation of changes in ES. The aim is to contribute to the improvement of SP methods through a better understanding of preference heterogeneity.

I address two important methodological questions for policy decisions informed by cost-benefit analyses using SP estimates. In the third paper, we analyse the spatial dimension in welfare analysis using environmental psychology and the concept of place attachment, the functional and emotional bond people have to a defined place. In the fourth paper, we test whether altruism, measured as real past altruistic behaviour in an unrelated decision domain, results in a higher willingness to pay (WTP) in SP surveys. We combine datasets on respondents' past donations and two unrelated CV studies, in which we elicit WTP for changes in different ES, stated altruism and environmental attitudes.

The papers are as follows:

1. Moving (back) to greener pastures? Social benefits and costs of climate forest planting in Norway
2. Mountains of trouble: Accounting for environmental costs in local benefit-driven tourism development
3. Spatial Dimensions in Stated Preference: The Role of Place Attachment
4. Altruist talk may (also) be cheap: Revealed versus stated altruism as a predictor in stated preference studies

The remainder of this introductory chapter is structured as follows. Section 2 summarises the conceptual framework for nonmarket valuation. Section 3 introduces the stated preference method. Section 4 introduces land use policy. Section 5 summarises the papers and their contributions, while section 6 concludes.

1.2 Conceptual framework

In economics, individuals are modelled as rational agents with stable and transitive preferences maximising utility within their budget constraints. Similarly, the

production side is modelled as businesses using inputs to maximise profits within their budget constraints. Prices and quantities of goods and services are determined by the intersection of demand and supply in markets.

The first fundamental theorem of welfare economics states that when there are no externalities, perfect information, and perfect competition, the market equilibrium will be Pareto optimal, meaning no further exchange would make one person better off without making another person worse off. The market price coordinates households and businesses so that society's scarce resources are put to their most efficient use. The second fundamental theorem of welfare economics states that any Pareto optimum can be supported by redistributing the initial wealth. If the policy maker wishes to correct the outcome of market equilibrium, the correction should be implemented through changes in endowments rather than prices.

Nonexcludable services imply that the price system fails to allocate resources efficiently. The consequent underprovision of nonexcludable ES suggests that the market outcomes are not Pareto optimal and that there are potential welfare gains to be made by policy interventions to correct the market failures.

CBA helps identify whether there are potential Pareto improvements to be made. Potential Pareto improvements, also known as Kaldor-Hicks improvements, depict positive net welfare gains through policy interventions with a possible ex-post re-allocation of resources from people made better off to those made worse off. When market failures stem from ES, nonmarket valuation methods help estimate the changes in welfare associated with the changes in ES. The nonmarket welfare impacts of ES are quantified in monetary units to enable direct comparisons with other welfare impacts of policy intervention in CBA.

Consider a representative agent with utility from a vector of market goods X and a vector of nonmarket ES E. According to the standard microeconomic model, the agent seeks to maximise utility subject to the budget constraint, y. The agent must account for the market prices P when deciding X, while the quantity of the nonmarket ES is given by $E = E^0$.

$$\max_x U(X, E)\ s.t.\ P * X \leq y, E = E^0. \quad (1)$$

Using the above maximisation problem, we derive the agent's indirect utility function:

$$v(P, y, E) \tag{2}$$

The indirect utility function represents the maximal attainable utility given the vector of prices and the budget constraint. The function incorporates preferences, budget constraint and market conditions. The agent reacts to price changes by changing the bundle of market goods.

Several alternative measures capture welfare impacts associated with price and quality/quantity changes. Perhaps the most well-known measure is the consumer surplus, the area between the price line and the ordinary demand curve[1]. However, the consumer surplus is not derived from the utility function. John Hicks developed compensating variation and equivalent variation as alternative welfare measures derived from an agent's utility functions before and after price changes (Freeman III et al., 2014). The compensating variation measure is the change in income that would keep the agent *at the initial utility level* after a price change. The equivalent variation measure is the equivalent change in income that would move the agent *to the new utility level* instead of the price change. There are minor differences in magnitude between consumer surplus, compensating variation and equivalent variation depending on the income elasticity of demand for the good or service (Freeman III et al., 2014).

In the papers in this thesis, I study the welfare effect of exogenous changes in ES. Shifts in the ES are out of the agent's control whilst affecting its utility. Compensating surplus measures the change in income that would keep the agent *at the initial utility level* after a quality or quantity change. Equivalent surplus measures the equivalent change in income that would move the agent *to the new utility level* instead of the quality or quantity change. Figure 1 depicts shifts in utility and welfare measures due to the improvement and degradation of ES.

[1] Also known as Mashallian demand, which includes both the income and substitution effects of price changes.

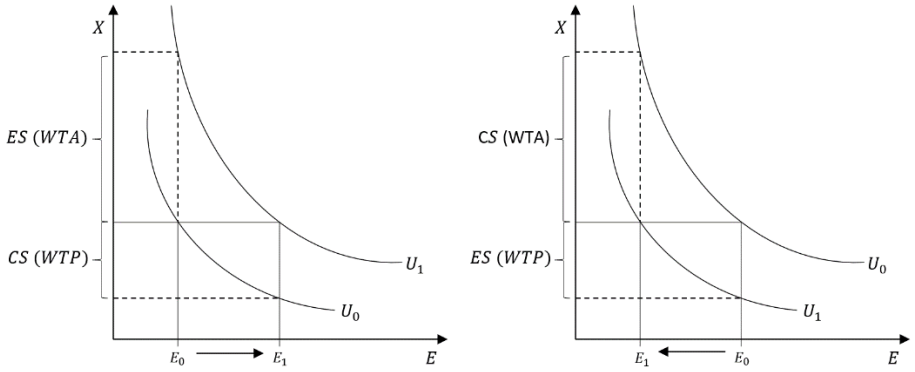

Figure 1 – a) Improvement of ES: Compensating surplus (CS) and equivalent surplus (ES) b) Degradation of ES: Compensating surplus (CS) and equivalent surplus (ES)

When the agent is facing an environmental improvement, the associated utility increase is measured by the maximum WTP to get an ES improvement (compensating surplus) or the maximum willingness to accept (WTA) money to forgo an ES improvement (equivalent surplus). When the agent faces an environmental degradation, the welfare is measured by the maximum WTA to get an ES degradation (compensating surplus) or WTP money to avoid an ES degradation (equivalent surplus).

In paper 1 of this thesis, we elicit the maximum WTP to get ES improvements (the compensating surplus):

$$v(P, y, E^0) = v(P, y - WTP, E^1) \tag{3}$$

In papers 2, 3 and 4 of this thesis, we elicit the maximum WTP to avoid ES degradation (the equivalent surplus):

$$v(P, y - WTP, E^0) = v(P, y, E^1) \tag{4}$$

1.3 Stated preference methods

Nonmarket valuation methods are needed to measure welfare changes associated with shifts in ES. Nonmarket valuation methods include revealed preference methods such as travel cost, hedonic pricing and averting behaviour models, and SP methods such as CV and CE. Revealed preference methods analyse agents' market

behaviour to infer the values of complementary ES, while SP methods capture TEV by asking respondents to trade off ES and money in surveys.

In CE, the environmental impacts of policies are separated into changes in attributes. The respondents are given several sets of hypothetical alternatives, each alternative depicting a different bundle of environmental attributes accompanied by a monetary attribute. Respondents are asked to choose the most preferred alternative or rank or rate the alternatives. The data allows the researcher to estimate the marginal rates of substitution between the attributes and the WTP for different ES. CV surveys elicit monetary values for scenario changes, where the scenarios consist of one or a bundle of several ES affected by a policy change. CV surveys ask respondents directly if or what they would be willing to pay to have the specified change in ES occur. The WTP elicitation could, for instance, be respondents choosing yes-or-no to a specific amount of money (single binary choice), respondents stating their maximum WTP (open-ended question) or respondents selecting an amount from a menu of costs (payment card question). In paper 1, we apply CE to elicit WTP, while in papers 2, 3 and 4, we apply CV. We use payment card questions in the CV surveys.

John Krutilla (1967) first introduced the concept of nonuse values and argued that individuals derive value from the existence of unique, irreplaceable environmental resources without necessarily putting the resources into use. He argued that the preservation of scenic wonders and fragile ecosystems is a part of the real income of many individuals (Freeman III et al., 2014). Although SP studies capture nonuse values, such values are difficult to define, isolate and measure. An approach is to define nonuse values as the difference between the TEV and the use values of ES (Freeman III et al., 2014). Day et al. (2019) combine revealed and SP data in a structural model to estimate use and nonuse values of improving the ecological status of a region's rivers. Their results suggest that nonuse values are a significant part of the welfare gains from improved river ES.

The concept and significance of nonuse values have led to questions regarding the validity of SP estimates. A criticism related to nonuse values is that self-signalling and the warm glow of causing scope insensitivity and embedding effects in SP (Bishop, 2018). Scope insensitivity depicts the situation when agents are not willing to pay more for higher quality or quantity of an ES. Embedding effects occur when the value of a bundle of ES depends on whether the services are valued alone or as parts of bundles (Bishop, 2018). Johansson-Stenman & Svedsäter (2012) find that people overstate their WTP for goods with a perceived ethical dimension to uphold a positive self-image. Entem et al. (2022) and Svenningsen & Jacobsen

(2018) find that people overstate their WTP for public goods with moral components. Bishop (2018), on the other hand, argues that altruistic and warm glow values are legitimate and should be included in the CV estimates and that there is little evidence of warm glow being the source of validity issues.

Substantial nonuse values underscore the importance of using SP methods to estimate valid and reliable values. To do this, SP designs should follow best practices and be incentive compatible. Incentive-compatible designs have truthful preference revelation as the dominant strategy and are consequential; respondents believe there is more than zero probability of their responses influencing decisions (Johnston et al., 2017). Thus, SP surveys should explain to respondents how results might affect policy implementation and present decision rules for implementing results. Further, the payment vehicles should be binding, credible, familiar, and non-malleable for respondents (Boyle, 2017). The surveys should present the status quo conditions, the mechanism of change, and the changes to be valued (Johnston et al., 2017).

Following Bishop & Boyle (2019), the question of the validity of nonmarket valuation studies can be divided into three concepts: i) If the study design follows best practice, meaning that the chosen valuation method, and the implementation procedures, enable measurement of unbiased values, the survey has *content validity*; ii) If results meet expectations on how true values should relate to other variables, for instance, that income elasticities are positive, the study has *construct validity*; and finally, iii) if the results are undisguisable from the results gathered from a source accepted as having a high level of validity, such as election results, the study has *criterion validity* (Bishop & Boyle, 2019). Regarding the overall validity and reliability of CV estimates and their implementation, Bishop and Boyle conclude that the CV method has stood up well in validity tests across the three concepts, but this "does not mean that any one application can be automatically considered accurate" (Bishop & Boyle, 2019, pp. 573).

The prime reason for conducting nonmarket valuation is to inform policies through CBA. An important part of implementing SP values in CBA is deciding the spatial scope of the affected population. The extent of the market for place-specific ES depends on the (negative) relationship between nonmarket values and the distance between the good and people. A negative association between values and distance is typically explained by factors such as i) increasing costs to access the good, ii) an increasing number of substitute goods, iii) increasing search and information costs, and iv) decreasing moral obligation and responsibility (De Valck & Rolfe, 2018; Glenk et al. 2020).

According to De Valck & Rolfe (2018), improved insight into the interaction between human and ecological systems through the development of constructs such as place attachment could make inputs from psychology more helpful in studying the spatial distribution of SP. As people bond with family, communities, animals, and objects, environmental psychology has shown that people also develop bonds with places (Low & Altman, 1992; Lewicka, 2011). Since optimal land-use policies imply accounting for welfare impacts of affected populations *across jurisdictions*, understanding spatial preference heterogeneity is essential when applying SP estimates in CBA (Johnston et al., 2017).

1.4 Land Use Policies

Climate change and biodiversity loss threaten humans' well-being (IPBES, 2019). Both the climate and biodiversity are nonexcludable nonmarket ES, and both are underappreciated in private and public decision-making, including land use policies. The UN has urged the global society to accelerate the inclusion of ES values in private and public decision-making. Thus, policies affecting ES must be reviewed and improved.

Segerson et al. (2006) provide a simple model of land allocation decisions between different uses. Land uses can be denoted a_1 and a_2, while the total land is $a_1 + a_2 = A$. For instance, might $i = 1$ be land developed as recreational homes and infrastructure while $a = 2$ might be undeveloped land, agricultural land, forests, or any other use. Land use generates a private return denoted as R_i. The private returns will differ between different uses depending on output and input prices and production technology. The land owner maximises the total return from the land:

$$\underset{a_1,a_2}{\text{Max}}\, R\,(a_1, a_2)\; s.t.\, a_1 + a_2 = A, 0 \leq a_i \leq A \tag{5}$$

If we assume linear returns to land, there will be a corner solution in which either $a_1 = A$, $a_2 = A$, or the land owner is indifferent between the uses. If we assume diminishing marginal returns to land, the optimal result might also be an internal solution:

$$R'_1(a_1) = R'_2(a_2) \tag{6}$$

This internal solution implies that the best land allocation is such that the marginal returns to land are equal between the two uses and the allocation (a_1^p, a_2^p) is optimal from the land owners' perspective. When land use creates externalities for third

parties, private optimal and social optimal allocations differ. We can include an externality of land use $G(a_1)$ in equation (5) to formulate the social optimal land use allocation problem. If we assume a linear marginal externality per unit of land, $G(a_1) = ga_1$ the social optimal land use will be the where the marginal social returns to land are equal between the uses:

$$R'_1(a_1) + g = R'_2(a_2) \tag{7}$$

If g is positive, the externality of the land use a_1 is positive, and the social return of a_1 is higher than the private return. Conversely, if g is negative, the externality of the land use a_1 is negative, and the social return of a_1 is lower than the private return. A negative externality is depicted in the figure below, where the allocation (a_1^s, a_2^s) is optimal from society's perspective.

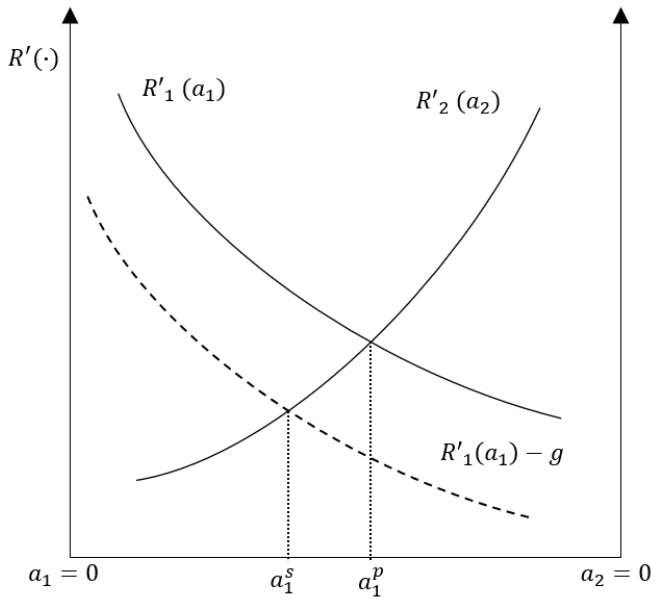

Figure 2 – Privately and socially optimal allocation of land to uses a_1 and a_2 in the presence of a negative externality

The efficient policy, following economic theory, would be to impose a Pigouvian tax or subsidy to remove the gap between private and social returns to land use. The tax or subsidy should be equal in terms of monetary value to the *marginal external effect* at the efficient allocation. If the externality is positive, the land use should be

subsidised, while if the externality is negative, the land use should be taxed (Segerson et al., 2006).

The value of affected ES due to changed land use tends to vary within an area. For instance, if a mountain is developed with recreational homes and infrastructure, building in some parts of the mountain affects the wild reindeer; building in other parts affects landscapes and recreation. Thus, externalities differ within the area independently of the land use per se. If so, an efficient tax on land must be differentiated to account for the specific value of ES affected at each part of the area. Results from CE, where effects of change in land use can be divided into values of changes in different ES, can be used to differentiate taxes and subsidies on land use.

A tax set equal to the marginal external cost will be efficient if the marginal external effect is linear in land use. If the marginal effect is nonlinear, a Pigouvian tax alone can no longer ensure efficiency (Segerson et al., 2006). Suppose the landowners make their land use decisions based on total returns rather than the marginal returns, for instance, comparing average farmland returns. In that case, the total external costs might not equal total tax payments (Segerson et al., 2006). Results from CV and CE, providing total values of changes in different ES due to land use changes, can be used to assess the overall land use policy within an area.

When it is challenging to achieve efficient land use policies using taxes and subsidies to modify landowners' marginal incentives, efficiency might be achieved using land use regulations. Some alternative regulative land-use policies include zoning, easements, and transferable development rights (TDR). Zoning, an important policy tool in Norway, restricts the types of uses on the land in different zones and, if implemented optimally, provides efficient land allocation. In Norway, municipalities use zoning regulations to preserve areas as nature or develop areas with recreational homes.[2]

A problem with zoning is the arbitrary distribution of outcomes. Say, landowner A might be prevented from developing recreational homes, while another landowner B receives the right to develop its land. In addition, the value of landowner B's land increases because landowner A is not allowed to develop his or

[2] When their zoning policies conflict with important environmental interests, government agencies can protest, while the Ministry of Local Government and Regional Development have the final say in conflicts.

her land; thus, this plot may be used for recreation. A TDR solution to the problem, not yet applied in Norway, would be to specify two zones, one development zone and one preservation zone. Landowners in the preservation zone receive development rights which the landowners in the development zone must buy to build recreational homes. The policy maker sets the development level within the area, while trading rights distribute the profits among landowners (Segerson et al., 2006). Another policy tool is easements, a contractual agreement between the landowner and, for instance, a government agency, in which the landowner sells the right to develop the land but might retain other rights. The compensation makes easements attractive to landowners and more politically acceptable than different types of preservation (Segerson et al., 2006).

I use nonmarket valuation methods to determine the size and direction of the externality g of different land uses in this thesis. I find that agricultural production, climate forests, and recreational homes affect the nonmarket values of ES and generate externalities unaccounted for by present policies in Norway. By combining SP and CBA, I identify potential Pareto improvements to be made by changing policies. As discussed above, in addition to identifying potential Pareto improvements, SP methods can help develop and advance more efficient and acceptable land use policies to correct such market failures.

1.5 Paper summaries

Paper 1 – Moving (back) to greener pastures? Social benefits and costs of climate forest planting in Norway

The Norwegian government is considering implementing a national climate forest program (CFP) for the sequestration of GHGs on former agricultural land. In recent decades, 8,500 km2 of pastures have been abandoned in Norway, of which 1,350 km2 have been relatively recently abandoned and are not yet reforested. When abandoned, they slowly grow into natural forests. The alternative land use the government is considering is afforestation with Norway spruce. Compared to the naturally regrowing forest, it is relatively densely planted, grows faster, and can thus contribute to climate mitigation by two processes: sequestering carbon while growing, and timber and biomass substituting other materials which use or production may be more carbon intensive (Taeroe et al., 2017).

There is a public debate about whether this management is acceptable as negative effects of climate forests include the reduction of biodiversity compared to

grazed pasture land, the latter containing many of the Norwegian red-listed species (Henriksen & Hilmo, 2015). Further, climate forests change land use in rural areas, which many see as an impairment of landscape aesthetics. The alternative – the natural succession into forests – is a third alternative. The loss of agricultural land in Norway to any type of forest is seen as a cultural ES loss in terms of landscape aesthetics, but probably also to sense of identity and place, as grazing has been an essential component of traditional farming.

We consider the costs and benefits of combinations of land use options compared to a status quo situation where an estimated 1,350 square kilometres of abandoned pastures across Norway undergo natural reforestation. To estimate the nonmarket benefits, we elicit people's preferences for different land use options. We gather a nationally representative CE internet survey to assess the trade-offs between GHG sequestration, biodiversity, and landscape aesthetics and derive welfare estimates based on future scenarios. We use secondary sources and literature to estimate the costs and market benefits of the land use options of CFP and maintaining pastures by grazing animals and compare them with the benefits within a CBA framework.

Our results indicate that the scenarios where either half of the abandoned pastures are recovered, or half of the pastures are recovered, and a quarter are designated to the climate forest program yield the highest net present value. The net present value of all land use scenarios remains positive when limiting the aggregation of WTP to rural households and allowing for potential hypothetical bias in benefit estimates and cost increases. Earlier studies found similar WTP for biodiversity and pasture preservation as ours, indicating convergent validity (e.g., Hynes et al., 2011; Campbell et al., 2008). The study demonstrates that landscape and biodiversity values are substantial and should be considered when designing agricultural and climate policies.

Paper 2 – Mountains of trouble: Accounting for environmental costs in local benefit-driven tourism development

Tourism has expanded over the last decades and has become one of the largest and fastest-growing sectors in the world economy (UNWTO, 2020). In Norway, tourists are motivated by the experience of nature, including mountains, forests, and wildlife (Innovation Norway, 2019). The Norwegian government target growth within tourism to create new jobs in rural areas risking population decline (Norwegian Ministry of Trade, Industry and Fisheries, 2017). Tourism already generates up to

40 percent of the economic activity at mountain destinations in southern Norway, of which investments in new private cabins are the most important economic impulse (e.g., Menon, 2019). New private recreational houses were built at a historic high level in Norway the past year (Handberg et al., 2022).

At the same time, land use changes due to developments are one of the more severe threats to biodiversity globally (IPBES, 2019) and in Norway (The Norwegian Biodiversity Information Centre, 2021). Extinction rates are about 1000 times higher than normal rates and severely negatively affect ecosystem functioning (Pimm et al., 2014). Cabin developments caused 40 percent of the loss of forests and 30 percent of the loss of wetlands by developments in Norway in the period from 2009 to 2019 (Rørholt & Steinnes, 2020).

Cabin developments affect market and nonmarket values. Building new cabins yields profit to local communities and reduces ES, imposing externalities on people receiving benefits from these. CBA is suitable for examining the trade-offs at the heart of many management problems but has been relatively neglected in tourism economics. This study combines SP, economic impact, and geospatial analysis in a CBA framework. The CBA is performed both at the local and regional level for small (S), medium (M), and large (L) developments in the Norefjell-Reinsjøfjell mountain area in Norway.

The L-development is the optimal tourism and land management locally as profits from property sales and construction outweigh the local nonmarket externalities. However, considering the additional market and nonmarket impacts outside the destination, S-development is the socially most profitable at the regional scale.

We conclude that nonmarket externalities inside and outside of the destination should be accounted for to achieve optimal tourism development. The geospatial analysis of impacts further improves CBA as a decision support tool for tourism developments as it illustrates the geographical distribution of externalities. The study provides an example of how SP and CBA are suitable for studying trade-offs between economic values and nonmarket ES in a tourism context. The increasing importance of tourism for economic activity, the parallel loss of ES and the need for climate change mitigation warrants more research on social optimal land use policies and tourism management.

Paper 3 – Spatial Dimensions in Stated Preference: The Role of Place Attachment

Land use decisions involving environmental goods affect people across space. Much of the why and how preferences vary over space remains unknown. The importance of the spatial dimension for understanding economic behaviour and welfare analysis is increasingly acknowledged in the nonmarket valuation literature (De Valck & Rolfe, 2018). Although there have been recent theoretical advances (e.g., Yamaguchi & Shah, 2020; Meya, 2020), empirical advances (e.g., Holland & Johnston, 2017) and advances in the understanding of underlying factors (e.g., Faccioli et al., 2020), the implications and complexity of spatial distributions warrants more research by economists (Glenk et al., 2020).

The natural landscape provides valuable nonmarket ES such as recreation, landscape aesthetics, sense of place, and biodiversity to people. Changed land use, buildings, and infrastructure in natural landscapes will often generate market incomes while reducing the quantity and quality of the natural landscape, which provides ecosystem services. Land management often ignores all or some of the affected nonmarket values (Bateman et al., 2013), partly because these are distributed across space and political jurisdictions.

We turn to environmental psychology and use place attachment, the functional and emotional bond people have to a defined place. Bonding is essential to being human; we bond with family, friends, communities, animals, objects, and places. These bonds secure people in their social and physical environments, connect them to the past and influence their preferences and behaviour (Walker & Ryan, 2008). Attachment theory suggests that an innate psychological system attaches individuals to other people for security, comfort, and growth (Scannell & Gifford, 2014). Environmental psychologists have shown that people also develop similar bonds with places (Low & Altman, 1992; Lewicka, 2011).

We conduct a CV study of new recreational mountain homes in southeast Norway and investigate the concept of place attachment to explain spatial preference heterogeneity and distance decay in their WTP to reduce cabin developments and preserve the mountain landscape and biodiversity. Using structural equation modelling, we find that place attachment diminishes with travel time and explains a substantial part of the causal effect of travel time on WTP. About 40 percent of the negative impact of travel time on WTP is indirectly channelled through reduced place attachment. Including place attachment also substantially improves the fit of our spatial econometric model. Based on our results, we

recommend future studies to explore further place attachment in spatial welfare analysis and benefit transfer exercises, particularly as a subjective control variable for substitute sites and recreational activities.

Paper 4 – Altruist talk may (also) be cheap: Revealed versus stated altruism as a predictor in stated preference studies

People value environmental goods for different reasons, including altruism toward others and future generations. Kahneman & Knetsch (1992) questioned the use of such estimates in CBA and argued that CV studies invited to a "purchase of moral satisfaction", leading to scope insensitivity. In a recent review of warm glow in CV, Bishop (2018) insists that such values should be included in the CV estimates, while we argue that if people receive a warm glow when stating their WTP taxes in the CV survey context, while they do not receive a corresponding warm glow when in fact paying the taxes, CV estimates might be biased.

Several other studies point out that respondents' warm glow feelings from stating high WTP will bias results if such motivations are context-specific and not transferable from the survey context to the policy context (Entem et al., 2022; Johansson-Stenman & Svedsäter, 2012; Chilton & Hutchinson, 2000). Psychological research has found observable physiological and psychological benefits of self-signalling by people doing "the right thing". They are rewarded by a release of neurotransmitters, increasing their body heat and experiencing a physical warm glow sensation (Van der Linden, 2015). Eckel et al. (2005) find no warm glow effects of paying taxes to support charity in a laboratory experiment. Thus, if stating higher WTP in SP releases neurotransmitters while paying the corresponding tax does not, a warm glow in SP surveys might bias results.

Altruistic preferences help explain the substantial nonuse values identified in numerous SP environmental valuation surveys. However, studies analysing the effect of altruism on WTP have underestimated the challenges of measuring altruism by stated measures. We exploit a naturally occurring decision domain to investigate the role of altruism in SP. We employ a novel dataset from an Internet survey panel that contains respondents' past donations of earned survey coins to charities. We use these data to analyse the effect of donation behaviour on the same respondents' WTP.

We analyse donation behaviour across two CV surveys on environmental topics. Donators are proven givers in an anonymous and unrelated setting, much like decision-making in a dictator game. The respondents who have donated to a

charity at least once are not significantly more inclined to state a positive WTP than other respondents in any of the studies. We find that respondents' past donations are associated with higher WTP, even after controlling for stated measures of altruism, ecological, and environmental attitudes. The donators are sensitive to scope; they increase their WTP to avoid more significant environmental impacts. This could indicate that donators in our data are motivated by pure altruism, not a warm glow. This might be reassuring regarding the validity of this survey and CV studies in general.

The results suggest that measures of stated altruism fail to capture important aspects of altruism, implying that previous studies of altruism based on such measures may be questioned. Future research should examine how past pro-social behaviour can be utilised to increase commitment to improve public goods, reduce public bads, and examine altruistic and warm glow preferences in welfare economics and CV studies. If donation history is unavailable, a possible solution would be to include a dictator game with charities as recipients in SP surveys (Umer et al., 2022).

1.6 Conclusions

Global biodiversity is under severe pressure. The negative development is disturbing but not surprising. Economic theory predicts an underprovision of nonexcludable nonmarket ES, and research should therefore demonstrate and value ES to inform and improve public and private decision-making.

I have two key motivations for this thesis. Since land use changes are identified as the most critical threat to biodiversity (IPBES, 2019), my first motivation is to use SP and CBA to value ES and inform land use policies. My second motivation is to help to improve validity and the use of SP estimates by refining the understanding of preference formation and heterogeneity.

In the first and second papers, we find substantial nonmarket values associated with changes in ES due to land use changes. I conclude that if decision makers consider the magnitude of these values in their trade-offs between climate, biodiversity and market impacts, public policies should be altered. Agricultural policies should be designed to preserve species-rich semi-natural pastures. Tourism development in Norwegian mountain areas should be restricted and reduced to protect landscapes, wildlife, and recreation.

Although the first and second papers pinpoint potential Pareto improvements by preserving ES, the papers do not go into how the policy maker should pursue

these improvements. The papers remain silent on whether the externalities should be accounted for using taxes, subsidies, regulations, or easements. The design of policies to best account for these nonmarket externalities would be an interesting topic for future research.

As discussed earlier, in economics, the decision-making process is modelled as consumers maximising innate stable preferences according to quantities and attributes of the commodities. Within psychology, descriptions of the decision-making process are more complex, and attitudes, shaped by affection and motivation, play a major role in explaining preferences (McFadden, 2001). The economist must try to understand unknown preferences, their underpinnings, and distribution when eliciting nonmarket values using SP.

In the third and fourth paper, we find that using psychological concepts and richer models of the choice process provide more information than the standard economic framework. In the third paper, we find place attachment to enhance the understanding of trade-offs between economic development and environmental goods and the spatial distribution of preferences towards environmental goods. In the fourth paper, we find that studies analysing the effect of altruism on WTP have underestimated the challenges of measuring altruism by self-reporting and that respondents' past donations are associated with higher WTP, also after controlling for stated measures of altruism.

Although it is nice to understand how nonmarket values are formed and distributed across people and space, there is a need to validate these findings in new studies and identify the practical implications of using SP. I view the results as the start of a quest towards understanding the psychological underpinnings of nonmarket values with potential consequences for SP design and implementation further down the line.

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Paper I

Moving (back) to greener pastures? Social benefits and costs of climate forest planting in Norway

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Abstract

Norway is considering a national afforestation program for greenhouse gas sequestration on recently abandoned semi-natural pastureland. However, the program may have negative impacts on landscape aesthetics and biodiversity. We conducted a nation-wide choice experiment survey to estimate non-market values, combined with secondary data on program costs and other impacts, to derive the social net return on land use scenarios. Our results indicate that the scenarios where either half of the abandoned pastures are recovered, or half of the pastures are recovered, and a quarter are designated to the climate forest program, yields the highest net present value. The net present value of all land use scenarios remains positive when limiting the aggregation of willingness to pay to rural households, and when allowing for potential hypothetical bias in benefit estimates and cost increases. Results indicate that landscape and biodiversity values are substantial and should be considered when designing agricultural and climate policies.

JEL classification: Q51, Q57
Keywords: climate forest, biodiversity, pastures, discrete choice experiment, nonuse values, cost-benefit analysis

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ABSTRACT

Norway is considering a national afforestation program for greenhouse gas sequestration on recently abandoned semi-natural pastureland. However, the program may have negative impacts on landscape aesthetics and biodiversity. We conducted a nation-wide choice experiment survey to estimate non-market values, combined with secondary data on program costs and other impacts, to derive the social net return on land use scenarios. Our results indicate that the scenarios where either half of the abandoned pastures are recovered, or half of the pastures are recovered, and a quarter are designated to the climate forest program, yields the highest net present value. The net present value of all land use scenarios remains positive when limiting the aggregation of willingness to pay to rural households, and when allowing for potential hypothetical bias in benefit estimates and cost increases. Results indicate that landscape and biodiversity values are substantial and should be considered when designing agricultural and climate policies.

1. Introduction

Norway has ratified the Paris Agreement to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial level. Norway committed to cut emissions of greenhouse gases by 40 per cent by 2030, while the Norwegian Climate Act target an 80–95 per cent reduction by 2050 compared to the 1990 level. Afforestation and forest management measures to increase carbon storage are becoming an important means of reaching the targets. However, these measures may come at the expense of other ecosystem services (ES) provided, and the question is how to make the right trade-offs from a societal perspective (Burrascano et al. 2016; Luyssaert et al., 2018).

The Norwegian government is considering implementing a national Climate Forest Programme (CFP) consisting of planting forest for the sequestration of greenhouse gases on former semi-natural pastures, that otherwise would be revegetated by natural forest. Semi-natural pastures (hereafter pastures) has been maintained by grazing and the ecosystem depends on grazing (or mechanical mowing) to maintain its characteristic biodiversity. In addition, the pastures provide provisioning and cultural ES such as landscape aesthetics, but probably also sense of identity and place, as pastures have been an important component of traditional farming and rural lifestyles. Pastures previously covered large areas but have been considerably reduced across Europe due to land use changes (Jepsen et al., 2015). An official report identified 9800 km^2 of abandoned pastures, of which 1350 km^2 have quite recently been abandoned and have not yet become forested (Norwegian Environment Agency, 2013).

When abandoned, the pastures slowly grow into natural forests consisting of tree species like birch (*Betula pubescens*), Scots pine (*Pinus sylvestris*) and in some regions of Norway, spruce (*Picea abies*). Compared to natural reforestation, spruce climate forests are relatively densely planted, grows faster and can thus contribute to climate mitigation by two processes: faster sequestering of carbon while growing, and timber and biomass substituting other materials that are carbon intensive in use or production (Taeroe et al., 2017). There is public debate on the planting of climate forests, since such land use reduces biodiversity (Henriksen and Hilmo, 2015b), and many people see the presence of climate forests as an impairment of landscape aesthetics (Grimsrud et al., 2019). The CFP requires avoiding the planting of climate forests on land areas that are important for recreation and of high value for

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biodiversity preservation (Norwegian Environment Agency, 2013). The CFP may not cause immediate extinction of any species, but planting monocultures of spruce will infringe on the land areas inhabited by species dependent on a landscape kept open by grazing. Over time, the loss of habitat requiring human maintenance may increase the risk of extinction, in the same way as the risk of extinction is increased by the loss of available natural habitat (Tilman et al., 1994). While several species, including some that are red listed, may expand their current habitats because of reforestation (Henriksen and Hilmo, 2015a), several red listed species are endemic to pastures (Henriksen and Hilmo, 2015b), due to the long-term management of grazing and/or mowing. The loss of pasture to any type of forest represents a loss of associated ES. Hence, an alternative to natural reforesting of abandoned pastures and the CFP would be to reverse reforestation and restore the recently abandoned pastures.

The CFP commenced with a three-year pilot starting in 2015 in the three counties of Nordland, Nord-Trøndelag and Rogaland. The decision of whether to scale up the programme should depend on an assessment of the costs and benefits of the different land uses. We consider the costs and benefits of combinations of land use options compared to the status quo situation. An official evaluation of the pilot program was recently released without a full economic assessment of costs and benefits (Norwegian Environment Agency, 2019). Our focus on land not yet reforested differs from studies of the Norwegian Environment Agency (2019) and Søgaard et al. (2019), which consider the effect of climate forest planting in already reforested abandoned pastures. In addition, we expand their analyses by also estimating the non-market benefits elicited from people's preferences for different land use options. We conducted a nationally representative choice experiment (CE) internet survey to assess the benefits of different land use options, including landscape aesthetics and greenhouse gas sequestration and biodiversity, and derive welfare estimates based on future scenarios. We use secondary sources to estimate the costs and market benefits of the land use options of CFP and recovering pastures by grazing animals, and compare them with the benefits, within a cost-benefit analysis (CBA) framework.

The main objective of the paper is, therefore, to estimate the welfare effects of land use options in a situation where there are trade-offs between the different ES provided. There is a relatively large related stated preference (SP) literature on assessment of different land uses, including national assessments of landscape aesthetics (e.g. Hynes et al., 2011; Campbell et al., 2008; Scarpa et al. 2007; Dallimer et al., 2015; Huber and Finger, 2019), forest ES such as biodiversity and recreation (Mönkkönen et al., 2014), forest management alternatives targeted to enhance recreational benefits (Mäntymaa et al., 2018), and carbon sequestration (Mogas et al., 2005; Varela et al., 2017).

This study contributes to, and expands on, this literature by integrating the values from the choice experiments (CE) into a full CBA of the Norwegian carbon forest program, pasture recovery and natural reforestation of abandoned pasture. We find that all our considered land use scenarios are preferable over the status quo of no management and natural reforesting.

The paper is structured as follows: The next section briefly presents the analytical framework of the CBA in terms of social cost and benefit components, and how they are defined and measured. Section three explains the underlying data for estimating costs and benefits and discusses the assumptions for the policy scenarios. Section four estimates and compares costs and benefits over time in terms of net present value and conducts sensitivity analyses of restricting the extent of the market. We conclude and discuss the implications of the results in the final section.

Table 1
The land use scenarios and the associated biodiversity attribute levels in the scenarios.

Scenarios	Biodiversity (species under threat)
Status quo	550
P1 Pasture - 50% of abandoned land	400
P2 Pasture - 25% of abandoned land	475
F1 Climate forest - 50% of abandoned land	700
F2 Climate forest - 25% of abandoned land	625
PF1 Pasture and climate forest (50%/50%)	550
PF2 Pasture and climate forest (50%/25%)	475
PF3 Pasture and climate forest (25%/50%)	625
PF4 Pasture and climate forest (25%/25%)	550

2. Analytical framework

The pastures in Norway have been the home of numerous vascular plants, including herbs, and pollinators and other insects that depend on meadows and pastures for their survival as a species. As of 2015, 635 species distinctive for pastures were threatened. Of course, afforestation of abandoned farms as well as modern farming practices on pastures which involves the use of more fertiliser is identified as causes (Henriksen and Hilmo, 2015a). Natural reforestation of abandoned pastures will allow species thriving in landscapes with more woody vegetation to increase their populations. Planted spruce for climate forests is a vegetation monoculture and has the lowest biodiversity of the analysed land uses (Aarrestad et al., 2013).

Landscapes sequester carbon at different rates. According to the Norwegian Environment Agency (2013), planted spruce forests sequester carbon in the above ground biomass faster than any other vegetation in Norway. If the chosen policy is to recover pastures, we will miss out on the sequestration associated with natural reforesting or spruce forests. The soil also stores carbon, and soil carbon storage is substantial for boreal forests (IPCC, 2000). There are knowledge gaps regarding the carbon sequestration potential of the soil of pasture (Dahlberg et al., 2013). At the time of this study we did not have adequate knowledge on soil organic carbon levels for Norwegian climatic conditions for the two other land uses. We, therefore, choose to focus only on carbon storage in vegetation above ground.

Benefits of planted spruce includes the timber value. The CFP requires that the spruce trees must first be felled after 60 years. Although the discounted value of net profits from forestry are relatively small, we account for these future incomes from forestry. According to several studies (see e.g. Greaker et al., 2005; Brunstad et al., 2005), Norway would, in a free-trade equilibrium with no subsidies, in theory produce no agricultural food. Since the recovery of pastures is dependent on government subsidies covering costs and toll barriers protecting the home market, we do not include farmer incomes of recovered pastures in this analysis. Thereby we implicitly assume the subsidies to cover the income.

2.1. Cost-benefit analysis, the decision rule and policy options considered

CBA is a method for ranking of policy options and finding whether policies are socially beneficial taking account of both the benefits and costs of the options as compared with a situation without policy intervention ("status quo" or "baseline situation"). The social welfare function summarises social preferences over allocations of resources and represents a preference ordering of individual utilities in CBA.

CBA ranks policy options based on a monetary criterion, which distinguishes CBA from other decision-making assessments such as for instance multicriteria analysis. As pointed out by for example Boadway (2006), the decision rule in an intertemporal context is the net present value (NPV) criterion. In our case, this criterion implies that the policy-maker should choose land uses for the abandoned pastures that maximise welfare in terms of the NPV of the future (change in the) flow of net benefits, as given in Eq. (1):

$$MaxNPV = \left\{ \sum_{t=1}^{T} \frac{\Delta B_t^A - \Delta C_t^A}{(1+r_t)^t} \right\} \quad (1)$$

where ΔB is the change in social benefit flow of the ES of land use and biodiversity following the combination of land uses, A, considered. Similarly, ΔC is the associated change in the social cost flow, r is the social discount rate (which may vary with time), T is the time period of the policy.

The status quo scenario is to let abandoned pastures naturally reforest as mixed forest, causing a reduction in the number of species threatened by extinction to only 550 species (Henriksen and Hilmo, 2015b). We investigate eight land-use scenarios to the status quo in our CBA (cf. Table 1); two scenarios where either half or a quarter of the abandoned pasture is recovered through agricultural production in the form of grazing (scenarios P1 and P2), two scenarios where either half or a quarter of the abandoned pastures are afforested through the climate forest program (CPF) (scenarios F1 and F2) and, finally, four scenarios combining afforestation and pastures (scenarios PF1 to PF4). Land use will affect landscape aesthetics, CO_2 sequestration and other values, and the associated species under threat range from 400 to 700 species in the different scenarios. Our simple set up implies linear relations between the land-use and the associated values. Thereby we disregard that spatial distribution of land-use may affect aesthetics and other values. We also assume an increase in pasture land use and a correspondent decrease in the CFP land use are equivalent in terms of impacts on biodiversity. We apply a seventy year horizon in our cost-benefit comparisons. We return to our assumptions for key parameters below.

2.2. Benefits

The total economic value of an environmental good produced by a policy measure equals the sum of all benefits/values of the change in the ES flow related to changes in land use. In our case this is the sum of the value attached to landscape aesthetics (a type of cultural service), carbon sequestration (a regulating service) and biodiversity (regarded as underpinning both ecosystem processes and a final cultural ES; see e.g. Mace et al., 2012).

The total economic value includes the benefits individuals derive from using the good (use values) and the value they place on the good even if they do not use it (non-use values). Landscape aesthetics affect both non-use and use values. Landscapes provide existence and bequest values through people's feelings towards how and for what purpose different types of land are managed and their sense of place, and use values through visual perceptions, such as observing landscapes while travelling or walking from home/cabin. The ability of landscapes to sequester carbon is a global public good, and the marginal benefit of carbon sequestration for individuals themselves approaches zero. Biodiversity is also a global public good (IPBES, 2019), in terms of biodiversity as basis for ES and future food security. Although the value of biodiversity is often attributed to containing a large part of existence value (non-use value), people also appreciate the experience of nature, enjoying flowers, birds and butterflies (use value). The value of carbon sequestration is more related to future generations' use values, i.e. bequest values. Thus, while it is currently a non-use value, it may, by time, turn into a use value for future generations enjoying a beneficial climate.

The economic value of the overall stream of social benefits can be defined by the compensating surplus (CS), which is measured by the beneficiaries' willingness to pay (WTP) for the benefits. This relationship is defined by the underlying conditional indirect utility function, where the maximum WTP for the policy measure described in scenario A, WTP^A, is defined as the reduction in income which makes the beneficiary indifferent between a situation with and without the policy measure (e.g. Bergstrom and Taylor, 2006) in Eq. (2):

$$V\left(P^A, Y - WTP^A; Q^A, QUAL^A, I\right) = V(P^0, Y; Q^0, QUAL^0, I) \tag{2}$$

Here P is a vector of prices for market goods, which may differ between the status quo/reference case, 0, and the land use scenario A. Y is the aggregated household incomes, Q is a measure of the quantity of land (in the status quo/reference case, 0, or for land use scenario A), as a percentage of abandoned pastures, QUAL a measure of land quality (in the status quo/reference case, 0, or for land use scenario A), for instance biodiversity associated with land use, and finally I is a measure of information available. Solving this equation for WTP^A the annual change in benefits from conducting policy measure A, as compared to a situation with no policy interventions, provides an estimate for the benefits in Eq. (3):

$$\Delta B^A \equiv WTP^A = f\left(P^A - P^0, Q^A - Q^0, QUAL^A - QUAL^0, I\right) \tag{3}$$

Eq. (3) defines WTP^A as the amount that can be subtracted from the household's incomes so that the population is indifferent with respect to natural reforestation in the status quo as opposed to an scenario land use. We define the market for land use scenarios (i.e. the population that could potentially gain utility from the chosen policies for land use) as the population of Norway, as these pastures and forests affect carbon sequestration and biodiversity, mainly non-use values, which means that any household in Norway in principle could derive utility.

2.3. Costs

Total social costs given in Eq. (1) can be broken down as follows in Eq. (4):

$$\Delta C^A = \Delta C_P^A + \Delta C_M^A \tag{4}$$

where ΔC_P^A is the annual program cost of implementing policy scenario A and ΔC_M^A is the change in marginal costs of public funds of implementing scenario A.

2.3.1. The cost of the Climate Forest Programme

The CFP aims to incentivise landowners to plant spruce on abandoned pastures to increase the uptake of CO_2 in standing biomass. The Norwegian Environment Agency examined possible organizational models, environmental aspects, costs and future benefits associated with the programme in 2013 and started several pilot projects in three counties to test the forest planting policy. The agency proposed that the CFP should produce 10 million spruce plants and plant 50 million square meters of abandoned pastures a year. The government will cover expenses, including production of plants, administration of the program, the planting and the first years of maintenance by the landowner. We include all these costs, annualised, in our calculations.

2.3.2. The cost of recovering pastures programme

Pastureland can be categorised into different types, such as cultivated and uncultivated pastures, and the different types are grazed by different animals, first and foremost sheep, which graze both cultivated and uncultivated pastures during spring, summer and autumn. There are also cattle, which graze mostly on cultivated pastures, and on mountain pastures during summer farming, and goats, which graze mostly on uncultivated pastures. The areas of focus for this study is abandoned semi-natural pastures, meaning these pastures are not cultivated or fertilised, and they need not be fenced.[1]

The long-term trend has been a reduction in pastures, investments, relative wages and number of farmers, which complicates the calculation of the costs associated with increase in pastures. We assume linear cost of recovering pastures, meaning more recovery cost the same per unit recovered.

[1] Except for within the relatively small designated management area for wolves, where sheep must be protected by fences. The designated area streches along the border to Sweden in the most southern part of Norway.

Table 2
– Attributes and levels in the CEs. The status quo level is marked in bold.

Attribute	Specifics	Level vector
Land use	Climate forest	0%, 25%, 50%
	Pasture	0%, 25%, 50%
	Natural reforestation	0, 25%, 50%, 75%, 100%
Biodiversity	Species under threat	400, 550, 700 species
Cost	Additional earmarked income tax per person p.a.	NOK 0, 300, 600, 900, 1200, 1500, 1800

Note: Reforestation is the residual of the land use Climate Forest and Pasture (so the percentages sum to 100 per cent).

2.3.3. The marginal costs of public funds

The distortionary effects of the taxation and tariffs necessary to raise revenue for pastures and climate forests (marginal cost of public funds) are an additional cost in all scenarios. Given that taxes are distortional to the economy, i.e. it is costly in efficiency terms to collect them (Sandmo, 1998), a substantial increase in governmental funding will, *ceteris paribus*, increase the marginal cost of public funds required to compensate farmers. To account for this, we apply a standardised net distortionary factor.

3. Measuring costs and benefits: Methods, data and assumptions

In this section we describe the methods used to estimate benefits and costs of the various land use options. There is no market information that could approximate the value of the ES benefits of land use and biodiversity. We decided to elicit people's preferences for these two ES benefits using the CE method. Thus, benefit estimates are based on data collected specifically for this purpose.

3.1. The Choice experiment survey and benefit estimation approach

3.1.1. Survey development

We held on one focus group to receive feedback on our prototype questionnaire design. After adjusting the questionnaire based on the feedback from the first focus group, we held a second focus group where we conducted one-to-one interviews to perform a final test of the questionnaire before sending out the survey to the Internet panel.

3.1.2. Survey design

The questionnaire contained an introductory section with questions about people's preferences for environmental policy objectives, the CE survey contained text explaining the main topic of the survey, starting

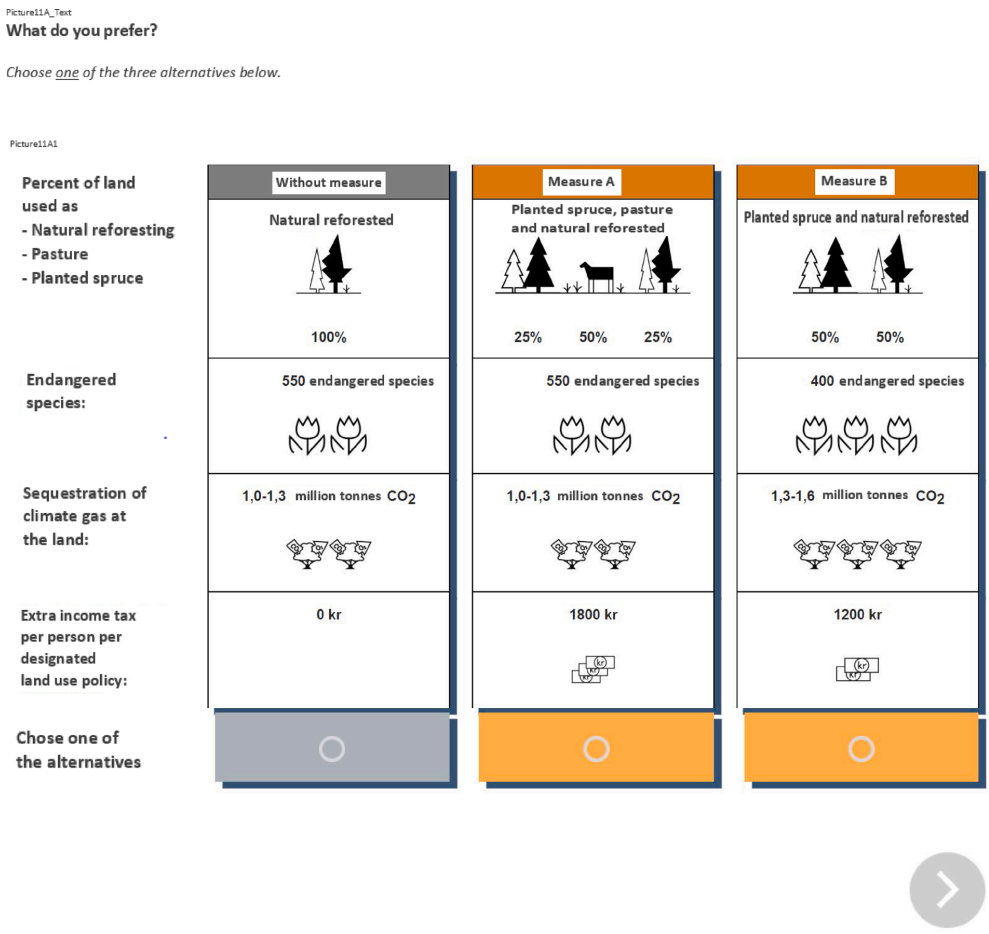


Fig. A4. Choice set example.

by describing the baseline situation of areas in Norway that were previously used for farming and grazing. The policy problem was defined as whether to restore these areas to pastures, set aside and utilise some areas for climate forest planting (of Norway spruce) for a sixty year period, or let them naturally reforest as mixed forest (status quo option). The policy alternatives were defined as various combinations of these three land uses, compared to an alternative representing the status quo situation of natural reforestation (see explanation below). Any active management choice would entail a cost, while leaving the areas for natural reforestation would be free. Based on focus group testing and a qualitative study conducted by means of Q-methodology (see Grimsrud et al., 2019), two main attributes for the CE, in addition to the cost, were identified: combinations of land-use and biodiversity. These attributes were in turn explained in the survey using photos and icons for illustrations (see examples in the Appendix A). For land use, examples of open, grazed pasture, mixed, natural reforestation and climate forest were shown using photos from three representative areas in the three counties of Nordland, Nord-Trøndelag and Rogaland in respectively Northern, Central and Western Norway. In the CE, land use were statistically designed as three different attributes (see Table 2), but graphically, it appeared as a single attribute consisting of combinations of them (see Fig. A4).

The survey then explained how biodiversity in terms of vascular plants such as flowers, herbs and grasses, as well as the occurance of insect species, are the highest in pastures and the lowest in climate forest (Aarrestad et al., 2013). The planted spruce by our design could never occupy more than 50 per cent of the total land area considered (see below for details), and consequently biodiversity levels were permitted to vary independently of the spruce attribute in the CE. The argument for permitting this variation in biodiversity levels was that the impact of planted forest on biodiversity is reduced if one is more careful when determining where to plant. This information was presented to the respondents before they were given the choice sets.

Finally, the survey explained above-ground carbon sequestration in the three land use types, from low (pasture) to high (climate forest). The amount of carbon sequestered was derived directly from the proportion of each type of land use in the alternatives in order for the different choices to be realistic – i.e. the highest level of carbon sequestration in the vegetation combined with land use that is all pastures would not appear credible to the respondent, violating content validity. Thus, while we represent carbon sequestration and storage graphically to the respondents as an attribute, statistically they are not, but are rather a specification of the characteristics of the land use attribute. Hence, the combinations of land uses give trade-offs between land use and biodiversity. As we ask for people's preferences, we are looking at changes in a given level, and we assume that these changes can result in the ES provision mentioned in the CE. The areas relevant for the CFP are generally not very accessible and most likely not much used for recreational purposes. Thus, to make sure that all the attributes were relevant, we omitted recreation from the CE. Instead, we chose to ask about recreation in separate questions.

The attribute levels were based on parameters from the initial report on the CFP. This report identifies the total amount of land that could potentially be planted with spruce (Norwegian Environment Agency, 2013). We set the maximum amount of planted spruce or pasture as 50 per cent of the total potential area. In addition, these land uses had levels of 25 per cent and 0 per cent. The amount of the landscape left to naturally reforest was derived as the residual area when the other land uses varied freely. As a result, natural reforestaton has five levels as shown in Table 2. Although the land use options vary by percentage in the choice cards, the respondents are given the exact land area size in the introductory information in the CE. An early estimate of the number of species under threat of extinction in Norway due to abandonment of pastureland was 550 (Henriksen and Hilmo, 2015b). Two other biodiversity levels were added in based on advice from biologists, an increase and a decrease of 150, or about 30 per cent of 550, in the number of species under threat of extinction. The levels of carbon sequestration were estimated on the basis of the CFP report for planted spruce and reforestation (Norwegian Environment Agency, 2013). For pasture we made the assumption that this vegetation can store one third of the carbon stored by planted spruce (Norwegian Environment Agency, 2013). Cost levels were based on feedback from the focus group and one-to-one interviews with respondents.

After receiving information about the impacts of the various land uses, respondents were introduced to the choice sets. They were informed that anything other than status quo would require active management that has a cost that would have to be paid for by an *annual* earmarked income tax levied on all Norwegian households. The CFP, and agricultural policy, is paid for by everyone, so this was not expected to generate much protest.

The CE design was found using SAS and uses the methods and procedures described in Kuhfeld (2009). A full factorial design would have $3 \times 3 \times 3 \times 6 = 162$ profiles and 81 choice sets. We chose to use a fractional factorial design with 18 choice sets based on the output from the MktRuns-procedure. The profiles used in the choice sets were then chosen using the MktEx-procedure with constraints. The design was constrained to prevent the lowest level of red listed species to occur together with the highest levels of area allocated to spruce planting. The status quo alternative was added to the final output of the MktEx-procedure. The ChoiceEff-procedure (Kuhfeld, 2009) optimised the combination of profiles into choice sets. The 18 choice-sets were blocked using the Mktblock-procedure.

Each respondent received either 6 or 12 sets of choices[2] and were asked to choose between two policy options ("Management option A and B") in addition to the status quo ("No management"). The order of the choice sets was randomised between individuals. The choice sets were followed by standard follow-up questions regarding which attribute (if any) they thought was the most important and whether it was difficult to answer. The survey then had a series of questions about recreational use and whether there are areas (counties) people prefer no climate forest planting, before concluding with socio-economic background questions.

3.1.3. Data collection

The data were collected from an Internet survey panel maintained by the survey company NORSTAT, as part of a large nation-wide, representative survey. Internet stated preference surveys have been shown to give reasonable response quality compared to more traditional survey modes such as personal interviews, mail or telephone (Lindhjem and Navrud, 2011a, b). The survey was conducted on a representative sample of the Norwegian adult population in April-May 2018, obtained through their panel. We obtained 977 completed surveys, using a median of 12 min to complete.

3.1.4. Econometric analysis and estimation of WTP for the scenarios

The CE and the corresponding results and welfare measures are based on the random utility model (RUM). RUM assumes that individual utility can be separated into a deterministic part and a stochastic part, as given in Eq. (5) (McFadden, 1974):

$$V_{ij} = v_{ij} + \varepsilon_{ij} \tag{5}$$

where V_{ij} is the indirect utility derived from choice j by individual i, v_{ij} is the deterministic part and ε_{ij} is the stochastic part of the utility.

The individual faces a choice among three alternatives in each choice situation and is assumed to choose the alternative giving the highest utility. In the survey, the respondent chooses among bundles of attributes; different land uses, biodiversity levels and costs. We use the

[2] This variation was introduced for another experimental test not reported here. The datasets of respondents who received 6 and 12 choice sets were merged here, to improve efficiency of the estimates.

random parameters logit model (RPL) to estimate of the attributes' effect on respondent choice and the marginal rate of substitution (MRS) between different attributes. The RPL model lets coefficients vary over respondents following an assumed density function of parameters in the survey population. The researcher specifies a distribution for the coefficients and estimates the parameters of that distribution through simulation. The utility of alternative *j* for individual *i* is given by Eq. (6):

$$V_{ij} = x'_{ij}\beta_i + u_{ij} + \varepsilon_{ij} \tag{6}$$

where u_{ij} is a random term with zero mean and whose distribution over individuals and alternatives depends on underlying parameters related to alternative *j* and individual *i*. Further, $x'_{ij}$is a vector of observed attributes, with the estimated corresponding parameters given by β_i while ε_{ij} is an unobserved error term (Hensher and Green, 2003). In most applications, the distribution of u_{ij} is assumed to be normal or lognormal (Train, 2009). We let all the nonmonetary attributes be specified as normally distributed, while the cost parameter is kept fixed, and we allow for correlation between the parameters. Dividing the attribute estimates by the cost parameter gives the estimate of marginal willingness to pay (MWTP) (Train, 2009), as given in Eq. (7):

$$MWTP = \frac{\frac{\partial V}{\partial x_1}}{\frac{\partial V}{\partial C}} = \frac{\beta_1}{-\beta_C} \tag{7}$$

where $-\beta_C$ is the negative coefficient of the cost attribute and reflect the marginal utility of income, while β_1 is the coefficient of a non-monetary attribute. When estimating WTP for the options in our CBA, we must estimate the combined welfare change represented by the corresponding bundles of attributes in each scenario. Deriving a welfare measure consistent with RUM requires calculating the Hicksian Compensating Surplus (CS) measure (Lancsar and Louviere, 2008).

Respondents are asked to evaluate each choice set independently, assuming that only one alternative can be realised. Thus, the CE is a so-called state-of-the-world experiment where a respondent values the changes in the attributes in the scenarios compared to the reference level (Holmes et al., 2017). The CS is given by Eq. (8):

$$CS^A = WTP^A = \frac{1}{-\beta_C}\left[V^A - V^0\right] \tag{8}$$

where V^A are the values of the indirect utility function for scenario *A* after the quantity change and V^0 is the status quo option where the abandoned pastures are naturally reforested (Holmes et al., 2017). The estimated parameters are bundled into the land use scenarios in accordance to Table 1. Eq. (9) exemplifies of how WTP for scenario P2 is calculated.

$$\begin{aligned} WTP_{P2} &= -\frac{\beta_1 \Delta x_1 + \beta_2 \Delta x_2}{\beta_C} \\ &= -\frac{Constant + \beta_{Pasture-25\%} * 1 + \beta_{\text{Biodiv}-150\text{ sp. no long. end.}} * 0.5}{\beta_C} \end{aligned} \tag{9}$$

The estimated parameters for non-monetary attributes are capturing changes in utility when departing from status quo, $V^A - V^0$ in Eq. (8).

3.2. Other benefits and costs

3.2.1. Benefits and cost of the climate forest programme

In 2013, the program was estimated to cost slightly less than NOK 100 million a year throughout a twenty-five year period (Norwegian Environment Agency, 2013), a total of NOK 2.4 billion in 2018 prices. When the government hand out afforestation grants to individual farmers, the farmers agree not to extract timber for the next sixty years. After sixty years the farmers are permitted to utilise the forestry resources. The survey respondents were explained that the farmers were assumed to harvest the trees after 60–80 years. We assume the CFP is implemented within 10 years, and that the costs are about NOK 190 million a year in 2018 prices, totalling NOK 1.9 billion NOK in the 50 per cent afforestation scenarios. The government will cover all expenses, including production of plants, administration of the program, and the planting and management of the climate forests by the forest owners.

In addition to sequestering carbon, planting of climate forests represents future forestry incomes. We assume a single rotation situation, meaning that once trees are harvested, the area may be used for something else, which is consistent across the three alternatives. It also reflects how land use is going to change in the future with climate change and expected changed demand for food and fibre products is highly uncertain, thus assuming a repetition of rotations into perpetuity would not be appropriate for the current analysis. We account for the future harvest incomes of the first rotation and assume that the trees are felled and sold when the trees are 60 years old, meaning that the first trees to be planted in 2022 are cut down in 2082 while the last three to be planted in 2028 are cut down in 2088. The estimated volume of timber in that future point in time is 55 cubic meters per thousand square meters, and we assume that future prices correspond to current prices.[3] We are only to include the net profits in our net benefits calculations, excluding the alternative use of labour and capital, and we assume a 25 per cent profit margin on the value of timber. The calculations are in accordance with valuation assumptions made by The Land Consolidation Courts of Norway (2013) and our resulting estimates are in line with an alternative estimation made by Søgaard et al. (2019).

3.2.2. Costs of recovering pastures

There are several studies investigating the costs of recovering pastures in Norway. Ebbesvik et al. (2017) investigate the cost of incorporating abandoned pastures when farms have excess capacity among labourers, in barns and outbuildings. They find that incorporating abandoned pastures cost about NOK 250 a year per thousand square meters. Small increases in the use of pasture, incorporating abandoned pastures into a farm with excess capacity, will be a lot less costly than a large scale increase in the use of pastures at national level. In our analysis, we investigate situations where the government decides to increase pastures by 337 or 675 square kilometres, more than 2.5 and 5 per cent of the total agricultural land in Norway. Such policies will necessitate both investment and stronger economic incentives for farmers to utilise the pastures. A cost analysis by Fjellhammer and Hillestad (2013) finds that investing in outbuildings and farm equipment reduces sheep farmers' profitability by NOK 1500–2300 per thousand square meters as an annual average. We therefore expect the cost of recovering pastures to be NOK 500 per thousand square meters on average, both when the use of pastures is increased by 337 square kilometres and when the use of pastures is increased by 675 square kilometres. At present, about 65 per cent of the farmers' income stems from governmental subsidies (Fjellhammer and Hillestad, 2013), and since the protection of the consumer markets from outside competition is an additional de facto subsidy, we expect this policy to be covered by governmental taxes and tariffs.

3.2.3. Transaction costs and marginal costs of public funds

In estimating the marginal cost of raising public funds, we follow the guideline of the Norwegian Ministry of Finance (2014), which recommends assuming a cost of NOK 0.2 to raise NOK 1 for a public project or policy. This means in practice that we add 20 per cent to the opportunity and transaction costs of the programs.

3.2.4. List of cost-benefit analysis assumptions

Further assumptions are provided in Table 3. We apply a time period of 70 years, from 2018 to 2088, including a ten-year implementation

[3] We assume 70 percent sawlogs and 30 percent pulpwood at a price of NOK 490 per cubic meter of sawlogs and NOK 240 per cubic meter of pulpwood.

Table 3
Assumptions applied in the cost-benefit calculations.

	Assumed	Source/Source of guideline
Start / end of analysis	2018 / 2088	
Year of assembly	2018	
Years of analysis	70	Norwegian Ministry of Finance
Years to full program implementation	10 years	
Benefits estimated from CE		
Included net profits from forestry in benefits		
Programs publicly financed		
Additional cost of public financing	20%	Norwegian Ministry of Finance
Discount rate	4% (2018–2057)/3% (2057–2088)	Norwegian Ministry of Finance
Real price growth	0.8 %	Norwegian Ministry of Finance
Number of households 2018	2 409 257	Statistics Norway
Number of households in 2060	2 959 136	Statistics Norway

period and 60 years of climate forest conservation through the program. Regarding the other CBA assumptions, the Norwegian Ministry of Finance presented a White Paper making predictions for Norway until the 2060s in 2013, and a White Paper recommending assumptions for CBA in 2014. We adopt assumptions on number of households, real price growth and discount rates from these government documents, and use the recommended risk-adjusted discount rates of 4 per cent per annum for the first 40 years, and 3 per cent per annum for the years thereafter (Norwegian Ministry of Finance, 2014).

4. Analysis and results

4.1. Estimation of annual benefits

The response rate for the CE survey was 16 per cent, and the completion rate was 82 per cent. The sample shows fairly good representativeness of the Norwegian population along the dimensions of gender, age distribution and education.[4]

Attribute levels for pastures, climate forest and biodiversity are dummy coded with the status quo of natural reforesting as the reference level. We include an alternative specific constant term coded as a dummy equal to one on the alternative scenarios, capturing respondent's unobserved preference for moving away from the status quo. Table 4 presents the RPL model estimated on CE data.

The coefficients of pastures, climate forest, biodiversity and income tax all have the expected signs. The coefficients for biodiversity show, as expected, a higher marginal value of a loss than of a gain of the same size.

The parameter coefficients indicate that respondent's value recovered pastures significantly higher than planted spruce. Respondents value pasture higher than natural reforestation (status quo). The two pasture coefficients are significantly different from each other but close in value; respondents' value 25 per cent pasture recovery almost at as much as 50 per cent pasture recovery. The coefficients for planted spruce are not significantly different from each other and only the 25 per cent level is different from the status quo at 90 per cent significance level.

All the standard deviation parameters are statistically significant and large relative to the mean coefficients, implying large heterogeneity among the respondents. The coefficients for s_{11} to s_{66} are the lower triangular Cholesky decomposition of the variance-covariance matrix. Twelve of these eighteen coefficients are significant, indicating substantial correlation between the parameters. The variance-covariance matrix and the correlation matrix are included in Table B1 in Appendix B. We find large correlation coefficients between the different levels of attributes. We have also run a model with independent parameters, not reported here, resulting in larger and significant parameters for planted spruce and a smaller significant constant parameter.[5]

We calculate the WTP for changes in non-monetary attributes relative to the base case, according to Eq. (9), following Holmes et al. (2017). We calculate standard errors and confidence intervals using the delta method. The results are presented in Table 5.

The scenarios involving some recovery of pastures yield higher WTP, reflecting both higher valued land use and increased biodiversity compared to status quo, F1, and F2. The scenarios involving solely the CFP (F1 and F2) are less popular, although the land-use is valued positively, this is severely dampened by the negative effects of the biodiversity reduction. Notice, the only reason this scenario has a positive WTP at all, is due to the constant term indicating a willingness to pay to

Table 4
Results of random parameters logit model discrete CE, correlated parameters simulated through 600 Halton draws. *** $p < 0.01$ ** $p < 0.05$ *$p < 0.10$.

Mean		Coefficient	Standard error
Pasture recovery: 25% of abandoned land	Mean	1.148***	0.11
	Std.dev.	2.646***	0.15
Pasture recovery: 50% of abandoned land	Mean	1.209***	0.13
	Std.dev.	3.271***	0.15
Climate forest program: 25% of abandoned land	Mean	0.167**	0.08
	Std.dev.	1.827***	0.10
Climate forest program: 50% of abandoned land	Mean	0.094	0.09
	Std.dev.	2.236***	0.12
Biodiversity: 150 species no longer endangered	Mean	0.346***	0.06
	Std.dev.	0.988***	0.09
Biodiversity: 150 additional endangered species	Mean	−0.477***	0.07
	Std.dev.	0.746***	0.10
Income tax (per 1000 krone) (fixed)		−0.971002***	0.00
Alternative specific constant		1.300***	0.10
s_{11}		2.65***	0.13
s_{21}		3.22***	0.15
s_{31}		1.41***	0.11
s_{41}		1.60***	0.13
s_{51}		0.37***	0.10
s_{61}		0.07	0.11
s_{22}		0.59***	0.12
s_{32}		−0.05	0.23
s_{42}		0.27	0.23
s_{52}		0.22	0.15
s_{62}		0.26	0.16
s_{33}		1.16***	0.09
s_{43}		1.49***	0.10
s_{53}		−0.06	0.11
s_{63}		0.32***	0.11
s_{44}		−0.40***	0.11
s_{54}		−0.89***	0.08
s_{64}		0.58***	0.12
s_{55}		0.01	0.34
s_{65}		−0.17	0.32
s_{66}		−0.12	0.32
Number of repondents/choice sets	977/8214		
Pseudo - R^2	0.277		
Log likelihood	−6,011.4		
LR $\chi^2(21)$	4621.3		

Note: 1 2018-NOK = 0104 EURO. The population's yearly WTP given in billion Norwegian 2018-kroner.

[4] Respondents with solely primary school is underrepresented in our data.

[5] Results available upon request.

Table 5
Willingness to pay (compensating variation) per household per year for land use scenarios (2018 NOK).

Scenarios	WTP per household	Standard error	CI 95% - LB	CI 95% - UB	The population's yearly WTP
P1 Pasture - 50% of abandoned land	2939	178	2591	3289	7.1
P2 Pasture - 25% of abandoned land	2699	143	2418	2981	5.6
F1 Climate forest - 50% of abandoned land	944	127	695	1193	2.3
F2 Climate forest - 25% of abandoned land	1265	109	1052	1478	3.0
PF1 Pasture and climate forest (50%/50%)	2680	200	2288	30573	6.5
PF2 Pasture and climate forest (50%/25%)	2933	202	2539	3329	7.1
PF3 Pasture and climate forest (25%/50%)	2373	175	2029	2716	5.7
PF4 Pasture and climate forest (25%/25%)	2685	170	2351	3018	6.5

move away from status quo regardless of the policy.

The highest WTP is obtained from the P1 pasture recovery of half of the abandoned land scenario and the PF2 scenario, which is not significantly different from each other, but significantly higher than the other scenarios.

We calculate the population's annual WTP for land uses by multiplying household WTP by the number of households in Norway in 2018 (see Table 5)[6] . We assume that planting of climate forests and recovering of pastures will be implemented during a ten year period, so that the population WTP figures will increase stepwise from zero to the levels presented in Table 5 during implementation of policies.

4.2. Estimation of other annual costs and benefits

4.2.1. Benefits and cost of the CFP

We consider an introduction of the scheme initiated in 2018 and completed within ten years. We assume the production of the spruce plants starts in 2020. In 2022 the planting starts, and as of this year, the total costs will be approximately NOK 230 million a year (see Table 6). We base our cost estimation on the Norwegian Environment Agency's program cost estimates, a recent report on the effect of planting on natural reforesting areas (Søgaard et al. 2019) and a recent evaluation of the CFP (Norwegian Environment Agency, 2019). We assume linear cost between 50 per cent and 25 per cent programs, except for administrative costs, which is higher in the 25 per cent scenarios.

In addition, we calculate the incomes from future forestry of the climate forest. We expect that on good site quality three quarters of the climate forest provides financially profitable forestry in the future, and thus a ten year of forestry incomes towards the end of our period of analysis. Given today's timber prices minus operating costs (25 per cent profit margin), we calculate the present value of future incomes at about NOK 30 million a year from 2078 to 2088 in scenarios where half of the abandoned pastures are afforested with spruce, and NOK 15 million when a quarter the abandoned pastures are afforested with spruce. From 2088 we allow land use to be changed – or continued. Thus, we look at a single rotation situation.

[6] The survey text introducing the annual earmarked income tax was somewhat ambiguous, both asking for individuals' WTP and stressing household budget constraints. Since we ask people to value public goods where for most respondents it may be natural to think about their household members, we chose the conservative approach to aggregate WTP by households rather than individuals. The literature is generally not clear on which unit to choose in SP surveys (Johnston et al., 2017; Lindhjem and Navrud, 2009), and it is hard to think of a tax or other payment vehicle that is measured out and paid by the household.

Table 6
Estimated annual costs of the CFP. Million Norwegian 2018-kroner.

Levels	1st Year	2nd Year	3rd Year	4th to 10th Year
50 % of abandoned pastures	61	111	181	230
25 % of abandoned pastures	61	86	121	146

Table 7
Estimated annual costs of the recovering pastures policy. Million Norwegian 2018-kroner.

Levels	1st Year	2nd Year	3rd Year	…	After 10th Year
50 % of abandoned pastures	34	68	101	…	337
25 % of abandoned pastures	17	34	51	…	169

Table 8
Summary of present value (PV) benefits, costs and net benefit compared to status quo in billion Norwegian 2018-kroner.

Scenarios	Household WTP (aesthetics, carbon sequestration and biodiversity)	Program net costs (incl. forestry incomes and cost of public financing)	PV Net benefits
P1 Pasture - 50% of abandoned land	167	−10	158
P2 Pasture - 25% of abandoned land	154	−5	149
F1 Climate forest - 50% of abandoned land	54	−3	51
F2 Climate forest - 25% of abandoned land	72	−2	70
PF1 Pasture and climate forest (50%/50%)	153	−13	140
PF2 Pasture and climate forest (50%/25%)	167	−12	155
PF3 Pasture and climate forest (25%/50%)	135	−8	127
PF4 Pasture and climate forest (25%/25%)	153	−7	147

4.2.2. Costs of recovering pastures

To simplify, we assume that both the 50 per cent and the 25 per cent scenarios of recovering abandoned pasture, through the reintroduction of grazing animals, are implemented stepwise over a ten-year period. This implies that pastures gradually recover from 2019 and are fully recovered, according to the land use specified in the respective scenarios, in 2029.

In the 50 per cent scenarios, we assume linearly rising cost from 2019 until 2029, where additional NOK 34 million NOK is funnelled to farmers in 2019, rising to NOK 337 million per year from 2029 and onwards throughout the time period analysed (see Table 7).

In the 25 per cent scenarios, we also assume linearly rising costs from 2019 until 2029, where additional NOK 17 million is funnelled to farmers in 2019, rising to about NOK 169 million per year from 2029 onwards.

4.3. Cost-benefit comparisons

The net present values of the population's willingness to pay and program costs calculated using the standard CBA assumptions listed above, are provided in Table 8. Our main result is that active use of the abandoned pastures, whether through pasture recovery, planting spruce forest in the CFP or a combination of these policies, is preferable to the status quo option of natural reforestation. When comparing our scenarios, we see that the 50 per cent and 25 per cent pasture scenarios (P1 and P2) yield larger net benefits than the 50 per cent and 25 per cent climate forest scenarios (F1 and F2).

The households' WTP for policy measures other than the status quo of natural reforestation of the abandoned pastures yield net benefits between NOK 51 and 158 billion, implying that any of the policies considered would be highly efficient use of public resources. According to our respondents' choices and the subsequent cost-benefit comparisons, our results indicate that the scenario P1 where half of the abandoned pastures are recovered yields the highest net present value. This scenario provides the largest household WTP together with the PF2 Pasture and climate forest (50 per cent/25 per cent) scenario but is a less extensive program and thus cheaper to implement than PF2. In conclusion, the difference in aggregated welfare between pure pasture and the combined policies with 25 per cent CFP land use are not large, indicating that the loss in aesthetic values of establishing climate forest may be compensated by carbon sequestration. Notice that the value of carbon sequestration, and potential substitution effects in future use of the wood is elicited through respondents' value hereof seen together with the land-use attributes.

4.4. Sensitivity considerations

Stated preference methods have been under scrutiny for estimating exaggerated welfare estimates, especially non-use values (Johnston et al., 2017). Murphy et al. (2005) found that among 28 stated preference valuation studies, 83 observations had a median ratio of hypothetical to actual value of 1.35. All our scenarios remain positive even if we cut the willingness to pay figures by half, meaning net present benefits are positive at a 100 per cent hypothetical bias level, while the scenario with the highest net present value change to the P2 Pasture (25 per cent/0 per cent) scenario.

Our cost estimates are uncertain. Although the costs could be underestimated, the scenarios considered yield benefit-cost ratios ranging from 16 to 35, suggesting that cost is unlikely to overturn total benefits. We test whether changing the estimated costs change the ranking of scenarios and find that the P1 Pasture (50 per cent/0 per cent) scenario remains the most beneficial scenario when multiplying costs by factors of 0.5, 1.5 and 2.

A central issue in CBA is defining the extent of the market (Loomis, 2000; Johnston et al., 2017). Should all households in the country count equally, or should the preferences of households closer to the abandoned pastures be given a higher weight than households further away? One can argue that households in the larger cities are likely to be less informed and affected by the ongoing abandonment of agricultural land and that the aesthetics related to landscapes are more relevant to households living in the affected areas. We check whether our results remain stable when restricting the analysis to rural households.

Unfortunately, we lack detailed geographical information on the abandoned pastures, thus we cannot easily determine which and how many households are close to abandoned pastures. As a second-best solution we use urban-rural dimension as an instrument. Although the urban-rural dimension is unrelated to landscapes and pastures, it should coincide with the approximate geographical location of abandoned pastures, which one is relatively more likely to encounter in rural areas where agricultural production is costlier due to difficult terrains and long distances. When running the model presented above and restricting the analysis to the 323 500 most rural households[7], rather than the whole Norwegian population, we find that all the scenarios retain the positive net benefits result. The P1 and P2 scenarios are the most efficient due to higher WTP for pasture recovery among rural households, revealing spatial heterogeneity of pasture ES values. Economic theory motivates several explanations for spatial welfare patterns, such as distance decay of use values, substitutes and complements distributed across space, and spatial dimensions of scope and diminishing marginal utility (Glenk et al., 2019). Shorter distance to use values of pastures and biodiversity such as visual perception of landscape, experiences of nature, flowers, birds and butterflies, might explain the higher WTP among rural households. See results in Appendix C.

5. Discussion and conclusion

Our CE and corresponding CBA indicate that recovery of abandoned pastures would be efficient use of land. Climate forests may be an efficient measure to meet the 80–95 per cent carbon dioxide emission reduction target in 2050, but other societal demands require land use management measures to recover semi-natural pastures as well, both because of landscape values and biodiversity benefits. Apart from the effect on the landscape itself, the result is driven by a strong preference for biodiversity conservation. From an economic point of view, any of the policy measures considered are highly beneficial compared to the status quo of natural reforesting. Recovering half of the abandoned pastures is the most preferred scenario, and while setting aside land area for climate forests for sixty years is slightly preferred over natural reforestation, respondents do have strong preference for departing from the status quo scenario of no management. Our results lend some support to the favourable assessment of the pilot program made by Søgaard et al. (2019) and Norwegian Environment Agency (2019). These studies conclude that recently abandoned pastures with high site quality should not be used for climate forests due to biodiversity concerns, while already reforested pastures, not considered in our study, are more suitable for the CFP.

Respondents were not scope sensitive to the area coverage. While this could be an indication of low validity of the survey, an alternative explanation is that people find that *some* traditional land use is important to keep, somewhat independently of specific size. The ranking of scenarios holds when increasing the costs, while when allowing for substantial hypothetical bias the scenario where a quarter of the abandoned pastures are recovered as pastures is most efficient.

There are some examples of similar, but not directly comparable studies. Hynes et al. (2011) find a compensating surplus of EURO 22 per person per year for a sustainable rural environment in Ireland, implying the same area of pastures as status quo and improved conservation of species and stone walls. This would amount to about NOK 600 per

[7] According to index number 5 and 6 in Statistics Norway's centrality index (Statistics Norway, 2017).

household in 2018 prices and is roughly similar to our WTP estimates for enhanced biodiversity. Huber and Finger (2019) find in a recent meta-analysis of monetary valuation studies of cultural ES aesthetics, thus including e.g. landscape aesthetics values but not carbon sequestration values, a willingness to pay by EURO 53 per person per year for an increase in grasslands in less-intensive land-use in mountain regions, about NOK 1300 per household in 2018 prices. In another study from Ireland, Campbell et al. (2008) find a WTP for safeguarding *some* pastures as EURO 190, and a WTP for safeguarding of *a lot* of pastures as EURO 210 per individual per year, which is higher but comparable with our results.

Designing public policies targeting a large geographical area, like an entire country, faces the problem that people may care less about the extent – but more about the process and where benefits are distributed. If this is a problem, it also carries over to similar surveys. Interestingly, similar to our findings, Campbell et al. (2008), as noted above, find a similar low scope sensitivity.

In the analyses we have excluded recreational values which is in line

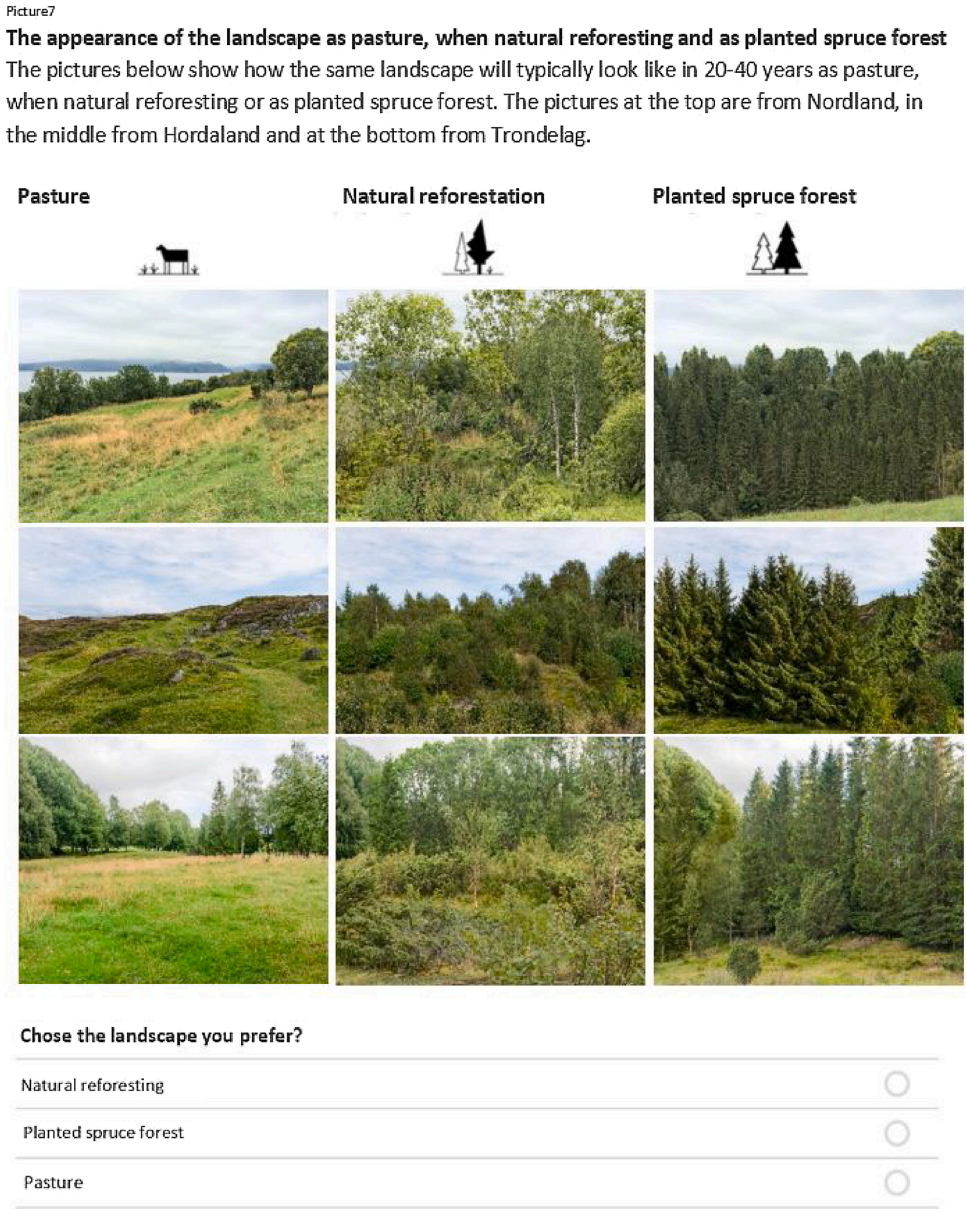


Fig. A1. Information regarding the land use attribute.

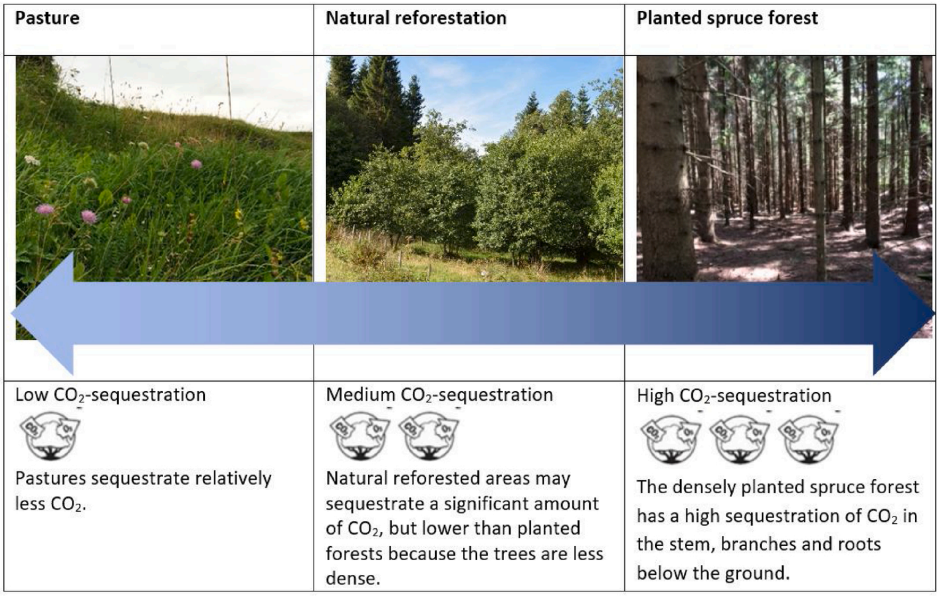
Picture9

Sequestration of greenhouse gases in the vegetation

The densely planted Norwegian spruce probably sequestrate and stores more greenhouse gases (CO_2) than pastures and natural reforesting areas.

It has been estimated that planting of 1,000 km^2 forests will take up 1.45 million tonnes of CO_2 a year over a period of 80 years. This corresponds to about 2.7 per cent of the total Norwegian emissions of approximately 53 million tonnes. Naturally reforesting areas stores about one-third as much CO_2 per km^2 as planted forest.

NOTE: In a given landscape one can influence the consequences for greenhouse gas sequestration in several ways. The greenhouse gas sequestration in forests can be increased by fertilization, denser planting and by other forest care.



Did you know before you received the information above that planted forests take up and store more greenhouse gases than pastures and naturally reforesting areas?

- Yes ○
- No ○
- I don't know ○

Fig. A2. Information regarding the GHG sequestration attribute.

with the lack of geographical specificity as it would require people to link national policies to where they specifically recreate. We have addressed this by telling respondents that climate forests will not be established in areas of importance for recreation. If they have ignored this, they could potentially have factored it in.

Further, aggregation of household level welfare estimates becomes an important issue in CBA, especially as the study is on a national scale. Many studies find unrealistically high welfare estimates when mean WTP estimates are aggregated over a national population (e.g. Sanchirico et al., 2013; Lindhjem et al., 2015). Recent guidance on the use of SP methods mentions that determining the extent of the market "remains a challenge for which research is warranted" (Johnston et al., 2017; p341-2). This issue is also closely related to non-use or existence values, as, for example in our case, only a small part of the population will experience or use the areas for which afforestation is considered. Hence, the extent of the market for non-use values may be difficult to

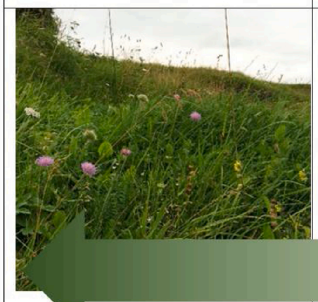
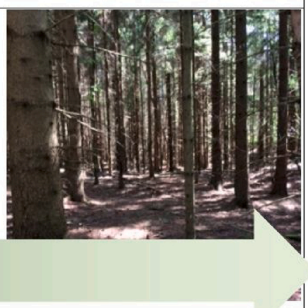
Picture8

What the land use implies for plant and animal life

Most endangered species in Norway are mammals, birds, vascular plants, lichen, butterflies or wasps. Butterflies and vascular plants (herbs and grass) are particularly dependent on pastures to thrive.

The table below shows that there are fewer habitats for endangered grass, herbs and butterfly species when moving from traditional operated pastures to planted spruce forests. The areas in natural reforesting will house species other than grazing land and planted spruce forest.

NOTE: In a given landscape one can influence the consequences for endangered species in several ways. Through careful mapping of plant and animal life, one can make sure that the most important habitats for endangered species are kept in traditional operation and are not planted with forests or grow back again.

Pasture	Natural reforestation	Planted spruce forest
		
High species richness  On these areas, endangered grass, herbs and butterfly species live. Due to reforesting and modern farming operations, one third of these species are threatened.	**Medium species richness**  These areas have fewer endangered grass, herb and butterfly species than pastures but will house some other species.	**Low species richness**  Dense, planted spruce has few grass and herbs and rarely shelter endangered grass, herbs and butterfly species.

Did you know before you received the information above that traditional operated pastures have more endangered species than planted spruce forest?

- Yes ○
- No ○
- I don't know ○

Fig. A3. Information regarding the biodiversity attribute.

assess and "distance decay" approaches may not be appropriate for high non-use value goods (Zimmer et al., 2012; Johnston and Ramachandran, 2014; Johnston et al., 2015). When we restrict the extent of the market to most rural households, we find net benefits to remain positive across scenarios, while scenario P1 and P2 become most efficient, due to higher WTP for pasture recovery among rural households. An interesting extension would be to go further into the distribution of values across geography.

We rely on general calculations of cost and income of recovering pastures and planting climate forests. A further enhancement of the CBA

Table B1
Variance (diagonal), covariance (lower triangular) and correlation (upper triangular, grey area).

		Pasture recovery		Climate forest program		Biodiversity	
		25% of abandoned land	50% of abandoned land	25% of abandoned land	50% of abandoned land	150 species no longer endangered	150 additional endangered species
Pasture recovery	25% of abandoned land	7.00	*0.98*	*0.77*	*0.71*	*0.37*	*0.10*
	50% of abandoned land	8.51	10.70	*0.76*	*0.72*	*0.40*	*0.16*
CFP	25% of abandoned land	3.74	4.51	3.34	*0.97*	*0.24*	*0.34*
	50% of abandoned land	4.22	5.29	3.97	5.00	*0.41*	*0.26*
Bio-diversity	150 species no longer endangered	0.97	1.30	0.43	0.90	0.98	*−0.62*
	150 additional endangered species	0.19	0.39	0.46	0.44	−0.46	0.56

would be to add more detailed figures on the costs and income possibilities related to different production scenarios. The estimated WTP for pastures, climate forests and biodiversity could be applied in agro-economic modelling, as Norwegian studies using such models have long called for values based on stated preference studies. Brunstad et al. (19992005), for example, adopt the Norwegian JORDMOD model, used by the government for agricultural policy planning purposes, to consider the values of public goods stemming from agricultural production. Brunstad et al. (19992005) had to resort to a crude transfer of values from an old Swedish study (Drake, 1992), since local values were non-existent. The inclusion of our results in agro-economic models could give a better knowledge of the total economic significance of the agricultural and food sector and how policy measures and framework conditions can best be designed. Our results indicate substantial positive externalities stemming from agricultural production.

In our analysis we estimate the value of carbon sequestration through people's perception hereof through the land use. Thus, we do not explicitly put an estimate on the carbon sequestration, but we do inform people of the carbon sequestration levels of the alternatives. This information is based on the climate sequestration from the pastures and forests and do not include the emissions caused by grazing animals (i.e. methane), thereby implicitly assuming that the meat produced would cause as much emission if produced under other circumstances. Pastures can be maintained both through different production methods associated with different emissions, such as harvesting grass for the purpose of landscape preservation, or by grazing sheep, goats and cattle. We do neither include the potential climate mitigation through future materials substitution due to increased forestry. Natural extensions of our analysis would therefore be to include the cost of emissions of methane gas associated with grazing animals in our CBA, include the effect of materials substitution due to increased forestry and explore the importance of albedo, increased by maintaining the open pastureland. Had we included such values, we would have come up with larger climate policy benefits of the scenarios. However, the difference in estimates of our scenarios is likely small, as carbon sequestration is only a part of the land use attribute evaluated.

Rather than having respondents valuing carbon sequestration indirectly through land-use alternatives, a possibility would be to calculate the value of carbon sequestration explicitly, using a unit price on carbon. Norway's national climate policy has in isolation no effect on the global climate, and therefore inclusion in (national) welfare economic analyses is best done from a cost-effectiveness approach, given the international commitment Norway has made (through the Paris agreement). It is in this light the current paper should be seen – a CBA of a policy to fulfill the overall climate policy through the use of land use changes. Expanding the analysis to let people make tradeoffs between different ways to obtain the goal would be a different approach that we leave for future research.

Table C1
Results of random parameters model discrete CE, correlated parameters simulated through 600 Halton draws. Most rural households. *** $p < 0.01$ ** $p < 0.05$ *$p < 0.10$.

Mean		Coefficient	Standard error
Pasture recovery: 25% of abandoned land	Mean	1.28***	0.39
	Std. dev.	2.76***	0.42
Pasture recovery: 50% of abandoned land	Mean	1.44***	0.45
	Std. dev.	3.35***	0.47
Climate forest program: 25% of abandoned land	Mean	−0.02	0.25
	Std. dev.	1.62***	0.33
Climate forest program: 50% of abandoned land	Mean	−0.25	0.28
	Std. dev.	1.91***	0.37
Biodiversity: 150 species no longer endangered	Mean	0.08	0.22
	Std. dev.	1.07***	0.31
Biodiversity: 150 additional endangered species	Mean	−0.49**	0.19
	Std. dev.	0.76***	0.28
Income tax (per krone) (fixed)		−0.00***	0.00
Constant		1.27***	0.33
s_{11}		2.76***	0.42
s_{21}		3.24***	0.47
s_{31}		1.21***	0.34
s_{41}		1.42***	0.36
s_{51}		0.64*	0.34
s_{61}		0.47	0.29
s_{22}		0.87***	0.31
s_{32}		0.40	0.43
s_{42}		0.57	0.53
s_{52}		−0.28	0.37
s_{62}		−0.17	0.31
s_{33}		1.01***	0.27
s_{43}		1.14***	0.29
s_{53}		−0.01	0.36
s_{63}		0.54**	0.28
s_{44}		−0.07	0.29
s_{54}		−0.74*	0.41
s_{64}		0.12	0.31
s_{55}		−0.37	0.45
s_{65}		0.11	0.36
s_{66}		−0.02	0.36
Number of respondents/choice sets	95/804		
Pseudo - R^2	0.274		
Log likelihood	−596.4		
LR $\chi^2(21)$	451.7		

Table C2
Willingness to pay (compensating variation) per household per year for land use scenarios (2018 NOK).

Scenarios	WTP per household	Standard error	CI 95% - LB	CI 95% - UB
P1 Pasture - 50% of abandoned land	6,454	2,223	2,096	10,812
P2 Pasture - 25% of abandoned land	5,996	1,927	2,219	9,773
F1 Climate forest - 50% of abandoned land	1,233	924	−578	3,044
F2 Climate forest - 25% of abandoned land	2,328	898	568	4,088
PF1 Pasture and climate forest (50%/50%)	5,702	2,123	1,540	9,864
PF2 Pasture and climate forest (50%/25%)	6,318	2,283	1,845	10,792
PF3 Pasture and climate forest (25%/50%)	4,765	1,783	1,270	8,260
PF4 Pasture and climate forest (25%/25%)	5,860	1,985	1,969	9,752

Note: 1 2018-NOK = 0,104 EURO.

Table C3
Summary of present value (PV) benefits, costs and net benefit compared to status quo in billion Norwegian 2018-kroner. Most rural households.

Scenarios	Household WTP (aesthetics, carbon sequestration and biodiversity)	Program net costs (incl. forestry incomes and cost of public financing)	PV Net benefits
P1 Pasture - 50% of abandoned land	49	−10	40
P2 Pasture - 25% of abandoned land	46	−5	41
F1 Climate forest - 50% of abandoned land	9	−3	7
F2 Climate forest - 25% of abandoned land	18	−2	16
PF1 Pasture and climate forest (50%/50%)	44	−13	31
PF2 Pasture and climate forest (50%/25%)	48	−12	37
PF3 Pasture and climate forest (25%/50%)	36	−8	29
PF4 Pasture and climate forest (25%/25%)	45	−7	38

CRediT authorship contribution statement

Endre Kildal Iversen: Conceptualization, Data curation, Formal analysis, Methodology, Resources, Software, Validation, Visualization, Writing - original draft, Writing - review & editing. **Henrik Lindhjem:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Validation, Writing - original draft, Writing - review & editing. **Jette Bredahl Jacobsen:** Conceptualization, Investigation, Methodology, Validation, Writing - original draft, Writing - review & editing. **Kristine Grimsrud:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Writing - original draft, Writing - review & editing.

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Appendix A. Example of information set and choice

Figs. A1–A3: The information provided about the CE attributes.

Appendix B. Variance-covariance and correlation

Appendix C. Rural analysis

Tables C1–C3

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Paper II

Mountains of trouble: Accounting for environmental costs in local benefit-driven tourism development

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Abstract

Tourism and recreational home developments generate much of the economic activity at mountain destinations in Norway. At the same time, resulting land use changes pose a severe threat to ecosystem services. Cost-benefit analysis (CBA) is suitable to examine the trade-offs at the heart of many management problems but has been relatively neglected in tourism economics. Other methods, such as local economic impact analysis, are much more common. This study combines stated preference, economic impact analysis, and geospatial analysis in a comprehensive CBA framework. The CBA is performed both at the local and regional levels for small (S), medium (M), and large (L) developments in the Norefjell-Reinsjøfjell mountain area in Norway. The L-development is the preferred tourism and land management locally as market benefits from property sales and construction outweigh the local nonmarket externalities. However, considering the additional market and nonmarket impacts outside the destination, the S-development generates higher total welfare benefits. We conclude that to achieve socially optimal tourism development, nonmarket externalities inside and outside of the destination should be accounted for. The geospatial analysis demonstrates the geographical distribution of externalities.

JEL classification: Q51, Q57
Keywords: tourism development, ecosystem services, cost-benefit analysis, stated preference, willingness to pay

1. Introduction

Tourism has expanded over the last decades and has become one of the largest and fastest-growing sectors in the world economy (UNWTO, 2020). In Norway, tourists are motivated by the experience of nature, including mountains, forests, and wildlife (Innovation Norway, 2019). The Norwegian government targets growth within tourism to create new jobs in rural areas risking population decline (Norwegian Ministry of Trade, Industry and Fisheries, 2017). Tourism already generates up to 40 percent of the economic activity at mountain destinations in southern Norway, of which investments in new private recreational homes[1] are the most important economic impulse (e.g., Menon, 2019). The construction of new private recreational homes in Norway was at a historic high level in 2021 (Handberg et al., 2022).

At the same time, land-use changes due to developments are the most severe threat to nature and biodiversity globally (IPBES, 2019) and in Norway (The Norwegian Biodiversity Information Centre, 2021). Extinction rates are about 1000 times higher than normal rates and severely negatively affect ecosystem functioning (Pimm et al., 2014). Recreational home developments caused 40 percent of the loss of forests and 30 percent of the loss of wetlands by developments in Norway in the period 2008 to 2019 (Rørholt & Steinnes, 2020).[2] Recreational homes and the associated infrastructure are significant factors behind the recent classification of wild reindeer as near threatened (Rolandsen et al., 2022).

Recreational home developments affect market and nonmarket values. Constructing new recreational homes yields profits to local communities and affects ecosystem services, imposing externalities on people within and outside the destination. The total economic value (TEV) of ecosystem services includes use values that stem from peoples' experience of nature and nonuse values that arise when individuals value nature for reasons such as altruism toward others and future generations (Iversen et al., 2022).

Tourism management should consider the interests of tourists and the tourism industry and the externalities affecting the welfare of the local population and the population outside the destination (Engström & Kipperberg, 2015). Socially optimal

[1] In our case study area, the average size of recreational homes built between 2017-2021 was 111 square meters. This is an increase from an average size of 64 square meters from 1983-1987 (Handberg et al., 2022). A standard newly built recreational home in Norway can be accessed by car and has installed electricity, internet and a fully equipped kitchen and bathroom.

[2] About 230 square kilometres of forests and 10 square kilometres of wetlands were developed over the period (Rørholt & Steinnes, 2020).

recreational home development must consider all welfare impacts. Unfortunately, land management tends to ignore nonmarket values (Bateman et al., 2013; Iversen et al., 2021).

Cost-benefit analysis (CBA) evaluates the effect of policy options on individual and aggregated welfare within a single welfare theoretic framework (Boadway, 2016). Although CBA is increasingly used across a range of economic sectors and areas (e.g., transport, construction, health, and environment) and would be highly suitable to examine the trade-offs at the heart of many management problems, CBA has been relatively neglected within tourism economics (Song et al., 2012). Other methods, such as economic impact analysis (e.g., Andersson & Lundberg, 2013) and computable general equilibrium modelling (e.g., Banerjee et al., 2015), have been more popular (Song et al., 2012).

Within economics, stated preference (SP) methods (i.e., choice experiments and contingent valuation) are the available tools for estimating changes in TEV of change in quality or quantity of nonmarket ecosystem services for use in CBA (Bateman et al., 2002). There is SP literature within tourism economics focusing on topics such as conservation and sustainability (e.g., Grilli et al., 2021; Chen et al., 2017; Alves et al., 2017; Lindberg et al., 2019), valuation of market goods (e.g. Román & Martín, 2016; Lyu, 2017), demand for events (e.g. Crouch et al., 2019, Brida et al., 2017) and conflicting interests between residents and tourists (e.g. Lindberg et al., 1999; Lindberg et al., 2001; Concu & Atzeni, 2012; Lindberg & Veisten, 2012).

However, there is little tourism research on the overall market and nonmarket welfare impacts of tourism development, comparing economic benefits and loss of ecosystem services combining SP and CBA. A review of the literature on tourism externalities finds that studies typically focus on attitudes and preferences towards tourism rather than valuing external costs and benefits in a welfare economic framework (Meleddu, 2014). There are a few studies on changes in the market and nonmarket values due to tourism. Concu & Atzeni (2012) study differences in tourists' and residents' preferences regarding the construction of new buildings on the seashore and tourism impact on the economy and crowding in Sardinia, Italy. Lindberg & Veisten (2012) assess local and non-local preference heterogeneity for tourism infrastructure development in a national park in the Gudbrandsdal Valley in Norway. These studies focus on SP alone, whereas combining SP results and economic impact analyses in a CBA framework enables weighting impacts to point to welfare-improving management options.

We fill this research gap by evaluating the welfare effects of investments in tourism development using the Norefjell-Reinsjøfjell (NR) mountain area in Southern

Norway as a case. The NR mountain is one of the most prominent mountain tourist destinations close to the Oslo area, with peaks up to 1,500 meters above sea level. The NR area is home to a ski resort and 7,500 private recreational homes generating more than 1.3 million overnight stays each year (Handberg et al., 2022). The NR mountain area is also home to a population of 550 wild reindeer under pressure from human activity (Punsvik, 2019). The five different municipalities regulating the land in the area currently consider the construction of 8,000 new private recreational homes in total in the coming years.[3] This study uses a CBA framework where the impacts of three distinct recreational home development scenarios are compiled to identify potential welfare improvements and the distribution of social costs and benefits across locals and non-locals. The study highlights and quantifies substantial externalities of tourism investments within and outside the destination.

We combine several data sources and methods to analyse how different recreational home development scenarios in the NR mountain area affect welfare. Contingent valuation (CV) of nonmarket externalities measures the compensating surplus of reduced recreational home construction. Official price statistics, information from local businesses, a survey of recreational homeowners, and an analysis of business profits are combined in an economic impact analysis to estimate the foregone producer surplus of reduced recreational home construction. The consumer and producer surplus of the scenarios are compiled at the local and regional levels in a CBA framework. Furthermore, we analyse the distribution of the nonmarket values associated with changing management in geospatial analysis. We aim to answer the following questions:

i) Which recreational home development scenario provides the highest welfare at the tourism destination?
ii) Which recreational home development scenario provides the highest welfare when including nonlocal externalities?
iii) Who benefits from (reduced) recreational home development?

The paper makes several contributions to the tourism and land management literature. The paper contributes to the tourism management literature by providing the first CBA on tourism development, combining CV and economic impact analysis methods. To our knowledge, no previous examples of tourism research on the total market and nonmarket welfare impacts of local tourism development exist. Further, as land use changes due to recreational home developments are among the most

[3] The municipalities are Krødsherad, Flå, Nesbyen, Sigdal and Nore og Uvdal.

severe threats to biodiversity and ecosystem services in Norway (Rørholt & Steinnes, 2020), the paper contributes to the land management literature by investigating whether local land management may be at odds with environmental interests. The paper also adds to environmental valuation literature by monetising the nonmarket values of mountain ecosystem services affected by land use changes.

The paper is organised as follows: Section 2 provides the analytical framework and the case, Section 3 presents costs and benefits, Section 4 presents the overall CBA results, and Section 5 discusses and concludes.

2. Analytical framework, methods, and data

2.1. Cost-benefit analysis and the decision rule

CBA provides a ranking of policy options that account for each option's social benefits and costs compared to a reference option without policy change. The social welfare function aggregates weighted individual utilities over allocations of resources, where the weight represents a preference ordering of individual utilities. The most frequently applied approach, which we also follow, is to put equal weight on individuals' willingness to pay. This individualistic approach is non-paternalistic and mimics market logic, although it also implicitly puts more weight on wealthier individuals' utilities due to their expected lower marginal utility of money (Brekke, 1997; Boadway, 2016).

The decision rule in an intertemporal context is the net present value (NPV) criterion (Boadway, 2016). This implies that the policymaker should choose the policy option that maximises welfare W in terms of the NPV of the future flow of net benefits, as given in Equation (1):

$$Max\ NPV =: \sum_{t=1}^{T} \left(\frac{B_t - C_t}{(1 + r_t)^t} \right) \quad (1)$$

where B is the social benefits flow, C is the social costs flow, r is the social discount rate, and T is the time period of the policy.

2.2 Case study context: The Norefjell-Reinsjøfjell (NR) mountain area

We study how tourism development affects social welfare using the NR mountain area in southeast Norway as a case. The NR mountain area, known for its landscapes and panoramic views, is a popular tourist destination that people visit for hiking, cross-country and alpine skiing, cycling and other recreational activities. The NR

mountain area is home to 7,500 private recreational homes, several hotels and alpine ski centres. The NR mountain area has an extensive network of hiking and skiing trails.

Tourism and the construction of recreational homes are important sources of income and critical for sustaining the communities in the NR mountain area (Handberg et al., 2022; Tofteng et al., 2018). The five municipalities in the NR mountain area, home to 12,500 inhabitants, are considering large-scale developments with the construction of up to 8,000 new recreational homes in the years to come.[4]

Recreational home development in the NR area competes for space with redlisted wildlife species, including reindeer (*Rangifer tarandus tarandus*), which is considered threatened (Artsdatabanken, 2021). Almost the entire European strain of 25,000 wild reindeer live in 24 administrative areas in southern Norway (Gundersen et al., 2019), of which a herd of 550 wild reindeer live in the NR mountain area.

Fig. 1 – Left: Pictures of NR landscapes, recreational homes, and wild reindeer. Right: Map of Norway, Viken, Oslo and the NR mountain area with population density in the background (lighter areas are more densely populated)

Land use changes due to recreational home developments may affect supporting ecosystem services (e.g. reducing habitats), regulating ecosystem services (e.g.

[4] In Norway, each landowner must apply for permission from their municipality to build recreational homes on their land. Nonlocal interests are represented by the County Governor's, other organisations', and individuals' right to object to municipalities' land use decisions. When municipalities and County Governors fail to agree, the Ministry of Local Government and Regional Development makes the final decision. However, local interests are given substantial weight when final decisions are made.

carbon sequestration) and providing ecosystem services (e.g. timber production). Notably, the construction of recreational homes affects valuable cultural ecosystem services in the NR mountains. Cultural ecosystem services include various services directly benefitting humans, such as landscape aesthetics and the experience of nature and wildlife through recreation and tourism (Daniel et al., 2012). Recreational home development in NR reduces recreational areas and changes landscapes under and above the tree line. Additional recreational homes increase the number of visitors, hikers, and cross-country skiers, potentially contributing to crowding. As a result, the local authorities are considering widening the trail paths and extending the trail network.

The construction of recreational homes and the associated infrastructure affects biodiversity by reducing forests and mountain vegetation and threatening the carrying capacity of the wild reindeer population. According to recent studies of wild reindeer, human activity close to migration and calving zones, could change their migration routes and induce stress (Gundersen et al., 2019). Due to the loss of habitat and increased human activity, an increased number of recreational homes will challenge the existence of the wild reindeer herd in the NR mountain area (Punsvik, 2019).

Fig. 2 – Left: Map of recreational home density in the NR mountain area (darker red areas have more recreational homes). Right: Example of a recreational home area in Gulsvikfjellet

People affected by the increased number of recreational homes are the users of the area, such as the local population, tourists staying in recreational homes and day-visitors, as well as the general population in Viken county, including the capital Oslo and other parts of Norway who could have nonuse values attached to the

preservation of landscapes, nature, animals and birds. There are around 2 million inhabitants in Viken county and Oslo – i.e., more than one-third of the Norwegian population. About five percent of these live less than an hour's drive away from NR, while 83 percent live less than two hours away.

2.3 Methods, data, and assumptions

We analyse three alternative recreational home development scenarios: Small development (S-development) and Medium development (M-development), to a Business-as-Usual (BAU) option of Large development (L-development). This subsection presents the benefits and costs of limiting the construction of new recreational homes and the methods used to calculate changes in consumer and producer surplus of the reductions. The complete list of assumptions applied in the CBA calculations is presented in Appendix A.2.

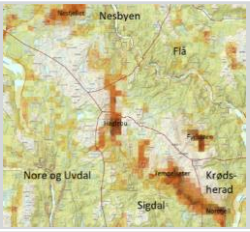
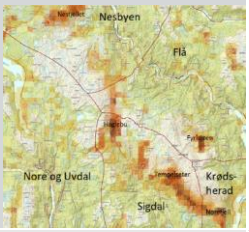
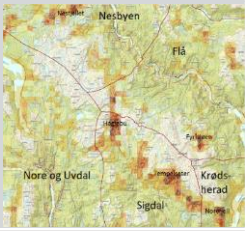
Measuring the consumer surplus using stated preference

Externalities from recreational home construction affect the use and nonuse values of the natural environment in the area. In the BAU option (L-development), it is expected that the ecosystem services of the NR mountain area will come under the strongest pressure. The other two scenario options, M-development and S-development, involve a reduction in the number of recreational homes constructed until 2040. These two options deliver benefits in terms of increased nonmarket values since the pressures on ecosystem services are reduced compared to the BAU option. The consumer surplus of reducing the number of recreational homes constructed in the future is measured using the CV method.

The CV survey presents to each respondent the L-, M- and S-development options as distinct management alternatives to investigate the welfare impacts of tourism development in the NR mountain area, see Table 1.

Respondents were asked to rank the three options from the most to the least preferred or choose a no-opinion alternative. If the respondent preferred a reduced recreational home development option to the BAU, we asked a follow-up question on their annual willingness to pay (WTP) increased taxes for changing the management option from BAU to their preferred option from 2021 until 2040. A horizontal payment card slider was used were 23 amounts on the scale ranging from 0 to NOK 12,000, including an option to specify the exact amount if the respondent preferred to pay more than NOK 12,000. There was also a "Don't know" response option. See the formulation of the WTP question and the payment card slider in Appendix A.1.

Table 1 – The options presented to respondents

	LARGE DEVELOPMENT	MEDIUM DEVELOPMENT	SMALL DEVELOPMENT
Recreational home density in 2040			
Total recreational homes in 2040	14,000 recreational homes	11,000 recreational homes	8,000 recreational homes
Growth until 2040	6,500 new recreational homes / 85% growth	3,500 new recreational homes / 45% growth	500 new recreational homes / 5% growth
Development	Over and under the tree line	Under the tree line	Under the tree line
Growth in hikers in 2040	100% more hikers 	60% more hikers 	20% more hikers 
Recreation above the tree line	Upgrading of current paths and expanding trail network	Upgrading of current paths	Paths as today
Recreation below the tree line	Large development in recreation areas	Some development in recreation areas	Little development in recreation areas
The wild reindeer population in 2040	Carrying capacity very strongly threatened	Carrying capacity strongly threatened	Carrying capacity somewha threatened

Note: Percentage growth from 2021 to the expected outcomes in each scenario in 2040.

The WTP is the respondent's valuation of the construction of fewer recreational homes, a reduction in the expected number of hikers, reduced pressure on the carrying capacity of the wild reindeers, and fewer landscape changes compared to BAU. We chose to set the time period to 2040 to balance an emergence of policy consequences while restricting the time horizon to provide payment vehicle realism.

The CV survey, valuation scenario and WTP question were designed to encourage truthful responses following the guidelines proposed by Johnston et al. (2017). We informed respondents that a tax increase would be equal and binding for household residents and all recreational home owners in the municipalities (local respondents) and equal and binding for every household in Viken and Oslo (non-local respondents). We used increased municipal tax as the payment vehicle for local residents and recreational home owners in the NR mountain area, while we used increased county tax as the payment vehicle for non-local respondents in other parts of Viken and Oslo counties.

We promote consequentiality, an essential feature of SP surveys achieving truthful responses, by stating that the desired level of development and WTP will be reported to relevant authorities and promote incentive compatibility by stressing cost uncertainty, following Vossler and Holladay (2018) and Vossler and Zawojska (2020). Vossler and Zawojska (2020) show that a payment card format with cost uncertainty provides equal WTP estimates as a single binary choice format.[5] The text introducing cost uncertainty was as follows:

"The municipalities are planning large recreational home development in the Norefjell area. Viken county, on the other hand, wants to reduce the development of recreational homes to protect recreation and wild reindeer for residents of Viken and Oslo. The fewer recreational homes are built in the municipality, the less the municipalities' income will be. Increased municipal tax for residents and cabin owners can cover the loss of income and preserve wild reindeer and recreation. Whether and how much municipal tax should have to increase is uncertain at this point."

Further, following Johnston et al. (2017), we applied a decision rule saying that if WTP is equal to or higher than the cost of changing policy, the construction of recreational homes will be reduced, and taxes increased.[6]

Measuring producer surplus using economic impact analysis

The expected BAU option, L-development, will generate the largest income and producer surplus across the economy from recreational home construction, recreational home maintenance and tourist consumption, while the other two options come at a cost in terms of reduced producer surplus compared to BAU. Recreational home construction generates incomes and profits across industries both within NR and outside the area. Income from sales of new recreational homes covers buying and clearing the land, construction and materials, and necessary infrastructure such as roads, access to water, and handling wastewater. Local businesses supply land, services, and materials to the recreational home market, and their incomes generate jobs and profits.

[5] According to SP guidelines "the most straightforward means to achieving incentive compatibility is through the use of a single binary-choice question for each respondent" (Johnston et al., 2017, p. 345).

[6] A formulation stressing that WTP above the cost would be counted as a vote in favour of the project was tried but due to comprehensibility considerations, we decided to revise the wording.

In the typical economic impact analysis, both wages and profits are usually estimated in full value, implying no opportunity costs of the production inputs. In CBA, it is essential to subtract the opportunity cost of resource use. This implies that only producer surplus is included as a benefit in the analysis. We assume that the producer surplus is equal to the profits of production after subtracting wage costs and costs of other inputs (Burgan & Mules, 2001; Dwyer, 2016; Boardman et al., 2017).

We multiply the prices of new recreational homes by the number of new recreational homes in the NR mountain area in the development scenario to estimate the total turnover in construction recreational homes. The local share of this turnover was determined in a recent impact analysis, carried out to supplement data collection for this paper (Handberg et al., 2022). We gathered information on the use of recreational homes and the yearly cost of recreational home maintenance along with the local construction companies' market share from the recreational home owners in the CV survey. The recreational homeowners' consumption of goods and services when visiting their recreational home was also gathered from recent impact analysis literature (Handberg et al., 2022).

To subtract the opportunity cost of capital and labour we multiply the estimated turnover with the operating margin among local and regional construction, tourism, and retail companies. The operating margin is obtained from a dataset consisting of all business accounts of registered companies within the NR mountain area, Viken and Oslo.

3 Cost-benefit analysis: Market and nonmarket impacts of management

The construction of additional recreational homes in the NR mountain area creates a range of impacts, of which some are market impacts such as incomes, jobs, and profits, while other impacts are nonmarket impacts such as affected landscapes, pressure on wildlife and tourism crowding. We apply CV valuation and economic impact analysis to monetise and compile the impacts in a CBA framework to evaluate policies both from a local and regional point of view.

3.1 Consumer surplus of reduced recreational homes development

Three main groups were targeted for data collection: the local population, the owners of recreational homes, and the population in Viken and Oslo counties. There are 5,800

resident households and 7,500 recreational home households in the five local municipalities, and approximately 900,000 households in Viken and Oslo. The sample frame was adult residents and recreational home owners with accessible telephone numbers and the survey company Kantar's panel of pre-recruited respondents from Viken and Oslo. We chose an internet survey data collection mode, and the local population and the owners of recreational homes were targeted using SMS with a link to the survey, while the population in Viken and Oslo were targeted through the survey company's high-quality randomly pre-recruited panel of respondents. The survey invitation was sent to 14,102 persons. We received 2,047 completed surveys which implies a real response rate of 14.5 percent. The real response rate was 29 percent of invitations to the survey company's panel, while the real response rate was 9 percent of the invitations sent by SMS. The three samples were selected using quotas matching population benchmarks for characteristics as recommended by Johnston et al. (2017). The data were collected in June 2021. Table 2 compares samples and populations.

Table 2 – Descriptive statistics, survey respondents and populations

	Resident households in NR municipalities		Recreational home households in NR	Other households in Viken and Oslo	
	Resp.	Pop.	Resp.	Resp.	Pop.
No. of respondents	378		559	1110	
Share women	48%	49%	44%	47%	50%
Age (adults)	53	52	59	53	48
Education level					
Primary school	5%	31%	0%	4%	24%
High sch./apprentice	45%	48%	15%	27%	35%
3-4 year university	32%	16%	37%	38%	27%
At least 5-year uni.	17%	4%	44%	29%	13%
Doctorate (PhD)	1%	<1%	4%	2%	1%
Household size	2.59	2.71	2.66	2.29	2.75
Household inc. (median)	1,000,000	634,000	1,500,000	1,000,000	700,000

Compared to the population, there is an underrepresentation of respondents with primary school education as their highest education level, and an overrepresentation of respondents with more than three years of university education. In addition, households are larger and have higher incomes, both in the local resident and the Viken/Oslo sample compared to the relevant populations. As for the owners of recreational homes, we have no data on the underlying population characteristics.

Respondents were asked what scenario option in Table 1 they preferred and could either report the most preferred option, rank all options, or answer no opinion. Fig. 3 reports the respondents' answers by samples. More than half of the respondents prefer the S-development option in all samples.

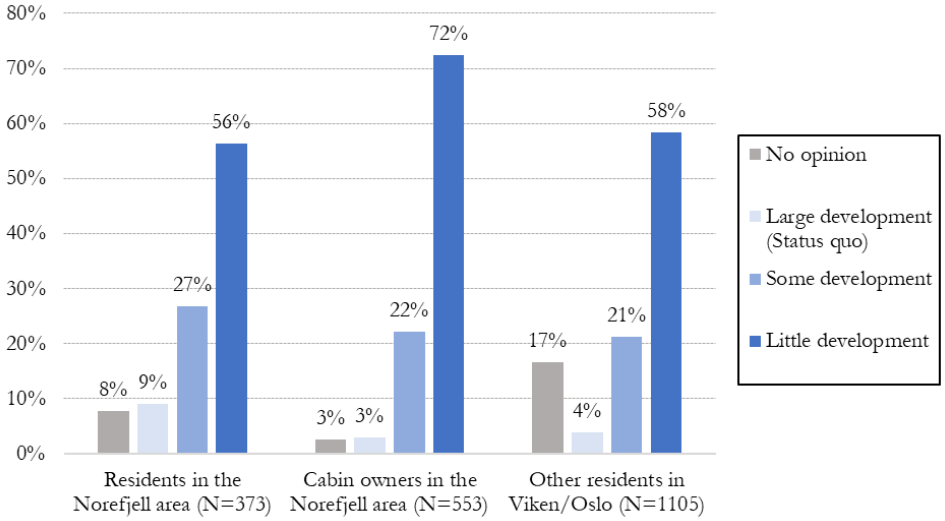


Fig. 3 – The options preferred by the respondents in the samples

Respondents who preferred either S-development or M-development were asked for their WTP increased municipal or county taxes to change the land use policies to their preferred option. Respondents who preferred S-development were asked a follow-up question regarding their WTP for M-development.

We follow the approach introduced by Cameron & Huppert (1989) when analysing interval payment card data. In the interval regression, the probability of observing an answer is equal to the cumulative distribution function (CDF) Φ, of the assumed distribution, in our case, the normal distribution, evaluated at the upper payment card bound WTP_{Ui}, minus the CDF evaluated at the lower payment card bound WTP_{Li}. The loglikelihood function of the interval regression model for a sample of *n* individuals can be expressed as follows:

$$log\ \mathrm{L} = \sum_{i=1}^{n} \log[\Phi(WTP_{Ui}) - \Phi(WTP_{Li})] \qquad (2)$$

Table 3 below presents the mean WTP per household for their preferred recreational home development option within each survey sample.

Among respondents that prefer reduced development, residents, and owners of recreational homes in NR have a mean WTP amounting to 3,000 NOK, while other residents in Viken/Oslo have a mean WTP at 1,300 NOK in increased county taxes.[7]

Table 3 – Mean unconditional annual willingness to pay estimates for S-development and M-development from 2022-2040.

Respondents:	Option	Resident households in NR municipalities	Recreational home households in NR area	Other households in Viken and Oslo
Respondents preferring reduced development	M	2,281 (188)	2,227 (140)	1,083 (118)
	S	3,743 (315)	3,123 (261)	1,372 (216)
All, incl. respondents preferring BAU or no opinion	M	1,900 (156)	2,113 (124)	844 (95)
	S	3,112 (290)	2,965 (231)	1074 (174)

Note: Norwegian kroner NOK (1 NOK = 0.1 EUR). Standard errors in parenthesis were identified using the delta method (Oehlert, 1992).

When including respondents preferring L-development or stating no opinion as having zero WTP, the mean WTP for an S-development is 3,112 NOK among local residents in the NR mountain area, 2,965 NOK for the owners of recreational homes, and 1,074 NOK for residents in Viken/Oslo.[8,9] These WTP estimates are used as input in the CBA. Respondents who ranked L-development as their first choice or stated "no

[7] We include zero answers and "don't know"-answers as zero while excluding protest zeros and protest "don't know"-answers. Protesters were identified by agreeing with one of the following statements: "It is not my household's responsibility to pay for the municipalities' reduced income", "What I answer will not affect the chosen management", and "I feel it is not right to weigh the environment in terms of money" or "I don't want to pay until I know what it costs".

[8] We elicited WTP for M-development among the respondents who ranked S-development as their first choice and M-development as their second choice, but we did not elicit WTP for S-development for the respondents who ranked M-development as their first choice and S-development as their second choice. For this group, we assume that the WTP for S-development is larger than zero since they prefer this option to L-development, and equal to or lower than their upper bound WTP for M-development since they prefer M-development over S-development.

[9] 216 out of 457 respondents who ranked M-development as their first choice, did not rank their second choice. As with the others, we set their lower bound WTP for S-development equal to zero and their upper bound WTP equal to their upper bound WTP for M-development. We multiply their WTP by the share (79 %) preferring S-development as the second choice among those respondents who ranked two alternatives. Unbiased estimates hinge on the assumption that there is no systematic difference between the respondents who rank two alternatives and respondents who rank one alternative.

opinion" are assumed to have zero WTP for M-development and S-development. In Table 4, we analyse the preference heterogeneity stemming from sociodemographic characteristics and respondent attitudes.

Table 4 – Regressions of WTP for S-development.

	(1)	(2)	(3)	(4)
Recreational home households in NR area	1390.8***	1398.6***	841.5***	1129.4***
	(369.2)	(290.2)	(284.0)	(412.0)
Resident households in NR municipalities	2454.7***	1991.9***	1628.3***	2645.4***
	(395.2)	(315.9)	(323.9)	(516.4)
Woman	73.73	332.4	-52.10	-90.79
	(294.2)	(232.9)	(225.1)	(332.3)
Age	-0.119	1.900	-1.911	-4.277
	(10.74)	(8.491)	(8.128)	(12.50)
Household size	-88.69	-44.34	86.64	187.5
	(135.0)	(103.6)	(99.00)	(156.7)
Household income (MNOK)	659.9***	672.9***	588.4***	803.1***
	(231.3)	(180.7)	(172.2)	(253.2)
Education level (1-5)	429.3***	492.5***	353.8***	518.9***
	(134.0)	(105.3)	(100.8)	(154.0)
Affected by work in construction			-649.6	803.4
			(655.3)	(1745.0)
Affected recreational activities			1447.2***	1435.2***
			(275.9)	(391.6)
Landscape changes are very negative in BAU			1222.4***	706.8
			(275.2)	(451.1)
More hikers are very negative in BAU			567.5**	405.3
			(268.1)	(357.4)
Incr. pressure on reindeer is very neg. in BAU			650.9**	498.9
			(259.5)	(407.5)
More local services are very positive in BAU			-579.2*	-331.5
			(310.8)	(565.5)
Better municipal economy is very pos. in BAU			-51.57	234.9
			(272.8)	(435.4)
Constant	-965.6	-1445.4**	-1957.4***	-2343.7**
	(943.1)	(734.7)	(731.9)	(1153.8)
Log(sigma) constant	8.567***	8.226***	8.169***	8.329***
	(0.0192)	(0.0212)	(0.0212)	(0.0271)
Number of observations	1,361	1,124	1,124	684
Pseudo R^2	0.005	0.010	0.021	0.019
Loglikelihood	-8065.4	-5949.6	-5885.5	-3196.0

Note: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors in parentheses. Norwegian kroner NOK (1 NOK = 0.1 EUR).

Our motivation is to answer the research question of who benefits from reduced recreational home development and to assess the validity of the survey. Models (1)-(3) include all respondents, except for protesters, while model (4) only includes respondents preferring reduced development. Models (2)-(4) omit respondents with missing data on questions as to whether they are affected by the development and on attitude questions.

We identify a significant income effect; one extra million NOK per household significantly increase the WTP with estimates varying around 600-800 NOK across the models. This result supports the construct validity of the results, as WTP is expected to increase with income (Bishop & Boyle, 2019). Higher educational levels among respondents also significantly increase WTP across all models.

Respondents who reported that their recreational activities will be affected by the construction of recreational homes have almost 1,500 NOK higher WTP than other respondents, ceteris paribus. The respondents who are the most negative towards landscape changes, more hikers and increased pressure on wild reindeer in the BAU alternative also state a higher WTP for S-development, while the respondents who are the most positive toward more local services in BAU have significantly lower WTP. When restricting the sample to respondents who prefer S-development in model 4, we find that preferences towards nature and local services are relatively less important in explaining the differences in WTP. The main reason for this is that the initial sorting of respondents by their preferred options, in which preferences are important explanatory factors, reduces the preference heterogeneity within the group of respondents who prefer S-development as their first choice.

3.2 Forgone producer surplus of reduced recreational home development

In the BAU L-development option, we stipulate that 6,500 new recreational homes will be built by 2040, 3,000 more than in the M-development option and 6,000 more than in the S-development option. We model a constant growth per year in the number of recreational homes, implying a difference of 167 built recreational homes between L-development and M-development and a difference of 333 built recreational homes between L-development and S-development per year until 2040.

These new recreational homes generate incomes, both inside and outside the destination, during their construction, and the accumulating number of recreational homes generate increasing incomes from maintenance of the recreational homes and an increasing number of tourists visiting every year. In absence of information on future travel behaviour and market outcomes, we assume that mean recreational

home prices, maintenance costs, overnight visits, and consumption per recreational home remain at today's levels.

3.2.1 Recreational home construction

To estimate the local and nonlocal producer surplus from recreational home construction, we need the price of new recreational homes in the NR mountain area, the local and nonlocal market shares, and the profit rate within the construction industry.[10]

Handberg et al. (2022) provide information on recreational home prices and market shares in the NR mountain area that is used in this study. They find, using official price statistics and interviewing 28 representatives of the construction industry in NR mountains, that a newly constructed recreational home in NR costs on average 4.3 million NOK, of which 1.4 million is the price of a plot of real estate ready to be built on and 0.53 million is the resource rent when selling plot regulated for recreational homes but not yet developed with necessary infrastructure. Local businesses and landowners have a 50 percent share of the overall recreational home market, of which locals receive 85 percent of resource rent from selling land, 80 percent of the income from clearing the land and 40 percent of the income from constructing the recreational homes.

3.2.2 Recreational home ownership costs

In addition to the investments, we estimate spending associated with the ownership and use of recreational homes. Our survey of the recreational home owners in the area indicates a mean annual cost of 45,000 NOK in maintenance, furniture and electricity, TV, and taxes, of which 33,000 NOK is local expenditure.

3.2.3 Recreational home users' consumption

Based on results from the CV survey, we assume that each recreational home is in use 55 days a year and by 3.1 persons per day. Following Handberg et al. (2022), we assume that each person spends 500 NOK per overnight stay on goods and services, where 45 percent is local spending. Similar visitor numbers and consumption levels are found in several other surveys of recreational home owners, in both the NR area and other places in southern Norway (e.g. Norsk turistutvikling, 2017).

[10] Standard Industrial Classification (SIC) codes 41 and 42.

3.2.4 Producer surplus

To measure the producer surplus, we analyse the profits associated with investments, maintenance, and consumption. We have data on business income, costs and profits going back to 2004 in a dataset from The Brønnøysund Register of Company Accounts, containing financial statements and activity information for all enterprises in Norway. We identify the turnover-weighted mean EBITDA[11]-margin among firms within construction, and tourism-related services and retail in Viken and Oslo. The EBITDA margin is the net income in terms of the percentage of its overall revenues. We find that the income of construction companies generates a 4.9 percent average profit rate on income in Viken and Oslo.[12] We further find that income among tourism and retail businesses generates a 4.8 percent profit rate on average in Viken and Oslo. We assume a five percent producer surplus on the income generated by construction, maintenance, and consumption. Handberg et al. (2022) find that the cost of getting the plot regulated is about 70,000 NOK per plot. Thus, we assume a producer surplus at 460,000 NOK per plot, and one plot per recreational home built.

3.3 Other impacts on the welfare of reduced recreational home development

In addition to the affected consumer and producer surplus, there are other types of impacts on welfare from changing the development policies.

3.3.1 Carbon dioxide emissions from construction of recreational homes

Leisure and tourism cause significant carbon dioxide emissions in Norway, of which recreational home tourism is a major contributor (Aall et al., 2011). When building recreational homes, both the use of materials and the construction itself contribute to carbon dioxide emissions (Walnum, 2020; Xue et al., 2020). Land use changes from forests, peatlands, and other types of land cover to buildings, roads, and other

[11] EBITDA stands for earnings before interest, taxes, depreciation, and amortisation. We include businesses operating for more than 3 years with at least 1 MNOK in turnover each year. We apply a rule saying that an average of at least 70 percent of the total value-added must be wages to avoid small businesses with self-employed owners inflating the profit figures.

[12] The NR mountain area had a very low registered unemployment rate the year before the corona pandemic, between 0.8 percent unemployment rate in Sigdal municipality and a 1.4 per unemployment rate cent in Krødsherad municipality in July 2022, lower than the Viken county unemployment rate of 1.9 percent, and the Norwegian unemployment rate at 1.7 percent (Norwegian Labour and Welfare Directorate, 2022).

infrastructure also cause carbon dioxide emission increases (Thorvaldsen, 2019). An investigation of the carbon dioxide effect of land use changes due to recreational home development in the Turufjell area of Flå municipality, only 10 kilometres north of the NR mountain area, found that 2,000 new recreational homes in that area release 190 thousand tonnes of carbon dioxide due to lost peatlands (Bråten & Olsson, 2020). This implies 95 tonnes of carbon dioxide emission per recreational home built. Magnussen et al. (2020) stipulate the emission of 200 tonnes of carbon dioxide per thousand square meters if the original land cover is a peatland and 60 tonnes of carbon dioxide if the land cover is forest. Further, Walnum (2020) finds that a typical newly built Norwegian recreational home will emit between 12 and 24 thousand tonnes of carbon dioxide in construction and materials. Most of the original land cover used to build recreational homes and infrastructure will be forests in the NR mountain area. The mean size of a plot of land per recreational home should be about a thousand square meters in the NR area (Handberg et al., 2022). We assume that the construction of one recreational home emits 75 tonnes of carbon dioxide emissions through land cover changes, materials, and construction. We use 614 NOK as carbon price in 2022 which increases to 1,300 in 2040, following recommendations made by the Norwegian Ministry of Finance (2021).

3.3.2 Willingness to pay for reduced development outside Viken and Oslo

The CV survey was sent to local residents, owners of recreational homes and residents in other parts of Viken and Oslo, while residents outside Viken and Oslo were not targeted. The reason was that we wanted the respondents to have some knowledge of the NR area as well as potentially also use the mountains. The share of "Don't know" and protest answers increased, as expected, with increasing distance between respondents' homes and the NR mountain area. We, therefore, restricted the scope of the market for the CBA to avoid compromising the validity of the design. We do indeed find a positive correlation between travel time to the NR mountain area and "don't know" and protest answers within the Viken and Oslo counties, indicating that restricting the scope of the market improved data quality. The drawback of setting the scope of the market to Viken and Oslo is a lack of information on the potential WTP to avoid the BAU-alternative among respondents outside Viken and Oslo. In any case, this limitation makes our non-market benefit estimates conservative.

4 Overall CBA results: Trade-offs between local and wider societal interests

4.1 Costs, benefits, and net benefits

When deciding the preferred management from a local perspective, we include impacts on the producer and consumer surplus among the local population, owners of recreational homes, and local producers with a time horizon ending in 2040. See additional assumptions applied in the CBA calculations in Appendix A.2. When deciding the preferred management from a regional perspective, we include welfare effects on the population in Viken and Oslo, nonlocal profits, and the social cost of carbon emissions. Table 5 presents the value of the costs, benefits, and net benefits of changing the management option from L-development to M-development or S-development – at the local and regional scale.

Table 5 – Present value (PV) of costs and benefits, and net present value (NPV) of reducing developments in the NR mountain area in Norway from L-development to M- and S-development for the period 2021-2040 in million 2021-NOK

	Local impacts		**Regional impacts**	
Reduced recreational home development from Large to:	M-development	S-development	M-development	S-development
PV of costs:				
- Construction	-230	-460	-482	-965
- Tourism consumption	-39	-78	-86	-171
- Property sales profits	-888	-1,775	-1,047	-2,094
PV of benefits:				
- WTP resident households in NR municipalities	152	192	152	192
- WTP recreational home households in NR area	216	294	192	294
- WTP other households in Viken/Oslo			10,200	13,015
- Reduced carbon emissions			120	241
Net present value of reducing development from L to S and M	-789	-1,828	9,073	10,512

We find that a move away from the BAU L-development option will reduce local net benefits. Although a large majority of both local residents and owners of recreational homes prefer the S-development option, and more than 80 percent of respondents in both samples would like to avoid an L-development, the large reduction in incomes and subsequent profits among local businesses and property owners outweigh the aggregated WTP for a change in policies. A larger reduction in recreational home construction implies larger losses in local welfare.

The S-development yields the highest NPV when including all impacts at the regional scale. When we include the use and nonuse values of residents in the surrounding counties of Viken and Oslo, the consumer surplus of changing policies from L-development to M-development or from L-development to S-development both surpass the loss of producer surplus by manyfold.

Although the S-development option yields the largest net benefits, the M-development option also substantially increases the overall welfare compared to the L-development option. A change from the L-development option to the S-development option results in a 16 percent higher net benefit than a change to the M-development option. This is due to a lower willingness to pay per recreational home not built, indicating that there is a diminishing marginal utility of reducing recreational home development, while losses in producer surplus increase linearly per recreational home not built.

4.2 Spatial distribution of nonmarket values

If the management were to change from the BAU L-development to the S-development option, property owners and producers within and outside the NR mountain area would miss out on large incomes and profits. At the same time, there would be beneficiaries among local residents and other residents in Viken and Oslo, and owners of recreational homes will also benefit.

To explore distributional effects, we run two regressions, one logit regression on whether respondents choose the S-development option, and one interval regression on WTP for S-development, using the same sociodemographic attributes as in Section 4: age, gender, income, and education. We include a variable on travel time by car from the NR mountain area to respondents' homes. The travelling time data are calculated between all Norwegian zip codes by the Institute

of Transport Economics and Menon Economics using GIS data on the Norwegian route network and the associated speed limits (Holmen, 2020).[13]

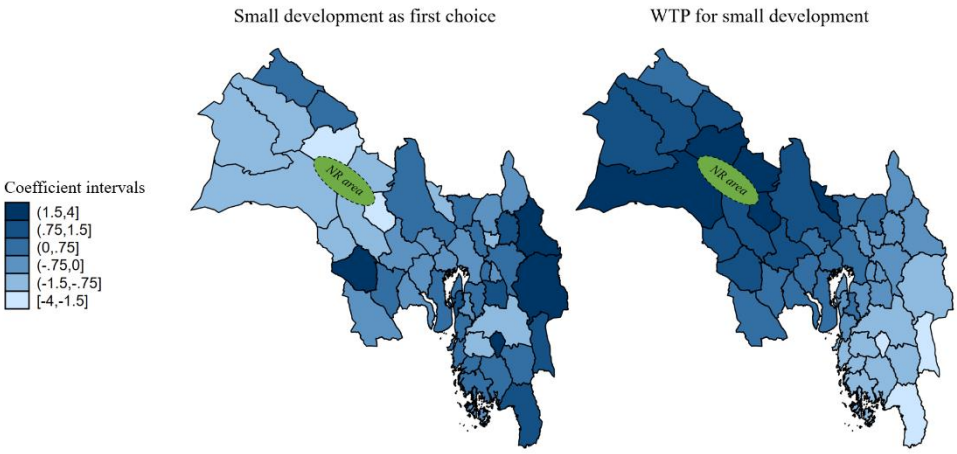


Fig. 4 – Probability of choosing the S-development option and predicted mean WTP per household from changing management option from L-development to S-development. Note: Mean standardised coefficients within municipalities in Viken and Oslo for residents in the NR mountain area and other residents in Viken and Oslo.

The regression results are found in Table 7 in Appendix A.3. Sociodemographic variables are important in explaining the probability of choosing the S-development option, while the estimated coefficient for travel time is insignificant. Travel time variable significantly explains, at the 1 percent level, WTP in the interval regression; one hour of increased travel time by car is associated with 1,600 kroner reduced WTP among respondents who prefer the S-development option.

We use the regression coefficients to predict each respondent's probability of choosing the S-development option and their WTP for this development option and calculate the mean predicted probability and WTP at the municipal level. Each respondent's predicted WTP is then standardised by subtracting the mean WTP and dividing by the standard deviation at the municipal level. Fig. 4 displays the geographical variation in the probability of choosing the S-development option and the mean WTP for this option.

We see two contrasting patterns when inspecting the maps in Fig. 4. Residents in and close to the NR mountain area seem less likely to prefer the S-development option than residents in areas further away, but there is variation across space and

[13] Driving one's own car is the preferred mode of transportation to the NR mountain area.

the travel time variable does not enter significantly, see the logit model in Appendix A.3. In contrast, even though a larger share of the residents in the NR mountain area prefers the M-development or L-development options than on average for all the municipalities, local residents in the NR mountain area still have the highest average WTP in Viken and Oslo for the S-development option. The WTP for the S-development option is lowest among the municipalities further away from the NR mountain area, indicating a distance decay in nonmarket values. Thus the models in Appendix A.3 predict that residents in the region southeast of Oslo, farthest away from NR in distance and travelling time, generally favour the S-development option, while their WTP for this option is the lowest.

5 Discussion and conclusion

Tourism development increases economic activity but affects several ecosystem services and biodiversity and causes externalities within and outside the tourism destination. Land use change due to land development is among the severe threats to biodiversity and ecosystem services in Norway, and recreational home development is a significant contributor (Rørholt & Steinnes, 2020; Artsdatabanken 2021). By monetising the nonmarket values of ecosystem services and biodiversity affected by land use changes in the NR mountain area, we identify substantial externalities often ignored in land use policies (Bateman et al., 2013).

We use the estimated nonmarket values as input in a CBA of recreational home development options at the local and regional scale. We find that large development yields the highest welfare at the tourism destination due to the large local producer surplus. In contrast, small development yields the highest welfare at the regional scale due to substantial environmental costs associated with recreational home developments. Local populations and residents close to the NR area and existing recreational home owners benefit the most if the management plan is changed to the small development option.

The costs of foregone local profits from property sales, construction and tourism consumption are higher than the benefits of avoided nonmarket externalities for the local residents and recreational home owners. Selling plots of land is the most lucrative part of the recreational home production value chain, and most of the landowners in the NR mountains are local residents.

Our results at the local scale are comparable to results in Concu & Atzeni (2012). They studied residents' and tourists' preferences regarding a reform on environmental protection with consequences for the tourism industry in Sardinia.

Like us, they find that environmental protection provides welfare gains to local residents. Contrary to our findings, tourists in their study do not seem to be concerned about environmental protection. Expanding on Concu & Atzeni (2012), we also include the changes in producer surplus in the different tourism management scenarios.

Most people in Viken and Oslo prefer the small development option. Since many people in these counties have positive WTP, the development level providing the highest welfare shifts from large to small. Although the loss of foregone producer surplus to landowners and businesses outside the NR area increases when reducing from the large to the small development option, the gain in nonmarket welfare for the population outside the destination increases more. Avoiding L-development by reducing to M-development yields the most considerable welfare improvement, while further reducing the development from M-development to S-development provides only a 15 percent increase in net benefit due to the apparent diminishing marginal utility of restricting the development.

In a similar setting, Lindberg & Veisten (2012) use a choice experiment to study local and non-local preferences for the potential development of a gondola affecting wild reindeer in the Gudbrandsdal region of Norway. Comparable to our results at the regional scale, they find that gondola development would get similar levels of support among locals and non-locals, and they further find that both groups experience similar levels of disutility from wild reindeer habitat loss. As Concu & Atzeni (2012), Lindberg & Veisten (2012) do not estimate changes in the producer surplus of the tourism development.

When analysing the preference heterogeneity, we find that wealthier households have significantly higher WTP for reducing to S-development, which supports the construct validity of the survey (Bishop & Boyle, 2019). We also find that people with higher education, people who say their recreational activities will be affected, and people who are very negative towards landscape changes, more hikers and increased pressure on wild reindeer in the BAU alternative will benefit by reducing to S-development. The geospatial analysis shows that the tourism L-development option causes nonmarket externalities with a distance decay outside the local municipalities. Distance decay in nonmarket values is found in many SP studies of changes in environmental goods, especially for use values (Glenk et al., 2020). The negative association between values and distance might be explained by factors such as increasing costs to access the area, an increasing number of substitute areas to the NR mountains, less knowledge and information about the NR area, and decreasing

moral obligation towards preserving the nature there (De Valck & Rolfe, 2018; Glenk et al., 2020).

Land-use policies should ideally consider the welfare of the affected population across political jurisdictions (Johnston et al., 2017). We have set the scope of the market for the NR mountain ecosystem services somewhat restrictive to avoid compromising the validity of the survey design and to generally be conservative in estimating non-market benefits. If people in other parts of Norway outside Viken and Oslo are affected by negative externalities from recreational home development in the NR area, the net benefits of S-development would be larger, strengthening our conclusions.

We evaluate future welfare impacts from the present, assuming stable preferences over time. A critique against using SP to value biodiversity is that preferences are myopic; people do not fully include the interests of future generations in their WTP (Lienhoop et al., 2015). The respondents have stated their WTP to reduce recreational home developments to protect wild reindeer and ecosystem services from 2022 until 2040. Under large recreational home development, the number of wild reindeer will be reduced and threatened by extinction at some point. Myopic preferences among our respondents would imply higher future WTP for reduced development as the wild reindeer population decline towards extinction.

Future policymakers may realise a need for changed policies due to increased opposition. However, the local policymakers have continued to open up new areas to recreational home developments, in line with large recreational home development being the management option providing the highest local welfare, even as the wild reindeer population has become increasingly threatened. A recent review finds that Norway's land-use planning system is unique compared to other Nordic countries in that private sector entities are the source of most planning proposals, while local protesters, environmental agencies and civil society have little opportunity to change plans or do more than comment on proposals (OECD, 2022).

The study disregards potential market adjustments. In a dynamic environment, a large recreational home development at the start of the period could harm the future attractivity of recreational homes in the NR mountain area, causing recreational home prices to drop and reducing investments in new recreational homes. If so, negative externalities of new recreational homes will be reflected in market prices and diminish the need for policy interventions. Yet, there has been a steady growth in recreational homes in the NR mountain area for many years without any sign of market satiation so far. We do not explore what future tourists would do if they could not buy a recreational home in the NR mountains. Suppose more

recreational homes are built in other mountain areas in Norway due to less development in the NR area. In that case, some of the positive environmental effects of reducing development in the NR area could be offset. Nevertheless, if tourism management in other destinations also considered nonlocal nonmarket values, as we would recommend, they too would have to care for overall environmental costs, reducing this potential offset.

We assume a nonnegative WTP for reduced recreational home development in the NR area to avoid double counting of market benefits in the CBA. This study finds, as do several other studies, that some respondents prefer more local services and jobs through economic development (Ahi & Kipperberg, 2020). It would be possible to include the demand for market values in the nonmarket valuation estimates by allowing for negative WTP among the respondents that prefer L-development. Although it is reasonable to assume that people would be WTP for better access to market goods, including negative WTP would be problematic since respondents' demand for market goods would turn up in both the elicited WTP and the increased producer surplus generated by the large development.

There are caveats related to generalising results from our samples to the broader population. Comparing with available population data, we find that our samples are similar in age and gender. However, households with higher incomes and respondents with more than four years of university education are overrepresented across samples. Further, the lower response rate among households invited to the survey using SMS may indicate self-selection into the survey. These caveats could suggest that WTP for reduced development of recreational homes may be overestimated. Due to the magnitude of the net benefits of reducing from large to small development, we believe our conclusions to the research questions are robust to the mentioned sampling issues. We hope future research will investigate our findings and shed more light on the cost and benefit of recreational home development.

Striking the right balance between nonmarket and market goods is a general problem in management across destinations, countries, and contexts. Our study is one example of how CV and CBA are suitable for studying trade-offs between economic values and values of ecosystem service in a tourism context. By including all local and nonlocal market and nonmarket welfare effects of recreational home developments, our study provides an empirical example of how local tourism policies solely accounting for local impacts may conflict with national environmental interests. The increasing importance of tourism for economic activity, the parallel loss of ecosystem services and the need for climate change mitigation warrant more research on

socially optimal tourism management. Future research should combine SP, economic impact analysis, and CBA to assess the social welfare implications of other land and tourism management issues in different contexts.

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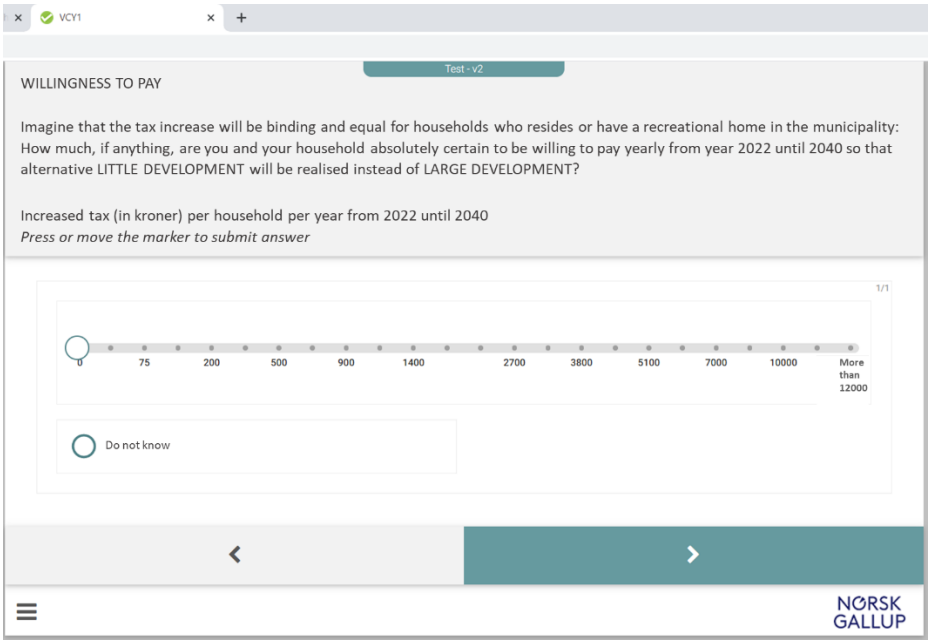
Appendices

A.1 Willingness to pay question



A.2 List of assumptions applied in the CBA

Table 7 describes the assumptions and inputs needed to calculate the net benefit of the Small and Medium recreational home development options, compared to the BAU scenario (I,e. Large recreational home development) over a time horizon of 18 years (the period 2022-2040 (18 years), we need to include some additional elements to the CBA, see list of all CBA assumptions in table 7.

Table 6 - Input data and assumptions used in the CBA of recreational home development in the NR mountain area

Element	**Assumed**	**Source/Source of guideline**
Start/end of the analysis	2022/2040	Own assumption
Project start	2022	Norwegian Ministry of Finance (2014)
Time horizon	18 years	Own assumption
Discount rate	4 % p.a.	Norwegian Ministry of Finance (2014)
Consumer surplus	Estimated aggregated WTP	Contingent Valuation survey
Producer surplus		
- Average price of new recreational home	4.3 MNOK	Handberg et al. (2022)
Property sales profit	*0.46 MNOK*	Handberg et al. (2022)
Cost of construction	*3.84 MNOK*	SP survey
- Annual cost of maintenance	45 KNOK	Handberg et al. (2022)
- Yearly tourist consumption	88.5 KNOK	Tofteng et al. (2018);
Local businesses' market shares (in %):		
- property sales profit	85 %	Handberg et al. (2022)
- recreational home construction	45 %	Handberg et al. (2022)
- recreational home maintenance	75 %	Handberg et al. (2022)
- tourism consumption	45 %	Handberg et al. (2022)
- Construction profit rate	5 % in Viken/Oslo	Business accounting data
- Tourism and retail profit rate	5 % in Viken/Oslo	Business accounting data
- Resource rent property profits	100 % of incomes	Handberg et al. (2022)
Number of households in 2022		
- Local; 5 municipalities in NR mountain	5850	Statistics Norway
- owners of recreational homes	7500	Handberg et al. (2022)
- Viken and Oslo counties	898000	Statistics Norway

Note: Prices in 2021- million Norwegian kroner (MNOK), 1 NOK = 0.1 EURO.

A.3 Spatial regression

Table 7 - Factors explaining respondents choosing S-development. WTP among respondents who prefer S-development.

	Logit	Interval regression
	Choose S-development	WTP
Hours drive from home	0.156	-1643.1***
	(0.101)	(446.8)
Woman	0.413***	-330.2
	(0.151)	(481.3)
Age	0.0652**	19.61
	(0.0302)	(60.85)
Log household income	-0.000497*	-0.453
	(0.000288)	(0.560)
Education level (1-5)	-0.408***	932.6**
	(0.152)	(369.2)
Constant	0.158**	300.2**
	(0.0687)	(128.2)
lnsigma constant	3.462*	-8813.5**
	(2.007)	(3877.5)
Number of observations	1,043	481
Pseudo R^2	0.030	0.013
Loglikelihood	-646.0	-2146.2

Note: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors in parentheses. Norwegian kroner NOK (1 NOK = 0.1 EUR).

Paper III

Spatial Dimensions in Stated Preference: The Role of Place Attachment

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Abstract

Land use policy decisions involving environmental goods affect people across space. The importance of considering the spatial dimension in welfare analysis is increasingly acknowledged, but there are still knowledge gaps to fill. We turn to environmental psychology and use place attachment; the functional and emotional bond people have to a defined place. We conduct a contingent valuation study of new recreational mountain homes in southeast Norway and investigate the concept of place attachment to explain spatial preference heterogeneity and distance decay in their willingness to pay (WTP) to reduce cabin developments and preserve the mountain landscape and biodiversity. Using structural equation modelling, we find that place attachment diminishes with travel time and explains a substantial part of the effect of travel time on WTP. About 55 percent of the negative impact of travel time on WTP is indirectly channelled through reduced place attachment. Including place attachment also substantially improves the fit of our econometric model. Based on our results, we recommend future studies to further explore place attachment in spatial welfare analysis and benefit transfer exercises, particularly as a subjective control variable for substitute sites and recreational activities.

JEL: Q51, Q57

Keywords: Stated preference, contingent valuation, distance decay, place attachment, willingness-to-pay, not-in-my-backyard, ecosystem services

1. Introduction

Land use decisions involving environmental goods affect people across space. Much of the why and how preferences vary over space remains unknown. The importance of the spatial dimension for understanding economic behaviour and welfare analysis is increasingly acknowledged in the nonmarket valuation literature (De Valck & Rolfe, 2018). Although there have been recent theoretical advances (e.g., Yamaguchi & Shah, 2020; Meya, 2020), empirical advances (e.g., Holland & Johnston, 2017) and advances in the understanding of underlying factors (e.g., Faccioli et al., 2020), the implications and complexity of spatial distributions warrants more research by economists (Glenk et al., 2020).

The natural landscape provides valuable non-market ecosystem services such as recreation, landscape aesthetics, sense of place, and biodiversity to people. Land use, buildings, and infrastructure in natural landscapes will often generate market incomes while reducing the quantity and quality of the natural landscape, providing critical non-market goods and services. Land management often ignores all or some of the affected non-market values (Healy, 1994; Bateman et al., 2013; Iversen et al., 2021), partly because these are distributed across space and political jurisdictions (Iversen et al., 2022).

However, land-use policies should consider the welfare of the affected population across political jurisdictions (Johnston et al., 2017). Stated preference (SP) methods are frequently used to elicit non-market values of changes in environmental goods.[1] The extent-of-the-market for place-specific environmental goods depends on distance decay in SP values. Distance decay implies that non-market values diminish as the distance between the good and individuals increases, and the market extends to the point where values are reduced to zero (Glenk et al., 2020). The negative association between values and distance is typically explained by factors such as i) increasing costs to access the good, ii) an increasing number of substitute goods, iii) increasing search and information costs, and iv) decreasing moral obligation and responsibility (De Valck & Rolfe, 2018; Glenk et al., 2020). Distance decay in non-market values is found in numerous SP studies (e.g., del Saz Salazar & Menendez, 2011; Rolfe & Windle, 2012; Schaafsma et al., 2012; Schaafsma et al., 2013; Johnston et al., 2015; Olsen et al., 2020).

[1] The total economic value of nonmarket resources includes use values stemming from peoples' experience or option to experience the nature, and non-use values stemming from knowing that others, today or in the future, may experience the nature, and knowing that the nature are in good shape (Bateman et al., 2002).

The first three reasons for expecting distance decay have strong microeconomic foundations (Glenk et al., 2020). Stable preferences are inferred from rational choices made to maximize utility subject to constraints such as income and time, attributes of the good, and its substitutes. Information and its effects on perceptions and beliefs are also incorporated into the microeconomic framework (McFadden, 2001). Psychological concepts such as attachments, attitudes, and feelings are less studied in economics, even though associated psychological measurement scales have been developed and validated (e.g., Williams & Vaske, 2003). According to De Valck & Rolfe (2018), improved insight into the interaction between human and ecological systems through the development of constructs such as *place attachment* could make inputs from psychology more helpful in studying spatial distribution in SP research. This encouragement has yet not been adequately addressed.

Place attachment is people's functional and emotional bond to a specific place, measured along different dimensions (Low & Altman, 1992). As with interpersonal attachment, place attachment is characterized by behaviours to maintain proximity to the object of attachment (Vorkinn & Riese, 2001; Scannell & Gilford, 2010; Dugstad et al., 2022). Place attachment also strengthens place-specific pro-environmental behaviour (Halpenny, 2010; Ramkissoon et al., 2013). Faccioli et al. (2020) partially address the literature gap highlighted by De Valck & Rolfe (2018) by investigating the significance of place identity, a dimension of place attachment, and environmental attitudes on willingness to pay (WTP) for peatland restoration across Scotland. Their results indicate that people who identify stronger with peatlands and Scotland tend to have higher WTP for peatland restoration in Scotland. They find place identity and WTP estimates for quality improvements to be heterogeneously distributed across space, but that they follow correlated patterns. Faccioli et al. (2020) state that distance to valued locations is less critical in explaining WTP than place identity. However, distance to locations is not included in their econometric model, and thus they cannot analyse the mediation between distance to the environmental good, place identity, and WTP.

Bao & Robinson (2022) argues that place attachment is closely linked to the endowment effect, an emotional bias causing individuals to value owned objects higher than market value (Thaler, 1980). The connection between place attachment and the endowment effect is also identified empirically (e.g. Clark & Lisowski, 2017; Liu et al., 2021). Bao & Robinson (2022) conduct a literature review of the use of behavioural insights in land use policy studies and conclude that there is great potential for further investigations into the endowment effect, and thus place attachment, in future research.

We further contribute to this literature gap, building on De Valck & Rolfe (2018) and Faccioli et al. (2020), by including additional aspects in the place attachment construct and using it as a mediator variable[2] to explain distance decay in WTP for a place-specific environmental good. Since the overall concept of place attachment has not previously been used to analyse distance decay in WTP, the study's main contribution is using place attachment to refine the understanding of distance decay effects and spatial heterogeneity in non-market valuation.

We conduct a contingent valuation (CV) study on households' preferences for constructing new recreational homes in a mountain area (Norefjell) in Norway. Three different development options are presented to the respondents; Large (L), medium (M), or small (S) in a mountain landscape home to wild reindeer already under pressure from human activity (Iversen et al., 2022). The respondents are first asked to choose the development option they prefer. After the respondents chose their preferred construction plan in the survey, those who chose the least expansive plan (S) were asked how much they would pay as an annual tax to avoid the L-development. Our first research question is whether travel time and place attachment to the mountain area affect people's preferred development level. Our second research question is whether place attachment helps explain distance decay in WTP. To evaluate our research questions, we use structural equation modelling (SEM) (Anderson & Gerbing, 1988; Hair et al., 2019), which simultaneously integrates factor analysis with multiple linear regression models. With this approach, the latent concept of place attachment can be incorporated into specified regression models as both a dependent and independent variable. We analyse place attachment as a mediator variable between WTP and travel time using SEM.

The article is structured as follows: We present the literature background and hypotheses in Section 2. We describe our method, including the preference model, the survey design, and the econometric modelling, in Section 3. In Section 4, we present the results, discuss the results in Section 5 and conclude in Section 6.

2. Literature background and hypotheses

The definition of place attachment depends on its underlying dimensions (Halpenny, 2010). Place attachment can both measure the perceived recreational functions of a particular place relative to its alternatives and the personal identification with the place often described by feelings of pride and well-being (Scannell & Gilford, 2010;

[2] A mediator variable is a variable that explains the causal relationship between an independent and dependent variable (Hair et al., 2019).

Brown et al., 2003). The construct depends on the characteristics of the place and how affections, cognition, and behaviour manifest in the attachment (Scannell & Gilford, 2010).[3] Bonding is essential to being human; we bond with family, friends, communities, animals, objects, and places. These bonds secure people in their social and physical environments, connect them to the past and influence their preferences and behavior (Walker & Ryan, 2008).

Attachment theory suggests that an innate psychological system attaches individuals to other people for security, comfort, and growth (Scannell & Gifford, 2014). Environmental psychologists have shown that people also develop similar bonds with places (Low & Altman, 1992; Lewicka, 2011). Place attachment has become a central concept in environmental psychological research and is gaining popularity across disciplines such as community psychology, sociology, human geography, leisure, and tourism sciences, and recently economics (Lewicka, 2011; Dugstad et al., 2022).

In environmental psychology, place dependency and place identity are two key dimensions of place attachment (Lewicka, 2011). Place dependency refers to people's bond with a place in terms of how functional the place is for recreation compared to other places (Williams & Roggenbuck, 1989; Moore & Graefe, 1994). If individuals experience strong place dependency towards a specific place, they prefer that place for recreation compared to other nearby or distant places. Place dependency is spatially determined, as travel time to the place is an essential aspect of functionality (Moore & Graefe, 1994; Rijnks & Strijker, 2013). Place dependency is thus related to travel costs and substitutes in economics, which explains distance decay effects in WTP for environmental goods (Glenk et al., 2020).

Place identity measures people's emotional attachment to a place and whether the place is essential for people's self-identity (Proshansky et al., 1983). Environmental psychological research consistently finds that place identity is positively related to pro-environmental behaviour (Halpenny, 2010; Ramkissoon et al., 2013). Similarly, within economic research, Faccioli et al. (2020) identify a positive link between place identity and increased WTP for ecosystem services. As with place dependency, place identity depends on the distance to the attachment place (Rijnks & Strijker, 2013; Bernardo & Palma-Oliveira, 2012; Xiao & Zhang, 2021).

We argue that place attachment integrates factors describing the negative association between values and distance in economics, such as the intensity of the use

[3] Individual held meanings may be related to personal experiences at the place, while collective held meanings may be related to symbols, culture, and religion shared within communities (Scannell & Gilford, 2010).

of nature and the consideration of substitutes. Therefore, place attachment would presumably be associated with higher WTP for desirable non-market goods and services (Faccioli et al., 2020; Dugstad et al., 2022) while also being spatially determined (Moore & Graefe, 1994; Rijnks & Strijker, 2013; Bernardo & Palma-Oliveira, 2012; Xiao & Zhang, 2021; Dugstad et al., 2022).

Landscape changes disrupting place attachment have provoked the NIMBY effect (not-in-my-backyard). The NIMBY effect depicts the situation when people oppose place-specific environmental changes they otherwise would not due to these changes occurring close to where they live (Devine-Wright, 2009). The NIMBY effect has been associated with selfish and irrational behaviour (Lake, 1993). As a secondary contribution, we examine whether place attachment strengthens preferences (i.e., NIMBY) for avoiding more extensive development plans of reactional mountain homes.

Thus, our first research question is whether distance to the environmental good and place attachment to the Norefjell area affects preferences for the preferred development plan. Distance is measured as travel time by car from the residential municipality to Norefjell. In line with the literature on NIMBY-effects (Devine-Wright, 2005; 2009), our first hypothesis is that shorter travel time increases the likelihood of choosing the S-development option. We expect place attachment to strengthen with shorter travel time and recreational use, and we expect place attachment also to increase the likelihood of choosing S-development.

In addition to Faccioli et al. (2020), a few earlier studies find a positive link between related concepts to place attachment and WTP for environmental goods. Dallimer et al. (2014) find that people with high emotional attachment to urban green spaces have higher WTP for biodiversity enhancement than others. Nielsen-Pincus et al. (2017) notice that place attitude was a significant predictor of respondents' WTP for a program designed to benefit drinking water quality in Oregon. Dugstad et al. (2022) find that people with stronger place attachment demand higher compensation to accept negative wind power externalities. López-Mosquera & Sánchez (2013) identify the affective and emotional bonds between people and the natural areas as the main determinants of WTP (López-Mosquera & Sánchez, 2011; 2013).[4] None of the above studies have included travel time or distance in the econometric model.

Our second research question is whether and to what extent distance decay in WTP changes when we include place attachment into the model. After the

[4] In one site, place identity is a significant and positive factor explaining WTP and place dependency is insignificant, whilst in the second site place dependency is significant and not place identity (López-Mosquera & Sánchez, 2013).

respondents choose their preferred construction plan in the survey, we ask those who chose the two least expansive plans how much they are willing to pay as an annual tax to avoid the L-development options. Focusing on this sample, we analyse i) whether there is a distance decay in WTP using the travel time variable, and ii) how the expected distance decay change when we include place attachment in the analysis, specified again to depend on the travel time variable. Since we argue that place attachment partially can explain distance decay effects on WTP, our second hypothesis is that stronger place attachment increases the WTP for S-development. Subsequently, we expect place attachment to explain a substantial part of the causal effect of travel time on WTP to avoid the degradation of natural landscapes.

3. Methods

3.1 Case study and survey design

The Norefjell mountain area, known for its landscapes and panoramic views, is a popular tourist destination for hiking, cross-country skiing, alpine skiing, cycling, and other recreational activities. The Norefjell area partly covers five municipalities and is home to 7,500 private recreational homes, several hotels, and an alpine ski centre. Almost the entire European strain of 25,000 wild reindeer lives in 24 administrative areas in southern Norway (Gundersen et al., 2019), of which a herd of 550 wild reindeer lives in the Norefjell area. Tourism and the construction of recreational homes are essential sources of income, critical for sustaining the communities in the Norefjell mountain area (Tofteng et al., 2018). The five municipalities in the Norefjell mountain area are considering large-scale developments, building up to 8,000 new recreational homes in the years to come. The construction of recreational homes affects ecosystem services such as recreation, landscapes, and biodiversity.

We conduct a CV survey on how the construction of recreational homes affects welfare using the Norefjell mountain area in southeast Norway as a case. The processes for determining whether attribute-based CE or scenario-based CV is appropriate should be based on the change being valued and insights from survey pretesting (Johnston et al., 2017). We started the survey development process by reviewing documents on tourism development and the ecosystem services in the Norefjell area, gathering pictures of new areas of recreational homes, and interviewing tourist hosts. We came to understand the carrying capacity of the wild reindeer herd, the number of hikers, the changes in landscapes, and the number and size of trails are correlated with the development of new recreational homes. We

organised two focus group sessions, and our priors regarding this correlation were supported in panel discussions. Due to the correlation between the effects of recreational home developments, we assessed that an attribute-based choice experiment would be perceived as less credible to the respondents. We decided to go ahead with a scenario-based CV survey instead.

The CV survey presents three distinct policy options to investigate the welfare impacts of tourism development in the Norefjell-Reinsjøfjell area. Respondents were asked to choose their preferred policy alternative. If S-development or M-development is preferred to the business as usual (BAU) L-development option, we ask respondents a follow-up question regarding how much they would be willing to pay in increased taxes for changing the policy from BAU to S-development or M-development.[5] The changes in values are, in comparison to the BAU, the construction of fewer recreational homes, a lower increase in the number of hikers, a lowered pressure on the carrying capacity of the wild reindeer, and less landscape changes, see Table 1.

CV valuation options and valuation questions were designed to encourage truthful responses following the guidelines proposed by Johnston et al. (2017). We informed local respondents that a potential tax increase would be equal and binding for every household resident and owning a recreational home in the Norefjell area, and informed non-local respondents that it would be equal and binding for every household in Viken and Oslo county. We used municipal tax as the payment vehicle for residents and owners of recreational homes in the Norefjell area, while we used county tax as the payment vehicle for non-local respondents in other parts of Viken and Oslo. We promote consequentiality[6] by stating that results will be reported to relevant authorities and promote incentive compatibility by stressing cost uncertainty, following Vossler & Holladay (2018) and Vossler & Zawojska (2020).[7] A

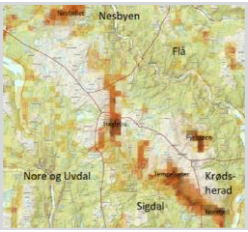
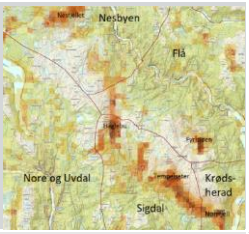
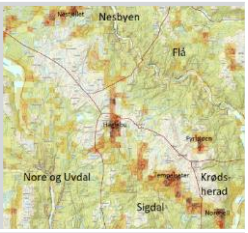
[5] Respondents who prefer S-development also got to state their WTP for a change from L-development to M-development.

[6] We randomly assigned four different consequentiality text to the respondents in Viken and Oslo varying between payment consequentiality, policy consequentiality, both payment and policy consequentiality and research purpose. About 12 percent of respondents were randomly assigned to the research purpose text. Consequentiality perceptions were not affected by our treatments.

[7] We introduced the following text on cost uncertainty to respondents with a home or recreational cabin in the municipalities *"The municipalities are planning large recreational home development in the Norefjell area. Viken county, on the other hand, wants to reduce the development of recreational homes to protect recreation and wild reindeer for residents of Viken and Oslo. The fewer recreational homes are built in the municipality, the less the municipalities' income will be. Increased municipal tax for residents and cabin owners can cover the loss of income and preserve wild reindeer and recreation. Whether and how much*

horizontal payment card slider was used were 23 amounts on the scale ranging from 0 to NOK 12,000, including an option to specify the exact amount if more than NOK 12,000 and "Don't know". Vossler & Zawojska (2020) show that payment card format with cost uncertainty provides the exact WTP estimates as the single binary choice format. Using the single binary choice format was until very recently considered the most straightforward way to ensure an incentive compatible with stated preference elicitation. Further, following Johnston et al. (2017), we applied a decision rule saying that if respondent WTP is equal to or higher than the cost of changing policy, the building of recreational homes will be reduced, and taxes will increase.[8]

Table 1. The options presented to respondents

	LARGE DEVELOPMENT	MEDIUM DEVELOPMENT	SMALL DEVELOPMENT
Recreational home density in 2040			
Total recreational homes in 2040	14,000 recreational homes	11,000 recreational homes	8,000 recreational homes
Growth until 2040	6,500 new recreational homes / 85% growth	3,500 new recreational homes / 45% growth	500 new recreational homes / 5% growth
Development	Over and under the tree line	Under the tree line	Under the tree line
Growth in hikers in 2040	100% more hikers 	60% more hikers 	20% more hikers 
Recreation <u>above</u> the tree line	Upgrading of current paths and expanding trail network	Upgrading of current paths	Paths as today
Recreation <u>below</u> the tree line	Large development in recreation areas	Some development in recreation areas	Little development in recreation areas
The wild reindeer population in 2040	Carrying capacity very strongly threatened	Carrying capacity strongly threatened	Carrying capacity somewha threatened

Note: Percentage growth from 2021 to the expected outcomes in each scenario in 2040.

municipal tax should have to increase is uncertain at this point". The respondents living in other parts of Viken, and Oslo were presented a similar text.

[8] A formulation stressing that WTP above the cost would be counted as a vote in favour of the project were tried and tested, but due to efficiency and comprehensibility considerations, we landed on a simpler and less concrete wording.

After the valuation questions, we operationalized place attachment using validated statements related to place dependence and place identity (Williams & Vaske, 2003).[9] Both place dependence and place identity was captured through three-item scales and combined into place attachment using a two-level measurement model described below. Responses were measured using a 7-point Likert scale ranging from 1 = Strongly disagree to 7 = Strongly agree, with 4 = Neither agree nor disagree.[10] Respondents were also provided a "Don't know" answer. These are treated as missing values in our analyses.

3.2. Structural equation modelling

There is increasing literature in environmental economics using latent variables to examine preference heterogeneity in SP research (Hess & Beharry-Borg, 2012; Hoyos et al., 2015; Mariel & Meyerhoff, 2016; Czajkowski et al., 2017a, 2017b; Pakalniete et al., 2017; Boyce et al., 2019; Zawojska et al., 2019; Faccioli et al., 2020), but this is primarily in discrete choice experiment studies. Most studies use the hybrid choice modelling framework, a particular structural equation modelling (SEM) framework that integrates a discrete choice component, see, e.g., Ben-Akiva et al. (2002)

SEM is a multivariate statistical approach that simultaneously integrates confirmatory factor analysis (CFA) and multiple linear regression analysis (Anderson & Gerbing, 1988). In other words, a model consists of measurement and structural components. The measurement component is a CFA where pre-defined observable indicator variables are used to verify one or several unobservable latent variables. In the structural component model, linear regressions define the relationship between exogenous and endogenous variables, which could both be observable and latent (Anderson & Gerbing, 1988). A model is usually estimated using the maximum likelihood estimation procedure, relying on a multivariate normal distribution assumption.

[9] Place dependency statements: 1. I get more satisfaction out of doing recreational activities in the Norefjell area than in any other mountain areas. 2. I would not substitute the Norefjell area to any other mountain area for the recreational activities I do here. 3. The Norefjell area has the best surroundings and facilities for the recreational activities I like to do. Place identity statements: 4. To be in the Norefjell area says a lot about who I am. 5. I strongly identify with the Norefjell area. 6. The Norefjell are feels like a part of me.

[10] The respondents were also allowed to answer "don't know" or skip the questions.

A general model can, according to the LISREL notation, be described by the three following equations (Jöreskog & Sörbom, 1989):

$$x = \Lambda_x \xi + \delta, \quad (1)$$
$$y = \Lambda_y \eta + \epsilon, \quad (2)$$
$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta. \quad (3)$$

Equation (1) and Equation (2) define the measurement components. In Equation (1), $\boldsymbol{x}$ is a vector of some indicators that define the vector $\boldsymbol{\xi}$ of exogenous latent variables with a matrix of factor loadings $\boldsymbol{\Lambda_x}$ and $\boldsymbol{\delta}$ is a vector of measurement errors. In Equation (2), $\boldsymbol{y}$ is a vector of some indicators that define the vector $\boldsymbol{\eta}$ of endogenous latent variables with a matrix of factor loadings $\boldsymbol{\Lambda_y}$ and $\boldsymbol{\epsilon}$ is a vector of measurement errors. Equation (3) defines the structural component. Here, **B** is a vector of regression coefficients of some latent endogenous variables on some other latent endogenous variables, **Γ** is a vector of regression coefficients of latent exogenous variables on $\boldsymbol{\eta}$ and $\boldsymbol{\zeta}$ is a vector of residuals for $\boldsymbol{\eta}$.

Figure 1 a) and b) displays the models visually. As can be seen, place attachment is specified as a second-order latent variable defined by the two dimensions of place identity and place dependency.[11] Place attachment depends on travel time to Norefjell, user intensity, and other socio-economic variables. Further, in panel a), "choice" is a binary variable and indicates whether the respondents prefer the S-development option, taking the value one if so and zero otherwise. The choice variable is specified to depend on place attachment, travel time, user intensity, and the same set of socio-economic characteristics as place attachment. As the choice variable is binary, we use the weighted least square mean and variance adjusted estimator (WLSMV) in the Lavaan package in R (Rosseel, 2012). This specifies the structural model on the choice to employ a probit link function so that we avoid the general issues of using a linear probability model.

In panel b) in Figure 1, we focus on the sample that prefers reduced development options and analyse how WTP depends on place attachment, travel time to and user intensity of the study area, and the same socio-economic variables as in panel a). As we used a payment card in the survey, WTP is not perfectly observed. We only know that it, assuming truthful revelation, lies between the chosen payment amount and the following higher amount on the payment card. Thus, we specify WTP as a single item latent variable with a measurement error of 15 %, as Hailu et al.

[11] In Figure 1 and in SEM notation graphically, circles represent latent constructs and squares represent observable variables.

(2005). Implicitly, we account for WTP not being perfectly pinpointed but measured within categories. This model uses maximum likelihood estimation with robust standard errors, and a Satorra-Bentler scaled test statistic (Satorra & Bentler, 1994; Rosseel, 2012).

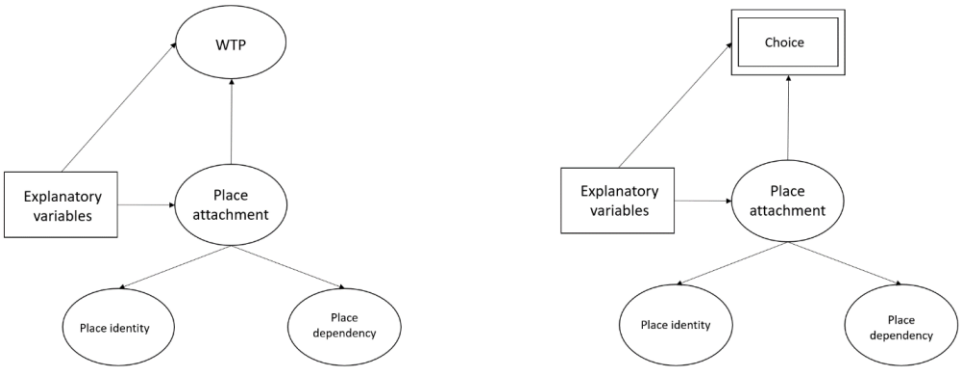


Figure 1 – a) Left: Theoretical model of preferences for development option. b) Right: Theoretical model of WTP for M-development or S-development option

In SEM, it is an established practice to evaluate the goodness of fit, reliability, and validity of the measurement components (Bagozzi & Yi, 2012), which should be executed before discussing the results of the structural models. Usually, the goodness of fit is evaluated by the following criteria (Hu & Bentler, 1999; Hair et al., 2019): root means square error of approximation (RMSEA) should be less than 0.08. The standardized root mean square residual (SRMR) should be less than 0.05. At last, the comparative fit index (CFI) and the Tucker-Lewis index (TLI) should be greater than 0.94.

To have reliability, the composite reliability score of the set of indicator variables should be greater than 0.7 (Fornell & Larcker, 1981; Bagozzi & Yi, 2012). Item reliability refers to "the amount of variance in an item due to underlying construct rather than to error and can be obtained by squaring the factor loadings'' (Chau, 1997, p. 324). Validity refers to the extent the observed indicator variables measure the latent concept of interest (Hair et al., 2019). To have validity, the standardized loadings should ideally be larger than 0.7, whereas the average variance extracted (AVE) should be greater than 0.5 (Fornell & Larcker, 1981; Hair et al., 2019). Satisfying the goodness of fit criteria also strengthens the validity.

4. Results

4.1 Sample and descriptive statistics

Three main groups were targeted for data collection: the local population in the five municipalities around the Norefjell mountain area, the owners of recreational homes in the area, and the population in Viken and Oslo counties. We chose this sampling strategy to achieve representativity among users and non-users close to the Norefjell mountain area and the surrounding region to the Norefjell area. Thus, we targeted both the local population and users and owners of recreational homes in the Norefjell mountain area and a representative sample of the population in Viken and Oslo. We performed an internet survey, and the three samples were selected using quotas matching population benchmarks for demographic characteristics as recommended by Johnston et al. (2017). The local population and the owners of recreational homes were targeted using SMS with a link to the survey. In contrast, the sample in Viken and Oslo were targeted using the survey company Kantar's panel of respondents. The data was collected in June 2021. The survey invitation was sent to 14,102 persons, of which 2,704 (19 percent) opened the invitation. We received 2,047 completed surveys from the survey company, which is 76 percent of the opened invitations and imply a real response rate of 14.5 percent. Table 2 presents descriptive statistics.

Compared to the population, there is an underrepresentation of respondents with the primary school as their highest education level, an overrepresentation of respondents with more than three years of university education, larger household size, and higher incomes, both among the local resident and the Viken/Oslo sample. As for the owners of recreational homes, we have less data on the underlying population characteristics. About 19 percent of the respondents answered "don't know" to the WTP answer and are set as missing observation. The traveling time data are calculated between all Norwegian zip codes by the Institute of Transport Economics and Menon Economics using GIS data on the Norwegian route network and the associated speed limits (Holmen, 2020).

Table 2. Descriptive statistics.

	All resp.	Norefjell area residents	Owners of recreational homes	Viken and Oslo residents
No. of respondents	2047	378	559	1110
Share women	46.2 %	47.5 %	44.0 %	47.4 %
Age (adults); in years	54.5	53.2	58.7	52.8
Education level				
Primary school	3 %	*5 %*	*0 %*	*4 %*
High school / Apprenticeship	27 %	*45 %*	*15 %*	*27 %*
3-4 year university	37 %	*32 %*	*37 %*	*38 %*
5-year university	31 %	*17 %*	*44 %*	*29 %*
Doctorate (Ph.D.)	2.5 %	*1 %*	*4 %*	*2 %*
Household income; in NOK	1 152 036	944 492	1 624 698	980 987
Travel time from home (hours)	1.30	0.16	1.49	1.58
Use intensity 2020 (days)	20	24.8	50.5	3.7
Place dependency	3.68	4.40	4.63	2.67
Place identity	2.76	3.69	3.82	1.82
Preferring S-development	61 %	56 %	72 %	58 %
Mean WTP per hh./yr. for small dev.	3177	1692	3867	1692

Note: Place dependency and Place identity consist of the three parcelled items each presented above.

4.2 Modelling results

3.2.1 Preferences for small development option

The results in this section include respondents who do not have missing values on the variables we use, including the place attachment scale. Thus, the models do not necessarily include the total sample.[12] First, our analysis starts by examining how travel time affects the likelihood of choosing the S-development option without including place attachment. This is evaluated by estimating a probit model, titled

[12] We did run the models that do not contain place attachment in this section where we included respondents with missing observation (or don't know) on the place attachment scale. These models provided similar results as the models presented in this section.

PROBIT. In the model, the dependent variable takes the value of one if the respondents chose S-development as the preferred option and zero otherwise.

Table 3. Probit regression on probability to choose S-development option without place attachment

	PROBIT Coef. (SE)
Variables	
hours	0.231** (0.107)
hours2	-0.038 (0.036)
user intensity	0.001 (0.001)
women	0.272*** (0.075)
age group 40 to 59	0.309*** (0.100)
age group 60 +	0.463*** (0.104)
high education (3 years or more university education)	0.1443* (0.085)
above mean income	-0.031 (0.083)
constant	-0.412*** (0.127)
Log-likelihood	800.775
Observations	1252
Adjusted McFadden Pseudo R-square	0.027

Notes: *p<0.10, **p<0.05, ***p<0.01. Standard errors (SE) are given in brackets.

The results are displayed in Table 3. By including a quadratic term, we allow for a non-linear effect of travel time on the likelihood. We can see that as travel time increases, the likelihood of choosing the S-development option increases. The quadratic term is not significant, so we have a linear effect. This can be explained by the fact that people who reside further away have fewer benefits from the market values generated by the L-development option, making the non-market values dominate their decision. On the other hand, people who reside closer benefit from the market values generated and tend to choose the more expansive scenarios. We can also see that women, older people, and people with higher education are more likely to choose the S-development option.

Next, we estimate the first conceptual model displayed in panel a) in Figure 1 using SEM, where both travel time and place attachment is specified to affect the likelihood of choosing the S-development option. Place attachment is further specified to depend on travel time, user intensity, and other socio-economic characteristics. We thus have two structural models, where the structural model on choosing S-development is specified as a probit link function. We again use a non-linear specification of travel time. The results are displayed in Table 4. Please note that we only look at respondents with complete responses on the place attachment scale, i.e., don't know answers, and missing values are excluded.

As discussed in Section 2.2, we start by evaluating the goodness of fit, reliability of the indicator variables, and validity. Table 4 shows that each goodness of fit

measure satisfies the previously listed established thresholds (Hu & Bentler, 1999; Hair et al., 2019). RMSEA is 0.02, SRMR is 0.02, CFI is 0.97, and TLI is 0.99. The indicator variables indicate reliability, as the composite reliability scores are above 0.7. The measurement components indicate validity, as each standardized loading is above 0.7 and the AVE is above 0.5.

Place attachment exerts a negative, significant, and sizeable effect on the likelihood of choosing the S-development plan. The other incorporated explanatory variables have the same tendency on the likelihood as in PROBIT in Table 3. However, user intensity is significant when controlling for place attachment. In the second structural model, place attachment depends negatively and significantly on travel time while positively and significantly on user intensity. There is clearly a spatial dimension of place attachment, where the first polynomial of travel time is negative and the second polynomial is positive, indicating a decreasing but diminishing spatial effect. Place attachment is further stronger among people with a university education. The place attachment construct is normalized to have a mean of zero and a unit standard deviation. Thus, the coefficients in the place attachment structural model can be interpreted as marginal changes in the standard deviation of place attachment, holding all other variables constant.

An appealing feature of SEM is that one can evaluate mediation effects, often referred to as i) direct effects, ii) indirect effects, and iii) total effects. Our model allows us to assess all mediation effects of travel time and user intensity on the likelihood of choosing S-development, where place attachment functions as a mediator variable. The direct effect is the displayed coefficient in the structural component of S-development in Table 4, e.g., 0.04 on user intensity. The indirect effect is defined as the product of the coefficient of the explanatory variable incorporated in the structural place attachment model and the direct effect of place attachment (i.e., -0.206) on the S-development likelihood. For example, for user intensity, the indirect effect becomes $0.012 \cdot (-0.206) = -0.003$. At last, the total effect is equal to the sum of the indirect effect and the effect place attachment has on the likelihood, which for user intensity becomes $-0.003 + 0.004 = 0.001$.

All mediation effects are displayed in Table 4. User intensity has two conflicting results on the likelihood of choosing the S-development option. The direct effect is positive, meaning that user intensity alone increases the likelihood of respondents to choose S-development. In contrast, the indirect effect through place attachment on this likelihood is significantly negative. This means that when increased user intensity increases place attachment, the likelihood of choosing S-development will decrease. In other words, people with higher user intensity and lower place attachment are

more likely to choose S-development. In comparison, people with higher user intensity and higher place attachment are less likely to choose S-development. The total effect is not significant due to these conflicting effects.

Table 4. Place attachment on probability to choose the S-development option

	S-development (coef.)	Place Attachment (coef.)
Structural components		
Place attachment	-0.206*** (0.062)	
travel time	0.143 (0.109)	-0.427*** (0.006)
travel time squared	-0.020 (0.037)	0.087*** (0.024)
user intensity	0.004** (0.001)	0.012*** (0.01)
women	0.282*** (0.075)	0.052 (0.040)
age group 40 to 59	0.326*** (0.099)	0.084 (0.056)
age group 60 +	0.475*** (0.103)	0.060 (0.058)
high education (3 years+ university education)	0.122 (0.085)	-0.108** (0.046)
above mean income	-0.030 (0.083)	0.008 (0.045)
Indirect effects		
One hour increase in travel time	0.052*** (0.017)	
User intensity	-0.003*** (0.001)	
Total effects		
One hour increase in travel time	0.154*** (0.058)	
User intensity	0.001 (0.001)	

Measurement components		
	Indicator variable	Standardized factor loading
Place dependency		
	pdep1	0.844*** (0.010)
	pdep2	0.875*** (0.009)
	pdep3	0.896*** (0.007)
Place identity		
	pid1	0.875*** (0.009)
	pid2	0.967*** (0.005)
	pid3	0.936*** (0.006)
Place attachment		
	Place dependency	0.931*** (0.014)
	Place identity	0.901*** (0.014)

Validity statistics	Place dependency	Place identity	Place attachment
Average standardized factor loading	0.872	0.926	0.917
Average variance extracted	0.760	0.858	0.840
Composite reliability	0.905	0.948	0.913
Observations	1252	1252	1252

Notes: *p<0.10, **p<0.05, ***p<0.01. Standard errors (SE) are given in brackets. RMSEA = root mean square error of approximation = 0.023; CFI = comparative fit index = 0.972; TLI = Tucker-Lewis index = 0.989; SRMR = standardized root mean square residual = 0.022; Chi-squared test statistics (p-value) = 86.742 with 52 degrees of freedom (p-value = 0.002); R-square S-development component = 0.073; R-square place attachment component = 0.320.

The indirect effect of travel time on the likelihood of choosing S-development is positive and significant, which indicates that travel time, mediated by place attachment, is essential for the respondents' preferred development option. In other

words, there is spatial variation in preferences through place attachment. The total effect of travel time on the likelihood is also positive and significant. The result further indicates that travel time influences choices for the development options. Implicitly, the result shows that people with stronger place attachment who live further away from the Norefjell area are more likely to prefer small development. In contrast, people with stronger place attachment who live closer to the Norefjell area are likelier not to choose small development.

3.2.2 WTP models

Now, we turn to the WTP models that evaluate spatial heterogeneity in WTP to get the S-development option instead of the BAU L development option, using place attachment as a mediator variable. The models thus only include the respondents who prefer the S-development option, as these were the only respondents asked to state their WTP to have S-development. Therefore, the sample size is smaller than the models in Tables 3 and 4. As previously discussed, we only look at respondents with a defined value between one and seven in the place attachment scale, i.e., exclude missing values and don't know answers.

Table 5 displays the *naïve* (standard) model where the travel time is included while place attachment is left out. We use two different methods to estimate this model. To the left in Table 5, we use SEM, where WTP is specified as a single-item latent variable with a 15% measurement error, defined by the logarithm of the WTP variable. The level of the measurement error is based on previous studies (Hailu et al., 2005; Dugstad, 2020). Thus, this model accounts for measurement errors accompanying WTP elicited by payment cards. The model to the right in Table 5 is an ordinary least square linear regression model, where the midpoint of WTP is specified as the dependent variable (log-transformed).[13] We include both models to show that they yield similar results to demonstrate that SEM is a reliable method that can be used to assess the relationship between WTP and explanatory variables in CV studies that utilize payment cards as a response format.

Travel time is again specified to follow a non-linear effect by including a quadratic term. We can see that WTP decreases significantly with travel time. This means people who reside further away have lower WTP, confirming a distance decay effect. The first polynomial is negative and significant, while the second polynomial is

[13] Cameron & Huppert (1989) showed that with a high number of payment card intervals such as in our survey, OLS midpoint parameter estimates, and the MLE interval parameter estimates are very similar.

positive and significant, so there is a significant diminishing non-linear effect. Thus, if travel time increases by one hour, WTP decreases with $100 \cdot (-1.090 + 2 \cdot 0.328 \cdot 1) = 43.3$ percentage points. WTP further significantly increases with user intensity, income, and education. Women have significantly higher WTP.

Table 5. Travel time on WTP to have S-development instead of large development

	WTP for S-development (coef.) SEM MODEL	WTP for S-development (coef.) OLS MODEL
Structural components		
Hours	-1.090*** (0.347)	-1.090*** (0.327)
hours2	0.328*** (0.113)	0.328*** (0.097)
user intensity	0.014*** (0.003)	0.014*** (0.004)
Women	0.577** (0.228)	0.577** (0.227)
age group 40 to 59	0.032 (0.333)	0.032 (0.347)
age group 60 +	0.314 (0.341)	0.314 (0.344)
high education (3 years or more university education)	0.906*** (0.274)	0.906*** (0.297)
above mean income	0.638** (0.252)	0.638** (0.264)
constant	-	5.303*** (0.486)
Observations	645	645
R-square	0.078	0.078

Notes: *p<0.10, **p<0.05, ***p<0.01. The dependent variable is the log-transformed midpoint WTP estimate of the chosen payment value and the next higher value. Standard errors (SE) are given in brackets. RMSEA = root mean square error of approximation = 0.000; CFI = comparative fit index = 1.000; TLI = Tucker-Lewis index = 1.000; SRMR = standardized root mean square residual = 0.000.

The more complex structural equation model, which includes both place attachment and travel time, is displayed in Table 6. In this model, we use place attachment as a mediator variable to explain spatial heterogeneity in WTP for S-development option. We have run the same model as in Table 6 analysing WTP for M-development and find very similar results, both in terms of coefficients direction and magnitude, see appendix, Table A.1.

The model satisfies all goodness of fit criteria (See Table 6), and we still have evidence of validity and reliability of the measurement models. The model in Table 6 is explained in Section 2.3 and visualized in Figure 1 (panel b). Consistent with the model in Table 4, there is a spatial dimension of place attachment, as travel time significantly influences place attachment. Since the first polynomial is negative while the second polynomial is positive, there is a U-shaped spatial effect. As mentioned, the place attachment construct is normalized to have a mean of zero and a unit standard deviation. Thus, the coefficients in the place attachment structural model can be interpreted as marginal changes in the standard deviation of place attachment, holding all other variables constant. When we consider the non-linear effect of travel

time on place attachment, we can see that if travel time increases by one hour, place attachment will decrease with $-0.416 + 2 \cdot 0.09 \cdot 1 = -0.236$ standard deviations. The effect size is comparable to what we find in Table 4, i.e., -0.253 standard deviations, where more observations were included. Since we have a non-linear quadratic specification of travel time in the place attachment structural equation model, we can see that the threshold level of travel time when the relationship between increased travel time and place attachment becomes positive is almost two and a half hours.[14]

Consistent with the models in Table 4, place attachment is highly dependent on user intensity. This reinforces the robustness of the result that place attachment depends on travel time and user intensity. Older people and women have stronger place attachment, while people with three years or more university education have less place attachment.

Turning to the structural model in Table 6, place attachment has a positive, sizeable, and significant effect on WTP. A one standard deviation change in place attachment increases WTP by 102 percentage points. As expected and consistent with the model in Table 5, there is a direct distance decay effect on WTP. If travel time increases by one hour, WTP decreases by 19.2 percentage points, accounting for the non-linear specification. Since we now include place attachment as a mediator effect, the direct effect of travel time on WTP is substantially smaller than what we found in the naïve WTP model in Table 5. As seen in the table and as expected, the indirect effect, mediated by place attachment, is significant and negative. If travel time increases by one hour, place attachment will decrease by 0.236 standard deviations (shown previously), causing WTP to decrease by 24.1 percentage points ($100 \cdot (-0.236 \cdot 1.023) = 24.1$). In other words, people who live further away with low place attachment have lower WTP, while people who live closer with strong place attachment have higher WTP. The total effect of an hour increase in travel time (i.e., the sum of the indirect and direct effects) is also significant and yields a 43.4 percentage points decrease in WTP.[15] This corresponds neatly with the distance decay effect found in the naïve WTP model in Table 5.

[14] Given by the following formula: $-0.416 \,/(2 \cdot 0.09) = 2.31$

[15] Calculated as follows: $1.023 \cdot (-0.416 + 2 \cdot 0.090) + (-0.664 + 2 \cdot 0.236) = 0.433$

Table 6. Place attachment on WTP to have S-development instead of large development

	WTP for S-development (unstandardized coef.)	Place Attachment (standardized coef.)
Structural components		
Place attachment	1.023*** (0.196)	
travel time (hours)	-0.664** (0.324)	-0.416*** (0.081)
travel time squared	0.236** (0.093)	0.090*** (0.018)
user intensity	0.001 (0.004)	0.012*** (0.001)
Women	0.474** (0.221)	0.101*** (0.057)
age group 40 to 59	-0.082 (0.334)	0.111 (0.087)
age group 60 +	0.084 (0.333)	0.225** (0.090)
high education (3 years or more university education)	1.028*** (0.292)	-0.120* (0.070)
above mean income	0.588** (0.256)	0.049 (0.061)
Indirect effects		
One hour increase in travel time	-0.241 *** (0.068)	
user intensity	0.012 *** (0.003)	
Total effects		
One hour increase in travel time	-0.434** (0.183)	
user intensity	0.013 *** (0.004)	

Measurement components		
	Indicator variable	Standardized factor loading
Place dependency		
	pdep1	0.847*** (0.018)
	pdep2	0.848*** (0.022)
	pdep3	0.900*** (0.014)
Place identity		
	pid1	0.846*** (0.018)
	pid2	0.973*** (0.007)
	pid3	0.945*** (0.010)
Place attachment		
	Place dependency	0.935*** (0.022)
	Place identity	0.894*** (0.019)

Validity statistics	Place dependency	Place identity	Place attachment
Average standardized factor loading	0.865	0.921	0.915
Average variance extracted	0.749	0.852	0.836
Composite reliability	0.899	0.945	0.911
Observations	645	645	645

Notes: *p<0.10, **p<0.05, ***p<0.01. Standard errors (SE) are given in brackets. RMSEA = root mean square error of approximation = 0.038; CFI = comparative fit index = 0.989; TLI = Tucker-Lewis index = 0.984; SRMR = standardized root mean square residual = 0.018; Chi-squared test statistics (p-value) = 100.401 with 52 degrees of freedom (p-value = 0.000); R-square WTP component = 0.152; R-square place attachment component: 0.352.

The direct effect of user intensity on WTP is not significant when controlling for place attachment. However, as expected, we find significant indirect and total effects of user intensity on WTP. If user intensity increases by one visit day, place attachment will increase by 0.012 standard deviations, which causes WTP to increase by 1.2 percentage points indirectly. Thus, people with higher user intensity that sense a strong place attachment have a higher WTP. When we examine the socio-economic

variables, we find a significant income effect; people with an income above the average have higher WTP. This increases the construct validity of the results, as WTP is expected to increase with income (Bishop & Boyle, 2019). We find that women have higher WTP and WTP is higher among people with a university education. When we evaluate the model fit, we see the structural component of WTP to have a higher r-square value (0.152 in Table 6) when place attachment is included. Without place attachment, r-squared is reduced to 0.099 (see Table 5). We conclude that including place attachment improves the model fit.

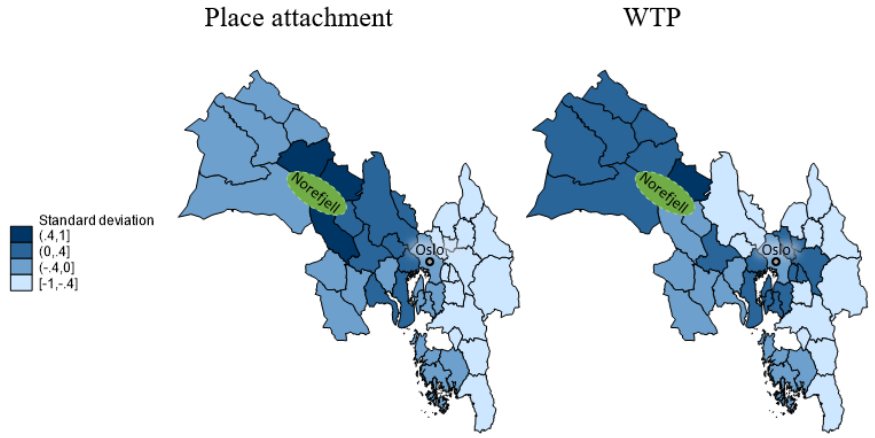


Figure 2 – a) Predicted place attachment for the Norefjell mountain area and b) willingness-to-pay (WTP) for small cabin development (instead of large) at the municipal level in Viken County and Oslo County. Average by municipalities. Municipalities with fewer than three respondents are grouped with neighboring municipalities with similar nature and industries.

Figure 2 displays two maps presenting the spatial distribution of predicted place attachment and WTP scores from the model in Table 6 by municipalities in Viken County and Oslo County. The maps indicate that respondents, on average, sense stronger place attachment and have higher WTP closer to the Norefjell area. The association between place attachment and distance is somewhat more substantial than the association between WTP and distance, partly due to clusters of higher WTP east and south of Oslo. The population in the wider Oslo area has higher average incomes, more education, and is more often female than the average citizen in Viken, all factors associated with higher WTP in our study, which could help explain the higher WTP in these areas.

5. Discussion

The first research question we introduce is whether travel time and place attachment to Norefjell affect people's preferences for the preferred development plan. The hypothesis is that less travel time and stronger place attachment increase the likelihood of choosing the S-development option, in line with the NIMBY effect. The results contradict this hypothesis. Firstly, without controlling for place attachment, we find that shorter travel time to Norefjell reduces respondents' likelihood of preferring the S-development option, which coincides with our hypothesis. Secondly, when we include place attachment, we find that respondents with stronger place attachment are less likely to prefer the S-development option. In the latter model, travel time has no direct effect on the likelihood of choosing S-development but a negative indirect effect through place attachment. Interestingly, we find that use intensity increases the likelihood of selecting the S-development directly, while a negative indirect effect of use intensity through place attachment cancels out the direct effect.

The negative effect of place attachment on the likelihood to prefer S-development could be perceived as the opposite effect of the place-related resistance to changes, known as the NIMBY-effect (Lewicka, 2011), which indicates that place attachment can also give rise to a reversed in-my-backyard (IMBY) effect. While the NIMBY-effect has been addressed as a selfish and irrational behavior (Lake, 1993), our results indicate that such type of opposition must be seen in the light of how people assess the market and non-market values. In this case, people who sense a strong place attachment seem to benefit more from market values than non-market values compared to other people and are more likely to accept developments in natural areas.

Most previous studies have found a positive relationship between place attachment and resistance to industrial developments in natural areas. In Norway, Vorkinn & Riese (2001) studied the attitudes toward developing a hydroelectric plant and found that the closer the threat, the stronger the relationship between place attachment and resistance to change. Tucker et al. (2006) found that individuals with stronger place identity, place dependence, and place attachment are more likely to undertake river protective behaviours in Australia. Devine-Wright & Howes (2010) studied residents' attitudes toward the planned construction of two hundred wind turbines in two small towns in Wales. Place attachment was correlated with the

NIMBY effect in the town associated with scenic beauty.[16] Dugstad et al. (2022) studied residents' preferences for a proposed rural land-based wind farm by conducting a discrete choice experiment. They found that place attachment increases the likelihood of choosing no wind farm (Devine-Wright, 2009). Our results contradict these previous findings.

An important dimension of place attachment is whether the attachment meanings are individually or collectively held (Scannel & Gifford, 2010). Suppose individual meanings based on personal recreational experiences in the Norefjell mountains are held. In that case, we should presumably expect place attachment to be negatively associated with the construction of several thousand extra recreational homes reducing the recreational quality of the area. Anticipation of reduced recreational quality might explain why users without place attachment to Norefjell are more inclined to choose S-development as their preferred alternative. On the other hand, if place attachment is collectively held with the Norefjell mountain as a shared symbol within the community, the community's shared interest in local economic development might dominate their interest in preserving the environmental good. Our results are comparable to Bonaiuto et al. (2002), who studied the attitudes of local and non-local residents towards establishing a new national park in Italy. They found that local residents had stronger place attachment and were significantly more negative towards preserving nature in the national park than non-local residents.

Our second research question is whether and to what extent distance decay in WTP among respondents who preferred S-development changes when we include place attachment into the model. The hypothesis is that place attachment increases the WTP and explains a substantial part of the effect of travel time on WTP. The results support the hypothesis in both models for WTP for S-development and M-development. Firstly, without including place attachment, we find that increased travel time to the Norefjell area has a negative nonlinear and diminishing effect on WTP for S-development, in line with expectations from the literature (e.g. Rolfe & Windle, 2012; Schaafsma et al., 2012; Schaafsma et al., 2013; Johnston et al., 2015; Olsen et al., 2020), and that use intensity significantly increases WTP. Secondly, when we include place attachment in the econometric model, we find place attachment to have a substantial positive effect on WTP for S-development. We also find that use intensity increases WTP solely indirectly through place attachment. Thirdly, and the most novel result and contribution in this study, we find, in line with the second

[16] In the other town, not perceived as scenic, there were no correlations between place attachment and NIMBY-effects (Devine-Wright & Howes, 2010).

hypothesis, that place attachment explains a substantial portion of the direct effect of travel time on WTP. Travel time has a direct, an indirect, and a total effect on WTP through respondents' place attachment. About 55 percent of the effect of one hour of travel time on WTP is indirectly channelled through reduced place attachment, while 45 percent of the total effect of one hour of travel time is the remaining direct effect on WTP.

The results imply that much of the observed distance decay in nonmarket values is explained by spatially diminishing place attachment to the Norefjell mountains. The results hold for both WTP for S-development and M-development and are generalizable to respondents who prefer reduced development.

As discussed in the Introduction, one explanation for the negative association between values and distance with a microeconomic foundation is the availability of substitutes (Pate & Loomis, 1997; Bateman & Langford, 1997; Glenk et al., 2020). However, as Glenk et al. (2020) pointed out, this has rarely been modelled formally. Instead, substitute availability has been used to explain distance decay on WTP. Interestingly, place attachment includes respondents' consideration of the functionality of Norefjell relative to substitute sites for recreation through place dependency. Users with stronger place dependency prefer the Norefjell mountain area to its substitutes for their recreational activities. In contrast, users with lower place dependency will consider available substitute sites as good or better alternatives. In essence, place dependency measures the subjective attractivity of Norefjell relative to substitute sites, and use of place attachment might reduce the need for the researcher to use other (objective) indicators of substitute availability and functionality, such as travel time to substitutes.

Place attachment is also a measure of respondents' affective bond to Norefjell through their place identity. Place identity captures the feelings related to the physical settings and symbolic connections that affect personal identities (Proshansky et al., 1983; Brown et al., 2015). Respondents with a stronger place identity to the Norefjell mountain have, perhaps due to use, childhood memories, or strong identification with the local community, developed a strong personal bond to the Norefjell area affecting their identities. Travel time to Norefjell helps predict stronger affective bonds to Norefjell, and stronger affective bonds to Norefjell predict increasing WTP towards preserving the mountain nature among respondents preferring S-development in Norefjell.

People who reside closer to Norefjell, without functional or emotional attachment to the mountain area, still value preserving the environment in Norefjell compared to similar people who reside further away. Interestingly, travel time to

Norefjell has significantly less effect on WTP for people without place attachment to the Norefjell mountains. The remaining distance decay effect on WTP, after controlling for use intensity, place attachment, and sociodemographic characteristics, might be explained by increasing travel costs to access the good, increasing information costs, and a decreasing moral obligation and feeling of responsibility towards preserving the nature there (Glenk et al., 2020).

6. Conclusion

We find the psychological concept of place attachment to refine our understanding of trade-offs between economic development and environmental goods and the spatial distribution of preferences towards environmental goods. A better understanding of the spatial dimension of the welfare distribution is important to inform the design of environmental policies. In economics, the decision-making process is modelled as consumers maximizing innate stable preferences according to quantities and attributes of the commodities. Within psychology, descriptions of the decision-making process are more complex, and attitudes, shaped by affection and motivation, play a major role in explaining preferences (McFadden, 2001). Environmental goods are valued using SP methods due to the absence of markets and the missing market information on preferences. The economist must try to understand unknown preferences, their underpinnings, and distribution. Applying the standard economic framework of the choice process seem to provide less information than the richer models of the choice process developed within environmental psychology.

More information on psychological aspects of the place, whether meanings are individually or collectively held, and cognitive factors such as memories, beliefs, and knowledge, could help improve our understanding of place attachment's effect on nonmarket values. Future SP research should also try to establish a generalizable association between place attachment and spatial heterogeneity in nonmarket values. It is important to point out that the identified relationship between place attachment and WTP in this study is limited to respondents who prefer reduced development and weigh the nonmarket benefits of reduced development over the loss of market impacts. If all respondents were asked to state their WTP for this respective plan, including the minority who prefer large development, the relationship would presumably be significantly weakened, perhaps also reversed. Thus, more research is warranted on the relationship between place attachment, WTP for environmental goods, and travel time. This would include research on what factors best predict

whether place attachment will lead to protests or acceptance towards economic development in natural surroundings, e.g., how people with place attachment assess the balance between market and non-market values.

Incorporating place attachment substantially improves the fit of our econometric model. As a result, incorporating place attachment could potentially improve the accuracy of benefit transfer exercises in land use appraisal (e.g., cost-benefit analysis), where a researcher transfers a value function from a study site to a policy site of a similar place-specific environmental good (Johnston et al., 2021). To conduct the value function transfer, the researcher must then gather information about place attachment on the policy site so that the mean score can be used in the value function, along with other covariates. Further, accurate cost-benefit analyses and benefit transfer exercises depend on deciding the correct extent-of-the-market and the correct mean WTP within that market, independent of political jurisdictions. Sampling place attachment at and around a policy site to spatially map place attachment could contribute to getting geographical information of the overall impacted population of people with familiarity and experience with the place-specific environmental good. Hence, along with improved accuracy of value function transfer, spatially mapping of place attachment could become a valuable tool in deciding the correct extent-of-the-market, particularly identifying an overall geographical area where people are familiar and care about a specific environmental good. At last, we also encourage SP researchers to use place dependency as a measure of the recreational functionality of a place relative to other places to further examine the spatial pattern of substitutes on WTP.

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Appendix

Table A.1. Place attachment on WTP to have medium development instead of large development

	WTP for S-development (unstandardized coef.)	Place Attachment (standardized coef.)
Structural components		
Place attachment	1.078*** (0.194)	
travel time	-0.559* (0.294)	-0.406*** (0.069)
travel time squared	0.221*** (0.079)	0.083*** (0.017)
user intensity	0.000 (0.004)	0.010*** (0.001)
Women	0.373* (0.207)	0.024*** (0.048)
age group 40 to 59	-0.611** (0.268)	0.065 (0.067)
age group 60 +	-0.319 (0.268)	0.121* (0.071)
high education (3 years or more university education)	0.271 (0.242)	-0.113 (0.057)
above mean income	0.704*** (0.232)	0.055* (0.052)
Indirect effects		
One hour increase in travel time	-0.258*** (0.060)	
user intensity	0.011*** (0.002)	
Total effects		
One hour increase in travel time	-0.376** (0.171)	
user intensity	0.011*** (0.003)	
Measurement components		
	Indicator variable	Standardized factor loading
Place dependency		
	pdep1	0.821*** (0.017)
	pdep2	0.850*** (0.018)
	pdep3	0.894*** (0.013)
Place identity		
	pid1	0.842*** (0.015)
	pid2	0.967*** (0.006)
	pid3	0.937*** (0.010)
Place attachment		
	Place dependency	0.906*** (0.022)
	Place identity	0.902*** (0.002)

Validity statistics	Place dependency	Place identity	Place attachment
Average standardized factor loading	0.855	0.915	0.904
Average variance extracted	0.732	0.841	0.818
Composite reliability	0.891	0.941	0.900
Observations	904	904	904

Notes: *p<0.10, **p<0.05, ***p<0.01. Standard errors (SE) are given in brackets. RMSEA = root mean square error of approximation = 0.028; CFI = comparative fit index = 0.993; TLI = Tucker-Lewis index = 0.990; SRMR = standardized root mean square residual = 0.017; Chi-squared test statistics (p-value) = 87.553 with 52 degrees of freedom (p-value = 0.001); R-square WTP component = 0.098; R-square place attachment component: 0.297.

Paper IV

Altruist Talk May (also) Be Cheap: Revealed Versus Stated Altruism as a Predictor in Stated Preference Studies

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Abstract

Altruistic preferences have been found to be important for explaining the substantial nonuse values identified in numerous stated preference surveys. However, studies analysing the effect of altruism on willingness to pay (WTP) have underestimated the challenges of measuring altruism by stated measures. We exploit a naturally occurring decision domain to investigate the role of altruism in stated preference studies. We employ a novel dataset, collected from an Internet survey panel, that contains respondents' past donations of earned survey coins to charities and use these data to analyse the effect of donation behaviour on the same respondents' WTP. We analyse donation behaviour across two contingent valuation surveys on environmental topics. Donators are proven givers in an anonymous and unrelated setting, much like decision-making in a dictator game. We find that respondents' past donations are associated with higher WTP, even after controlling for stated measures of altruism, ecological, and environmental attitudes. The results suggest that measures of stated altruism fail to capture important aspects of altruism, implying that previous studies of altruism based on such measures may be questioned. The results also support research demonstrating that altruistic behaviour in one decision domain is a good predictor of altruistic behaviour in other domains.

JEL classification: Q51, Q57
Keywords: prosocial behaviour, altruism, contingent valuation, donations, willingness to pay

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Altruist Talk May (also) Be Cheap: Revealed Versus Stated Altruism as a Predictor in Stated Preference Studies

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Abstract
Altruistic preferences have been found to be important for explaining the substantial non-use values identified in numerous stated preference surveys. However, studies analysing the effect of altruism on willingness to pay (WTP) have underestimated the challenges of measuring altruism by stated measures. We exploit a naturally occurring decision domain to investigate the role of altruism in stated preference studies. We employ a novel dataset, collected from an Internet survey panel, that contains respondents' past donations of earned survey coins to charities and use these data to analyse the effect of donation behaviour on the same respondents' WTP. We analyse donation behaviour across two contingent valuation surveys on environmental topics. Donators are proven givers in an anonymous and unrelated setting, much like decision-making in a dictator game. We find that respondents' past donations are associated with higher WTP, even after controlling for *stated* measures of altruism, ecological, and environmental attitudes. The results suggest that measures of stated altruism fail to capture important aspects of altruism, implying that previous studies of altruism based on such measures may be questioned. The results also support research demonstrating that altruistic behaviour in one decision domain is a good predictor of altruistic behaviour in other domains.

Keywords Prosocial behaviour · Altruism · Contingent valuation · Donations · Willingness to pay

1 Introduction

Altruistic preferences shape prosocial behaviour across several decision domains and affect market outcomes, donations to charities, volunteering time, and elections (Bolsen et al. 2014; De Oliveira et al. 2011). Understanding such preferences have proved to be highly important in environmental economics for valid and reliable non-market valuation

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of environmental goods (e.g., McConnell 1997; Carson et al. 2001) and for the design of more effective or acceptable policy instruments (Svenningsen and Thorsen 2020; Dasgupta et al. 2016; Gsottbauer and Van den Bergh 2011; Menges et al. 2005).[1] By prosocial behaviour, we mean people's actions that benefit others or society and are motivated by people's social preferences, such as altruism and reciprocity.[2] Altruism may motivate people to donate money to charities or to help known and unknown people in any manner. Although prosocial behaviour alleviates collective action problems in real life, altruistic preferences have led to theoretical and practical difficulties in welfare economics and cost–benefit analysis (Bergstrom and Cornes 1983; Flores 2002; Bergstrom 2006; Binder 2020).

People value environmental goods for different reasons, including altruism toward others and future generations. Stated preference (SP) methods (contingent valuation (CV) and choice experiments (CE)) are the only methods that can capture both use and non-use values associated with changes in environmental goods for cost–benefit analysis. Kahneman and Knetsch (1992) questioned the use of such estimates in cost–benefit analysis and argued that CV studies invited to a "purchase of moral satisfaction" leading to scope insensitivity.[3] In a recent review of warm glow in CV, Bishop (2018) argues that such values should be included in the willingness to pay (WTP) estimates from CV studies and points to that there has been little evidence of warm glow being the source of validity issues.[4] We argue that if people receive a warm glow when stating WTP taxes in the CV survey context, while they do not receive a corresponding warm glow when in fact paying the taxes, CV estimates might be biased.[5]

Since altruism is an essential factor when explaining substantial non-use values (Bouma and Koetse 2019), altruism is also important for policy decisions based on cost–benefit analyses that use CV estimates. Research to date has analysed the effect of (stated) altruism on WTP and hypothetical bias, focusing on the validity and reliability of the WTP measure, while the validity of the self-reported altruism measures applied has not been investigated in CV studies to our knowledge. This paper investigates altruistic preferences motivating prosocial behaviour across decision domains. We utilise novel data on Internet panel survey respondents' past donation behaviour as an indicator of altruistic preferences when analysing WTP for environmental goods in two separate CV surveys. For one of the

[1] This is also an important topic in valuation of environmental health risks and design of health policies (e.g. Jacobsson et al. 2007; Dickie and Gerking 2007).

[2] Reciprocal preference is when individuals want to respond to actions perceived to be kind in a kind manner and to actions perceived to be hostile in a hostile manner (Fehr and Schmidt 2006). Reciprocity promotes social norms, by encouraging hard-working colleagues or sanctioning free riders (Czajkowski et al. 2017).

[3] Sensitivity to scope in nonmarket valuation refers to the property that people are willing to pay more for a higher quality or quantity of a nonmarket public good (see e.g., Dugstad et al. 2021).

[4] Andreoni (1989) terms prosocial behaviour entirely motivated by the concern for others as pure altruism, prosocial behaviour entirely motivated from *the warm glow* of giving pure egoism, while prosocial behaviour motivated by both altruism and egoism, he terms impure altruism. In Andreoni's framework, warm glow reflects the utility a consumer gains from personally donating toward a public good (Bishop 2018).

[5] Whether or not to include altruistic preferences in cost–benefit analysis at all has been discussed in welfare economics (Flores 2002). Bergstrom and Cornes (1983) argue that cost–benefit analysis should only take self-regarding egoistic preferences into account. The sympathetic gains each person obtains from other's enjoyment of shared public goods should be balanced out by the sympathetic losses each bears from the share of its cost paid by the others (Bergstrom 2006). Flores (2002) showed that for larger discrete changes in public goods, efficient policies depend on the distribution of benefits and costs, and one must therefore take prosocial preferences into account.

surveys, we also elicit respondents' altruistic, ecological, and environmental attitudes and compare the effect of stated altruism and actual past donations on respondent WTP.

Our measure of altruistic prosocial behaviour captures both pure altruistic motives and partly warm glow of giving following the framework of Andreoni (1989). The measure captures warm glow motivated by self-signalling and should be independent of other confounding motives such as warm glow motivated by signalling towards others, often termed social desirability bias, and reciprocity. Donating respondents in our study first earned their money by answering surveys and then made an impersonal and anonymous donation decision, which suggest altruism or warm glow are motivating them.

We examine the association between individuals' past donations of their survey coins and the stated WTP at the extensive and intensive margin in two (unrelated) CV surveys with different respondents: (1) coastal ecosystem service protection from oil spill damages, and (2) impacts of climate forest planting. The data sets from both surveys are merged with data on each respondent's past donations of earned survey coins from the survey company.

The remainder of this paper proceeds as follows. Section 2 provides a literature background, the conceptual framework, and hypotheses. Sections 3 and 4 present the study design and empirical results. Section 5 discusses the results and concludes.

2 Literature, Conceptual Background, and Hypotheses

2.1 Literature Background

Validity of the SP methods has been criticised for various reasons including the handling of altruistic preferences related to non-use values. As mentioned, Kahneman and Knetsch (1992) argue that CV studies invite a "purchase of moral satisfaction", causing scope insensitivity and embedding effects. Chilton and Hutchinson (2000) show that the warm glow motive may be present in most respondents' WTP but that this may not imply scope insensitivity. Moreover, Johansson-Stenman and Svedsäter (2012) develop and test a model where people derive utility from a positive self-image and self-honesty and find that people overstate their WTP for goods with a perceived ethical dimension to uphold a positive self-image. Along similar lines, Entem et al. (2021) and Svenningsen and Jacobsen (2018) find that people overstate their WTP for public goods with moral components.

Bishop (2018) claims that there should not be warm glow effects in CV studies since respondents typically are asked for their willingness to pay taxes and not for their willingness to donate. Bishop (2018) contends that a bias might occur if the payment vehicle in a CV study is designed differently from how payments actually would have been made. But this would be a payment vehicle bias due to survey design issues and not a problem relating to warm glow.

Several other studies point out that respondents' warm glow feelings from stating high WTP bias results if such motivations are context specific and not transferable from the survey context to the policy context (Entem et al. 2021; Johansson-Stenman and Svedsäter 2012; Lusk and Norwood 2009; Chilton and Hutchinson 2000). Entem et al. (2021) argue that respondents' altruistic preferences and social desirability bias can contribute to

hypothetical bias, even in incentive-compatible SP surveys.[6] Warm glow feelings can be interpreted as an intrinsic self-image gain derived from contributing to the public good (Daube and Ulph 2016). Psychological research has found observable physiological and psychological benefits of self-signalling by people doing "the right thing". They are rewarded by a release of neurotransmitters increasing their body heat and experience a physical warm glow sensation (Van der Linden 2015). Eckel et al. (2005) find no warm glow effects of paying taxes to support charity in a laboratory experiment. Thus, if answering with higher WTP in SP releases neurotransmitters while paying the corresponding tax do not, warm glow in SP surveys might bias results.

To analyse altruism in a study unrelated to SP, Ekström (2018) utilises reverse vending machine donation data. When customers recycle their cans and bottles, they can choose whether to keep the money or donate it to a charity. Ekström (2018) points to several reasons for why this decision situation is suitable for use in studying altruistic preferences: monetary incentives for donations are absent, there is no reciprocal motivation between the donator and the charity, and solicitation is typically impersonal and anonymous. We analyse altruism using data from a similar decision situation: a survey company's data on enrolled Internet panel respondents' donations of coins earned through taking part in surveys to charities. By answering questions in regular online surveys, respondents earn coins they may use freely on either private goods or donations to charities in an online shop. As in Ekström (2018), the decision involves an anonymous and impersonal choice between self and others with no expectation of monetary or nonmonetary compensation in return.

The decision setting resembles the nonstrategic decision setting in dictator games.[7] Anonymous pay-off maximising respondents are expected to keep the whole endowment for themselves (Franzen and Pointner 2012) but observed behaviour in laboratory experiments rejects this expectation; most subjects exhibit prosocial behaviours.[8] Bekkers (2007) compares decisions regarding the donation of survey coins to dictator games and confirms close similarities in results and donator characteristics. About 6% of the survey respondents donated their money, and donations increased with age, education, income, trust, and prosocial value orientation as found in dictator games (Bekkers 2007). Experiments indicate that subjects are less inclined to donate when they first earn their endowments through tasks and when anonymity is convincingly implemented (Franzen and Pointner 2012).

Carpenter (2018) finds the self-reported altruism measures used in the literature to have varying predictive power. Although several studies have verified that self-reported altruism is an important determinant of WTP in CV studies (Nunes and Schokkaert 2003; Clark and Friesen 2008; Nunes et al. 2009; Nielsen and Kjær 2011; Kotchen 2015; Ma and Burton 2016; Bouma and Koetse 2019), all former studies of altruism, to our knowledge, use Likert scale survey statements in their attempts to capture aspects of altruism.[9] Such altruistic

[6] Hypothetical bias problems have led to several important methodological developments and updated guidelines (Johnston et al. 2017; Kling et al. 2012).

[7] The dictator game is a one-shot decision game in which an endowment is assigned to one of two players, and the dictator distributes the amount between them, while the recipient must simply accept the allocation.

[8] Engel (2011) conducts a meta-study and finds that about 63% of dictators allocate some coins to the recipients and that 28% of total coins are allocated to the recipients, while 72% is kept by the dictator. The proportion of coins allocated depends on various conditions. For example, donations are reduced when dictator endowment is earned through tasks, the dictators' age increases donations and deserving recipients receive more donations (Engel 2011).

[9] For example, statements such as "There are some funding campaigns to which my family and I feel very close and therefore we do not hesitate to contribute a donation" or "It is difficult for me to decline my help

statements may capture certain altruistic preferences (Hartmann et al. 2017), but the measures could be biased and blurred by idealised personality bias[10] or social desirability bias (Carpenter 2002). Carpenter and Myers (2010) argue that the incentivised dictator game is the best indicator of altruism. Others, such as Falk et al. (2016) and Carpenter (2018), employ the incentivised dictator game with a charitable organisation as the recipient as the standard for developing and testing altruism survey questions.

Individuals' altruistic behaviour across decision domains have previously been studied through comparisons of laboratory and field experiments (Franzen and Pointner 2013; De Oliveira et al. 2011; Carpenter and Myers 2010; Galizzi and Navarro-Martinez 2019; Landry et al. 2010; Yeomans and Al-Ubaydli 2018), while Bolsen et al. (2014) examine prosocial behaviour across two field settings, comparing voter turnout and water saving during drought. De Oliveira et al. (2011) identify "giving types" through an experiment where participants can donate to multiple charitable organisations and find that individuals who give to one organisation donate significantly more to other (unrelated) organisations as well. They discover that giving decisions are not explained by observable individual characteristics but by latent preferences for donating. Others find a lack of correspondence in behaviour across different settings. For example, Galizzi and Navarro-Martinez (2019) do not find persistent altruistic behaviours across social preference games, field situations related to giving money and helping others, and self-reported measures of altruistic tendencies shown in the past.

2.2 Conceptual Framework and Hypotheses

Following Lusk and Norwood (2009) and Carlsson et al. (2018), we assume an indirect utility function that is additively separable into consumption and altruistic preferences:

$$U = v(G, M) + I\left(v^{-i}\left(G, M^{-i}\right), g\right), \tag{1}$$

where v represents an indirect utility function of a public good G and income M. The second part $I(\bullet)$, is an altruistic component of the utility function, depending on altruistic preferences for others' utility v^{-i} as a function of the public good G and others' income M^{-i}, and warm-glow utility arising from contributing g. We assume positive and diminishing marginal utility, and derive the marginal WTP for an exogenous change in the public good as follows:

$$MWTP = \frac{\frac{\partial U}{\partial G}}{\frac{\partial U}{\partial M}} = \frac{\frac{\partial v}{\partial G} + \frac{\partial I}{\partial v^{-i}}\frac{\partial v^{-i}}{\partial G}}{\frac{\partial v}{\partial M}} \tag{2}$$

If $\frac{\partial v}{\partial G} > 0$ the individual gets utility from the public good. If $\frac{\partial I}{\partial v^{-i}} > 0$ the individual gets utility from others' utility, which is like pure altruism in Andreoni's (1989) framework. If $\frac{\partial I}{\partial g} > 0$, the individual gets utility by paying for the public good per se, much like the warm glow of giving in Andreoni's (1989) framework.

Footnote 9 (continued)

to other individuals who, either in the streets or at my door, beg for charity". Examples are taken from Nunes and Schokkaert (2003).

[10] Respondents reporting how they want to perceive themselves.

Our first hypothesis is that past donations predict higher stated WTP in CV surveys when controlling for individual characteristics. This hypothesis implies that a "giving type"-respondent has higher WTP for environmental goods across the two CV surveys than a respondent that is not of the "giving-type". We expect a respondent's past donations to predict an increased propensity to state a positive WTP (the extensive margin) compared to non-donating respondents. We also expect a higher predicted mean WTP (the intensive margin) of respondents who have donated their survey coins in the past than respondents who have not made such donations. We further test whether past donations are associated with scope insensitivity.

Our second hypothesis is that past donations are significantly and positively associated with WTP even when controlling for self-reported altruism and other attitudes and individual characteristics. Support for this hypothesis implies uncovering new information on the role and importance of altruism not picked up by self-reported altruism measures in SP surveys.

3 The Data

Data were collected in two CV surveys, which both were coupled with information on how individual respondents spent their earned survey coins. We first present the donation data across the two surveys and then describe each of the two valuation surveys.

3.1 The Donation Data

The data on survey points earned, historical survey coin spending behaviour and Internet panel background information were made available from a reputable Norwegian survey company. The system for awarding and spending survey coins has evolved within the survey industry. Within the survey company's system, a minute of stipulated time spent answering surveys is typically awarded NOK 1 (equal to about 0.1 euros). Respondents can normally spend the money whenever they want (from the first coin earned) in an online shop that offers different private consumption options or donations to various types of charitable organisations.

In the first survey on protection from oil spill damages (Study 1), there were limitations due to confidentiality rules, and we were only given summary data for each respondent on the overall use of survey coins throughout the panel membership and the option the respondent had chosen most frequently. The categories they could spend their coins were private consumption in the form of gift cards (typically used for private consumption), cinema tickets or lottery tickets, or various types of donations termed "general" or for a specific voluntary organisation conducting various community tasks free of charge (e.g., supporting the elderly). The oil spill study contained 4846 respondents who completed the survey answering the CV payment card question. For a significant share of the respondents (38%), we have no data because they had not yet spent their survey coins at the time of the CV survey. These respondents were, therefore, removed from the sample, leaving 2461 unique respondents of whom 12% donated their coins to a charity of some kind.[11]

[11] We have run the models presented in this paper coding respondents without data on the spending decision as non-donators. The results are not sensitive to removing these respondents.

In the second survey on the impacts of climate forest planting (Study 2), we have data on respondents' use of survey money during a period of five years (2014 to 2018). Respondents spent their coins in a survey shop similar to the one described above, which offered a range of products and gift cards or donated their coins to various types of charities. Our dataset contained 731 respondents who had completed the survey answering our CV payment card question.[12] Of these, 615 respondents had spent the coins obtained by the survey company, while we have no data on the remaining 116 respondents because by the time of the CV survey, they had not yet spent their survey coins. About 13% of the 615 respondents donated their coins to a charity at least once. The shares of donating survey respondents are higher than in Bekkers (2007), which explores decisions concerning donation of earned survey coins and finds that 6% of respondents chose to donate their earnings to charities in their panel. The difference is explained by the fact that each respondent in our datasets made several spending decisions. About 8% of all spending decisions in the Study 2 dataset were donations.

See Tables 1 and 2 for an overview of our spending decision data sets.

Table 1 shows the number of donators among our respondents in studies 1 and 2. In Study 1, we only know whether the respondent chose predominantly to donate during her or his panel membership. In Study 2, we have more information on the donations made by

Table 1 Descriptive statistics of donations made by respondents

	Donated (at least once)	Percent donators of respondents (%)	Total respondents
Study 1—Oil spill	289	12.0	2461
Study 2—Land use	78	12.7	615

Table 2 Descriptive statistics of donations made by respondents in Study 2—Land use

	Times donated	Number of respondents	Number of spending decisions (mean)	Share of coins donated (mean) (%)
Non-donators	0	537	2.94	0
Donators	1	44	2.29	42.9
	2	15	2.4	77.0
	3	11	3.27	81.5
	4	3	4.33	93.3
	5	5	5	96.8

[12] We removed 120 protest answers. Removed answers are respondents that believe tax levels are already high enough, believe it is not right to trade-off nature and money and will not pay before price is known. The removal of their responses does not affect our chosen measures. We also removed 160 responses where people answer "Don't know" to the WTP question. Removing these respondents do not change the distribution of past donations.

Table 3 Descriptive statistics of respondent characteristics in the data sets

	Donating respondents		Not donating respondents		Difference in means between groups
	Mean	N	Mean	N	
Study 1—Oil spill protection					
Age	49.9	289	44.5	2127	5.04***
Male	43%	289	49%	2127	−6%*
Married	67%	284	64%	2107	−3%
Household size	2.39	289	2.45	2113	−0.06
Higher education	59%	289	58%	2127	1%
Household income	737,644	289	689,882	2127	47,762*
Study 2—Climate forest impacts					
Age	58.8	78	53.5	537	5.37**
Male	46%	78	50%	537	−4%
Married	50%	78	51%	537	−1%
Household size	2.08	78	2.31	537	−0.23
Higher education	65%	78	66%	537	−1%
Household income	700,256	62	745,982	448	−45,982
Interested in					
Charitable work	56%	78	36%	537	20%***
History and culture	58%	78	53%	537	5%
Food and wine	51%	78	56%	537	−5%
Politics	51%	78	51%	537	0%
Economy	31%	78	48%	537	−17%**
Outdoor recreation	33%	78	36%	537	−3%

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. Two sample t-test with unequal variances. Higher education is defined as holding a Bachelor's, Masters' or PhD degree

the respondents. Unfortunately, the survey company was not able to release details on how much the respondents donated, both individually and in total.[13]

As shown in Table 2, most donators (44 out of 78) only donated once before participating in Study 2, while they had made 2.29 spending decisions on average. This implies that many of these respondents had donated once and spent their coins on private consumption on another occasion. Respondents who donated once donated an average of 42.9% of their total survey coins throughout the last five years of their panel membership. On average, the more often the respondent donated coins, the higher the overall share of coins donated. Respondents donating 5 out of 5 times, donated 96.8% of their overall coins in that period. 33 out of 78 respondents had donated all their coins, with 14 respondents donating all their coins on one single occasion, without making any additional spending decisions, while 20 respondents donated all their coins more than once.

[13] We know that about 100,000 respondents in the survey panel donated a total of 1.7 million NOK in 2020. If about 7.5% of the respondents donated that year each, on average about 225 NOK (1NOK0.1EUR) was donated per donator.

In a meta-study of donation decisions in dictator games, Engel (2011) finds that older people often donate more than others, students donate less, while women donate more. The respondents who donated at least once in our data set are significantly older than other respondents, but do not differ much in terms of gender, household type and size, and education level. Table 3 describes the socio-demographic characteristics of donating and non-donating respondents.

The differences in socio-demographic characteristics between donating and non-donating respondents across the two studies are relatively small. Age is the only consistent and substantial difference between the groups, with donating respondents in both studies on average about five years older than other respondents.

We find larger differences when comparing the stated interests between groups in Study 2. Donating respondents are significantly more interested in charitable work and significantly less interested in the economy than the non-donators. An interest in charitable work may indicate that donators are more interested in prosocial behaviour than other respondents. Similarly, less interest in the economy may indicate less interest in business, consumption, and money, and might imply a lower marginal utility of money among donating respondents. We also note that donating respondents have about the same interest in politics as other respondents.

3.2 CV Survey on Protection of Coastal Ecosystem Services from Damage Due to Oil Spills

The topic of the first CV survey was people's WTP to avoid environmental damage due to oil spills at four different sites along the Norwegian coast. The survey, conducted in 2013, built on experiences from previous CV surveys of major marine oil spills; especially that of Carson et al. (2003) on the Exxon Valdez oil spill in Alaska (which formed the basis for much of the methodological discussion of CV that followed[14]) and that of Loureiro et al. (2009) of the Prestige oil spill in Spain in 2002. The aim was to establish a set of unit values for a range of types of damage to ecosystem services due to oil spills for use in a cost–benefit analysis of measures conducted by the Norwegian Coastal Administration for preventing oil spills from ships (details of the survey design and process are given in Navrud et al. (2017)).

After thorough testing in focus groups, one-to-one interviews and piloting, the survey was conducted with random sampling of respondents from the survey company's pre-recruited, high-quality Internet panel for three regional samples and for one national sample (asked about damages outside Lofoten Islands, a nationally important site). We obtained a sample of 4846 complete responses, with a response rate of ca. 18–20% across the subsamples.

Each respondent received four CV scenarios (from small to very large losses of coastal ecosystem services), where preventive measures could avoid all damage due to oil spills for the next few years and leave the environment in the present condition (Fig. 1). Four categories of damage were described: harm to birds, harm to seals, damage to the coastal zone and harm to other marine life. Damage was assessed using expert knowledge, and the

[14] The result of which was a set of guidelines for CV studies by the National Oceanic and Atmospheric Administration's so-called Blue Ribbon Panel on contingent valuation (Arrow et al. 1993).

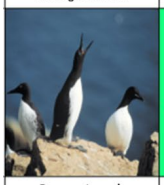
	With measures	Without measures			
	Present conditions	**Small loss**	**Medium loss**	**Large loss**	**Very large loss**
Damage to birds					
	The area is an important breeding, migration and wintering ground for seabirds. The bird populations are in good condition.	The bird populations are in good condition. In total **1000** dead birds	The bird populations recover after **1** year In total **7 500** dead birds	The population of common eider is locally endangered. Other bird populations recover after **2** years In total **20 000** dead birds	The common eider and common murre populations are locally endangered. Other bird populations recover after **4** years. In total **50 000** dead birds
Damage to seals					
	Parts of the area are important to seals. The seal population is in good condition	The seal population is in good condition In total **10** dead seals	The seal population is in good condition In total **40** dead seals	The population of harbor seal recovers after 2 years In total **150** dead seals	The population of harbor seal is locally endangered In total **300** dead seals
Damage to coastal zone					
	The area is very important for recreation and outdoor life The area has a large cold-water coral reef, rich marine eelgrass meadows and a valuable natural environment	**5** km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after **6** months	**30** km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after **1** year	**150** km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after **3** years	**400** km of coastal zone consisting of *bare rock shores and beaches* soiled with oil Affects land and water based outdoor life Affected areas can be used as normal after **5** years
Damage to other marine life					
	Fish and shellfish in the area	Can be harvested as before. Safe to eat seafood Spawning areas for fish are unaffected	Can be harvested as before. Safe to eat seafood after **1** year Spawning areas for fish are unaffected	Fish, shellfish, mussels and seaweed should not be eaten until **3** years after the spill Spawning areas for fish are unaffected	Fish, shellfish, mussels and seaweed should not be eaten until **5** years after the spill Spawning areas for fish are unaffected

Fig. 1 Damage/loss table used in the Contingent Valuation (CV) survey to describe four different environmental loss levels for an oil spill (example from the Oslo fjord area)

descriptions were slightly different for each of the four oil spill sites included (two on the west coast, one in the Oslo fjord and one off the iconic Lofoten Islands in the north).

Validity checks common in CV studies confirmed rational, valid responses (e.g., clear sensitivity of WTP with higher damage levels). The subsamples were representative of the regional/national population with regards to selected socio-demographic characteristics (i.e., age, gender and education level).

After a typical CV survey build-up with information, knowledge and warm-up questions, respondents were presented with the damage table and asked what their maximum household WTP an annual tax would be for a ten-year period to avoid each of the damage levels in turn. The environmental situations with and without preventive measures were shown for pairwise comparisons, and the remaining columns faded out. A horizontal payment card slider was used for each damage level. There were 23 amounts on the scale, ranging from NOK 0 to NOK 15,000, including an option to specify the exact amount if it was more than NOK 15,000, and "Don't know".

3.3 CV Survey of the Effects of Planting Forest to Mitigate the Impact of Climate Change

The topic of the second CV survey, conducted in 2019, was land use options for abandoned on- and off-farm pastures in Norway. In recent decades, 8500 km^2 of semi-natural pastures have been abandoned, of which 1350 km^2 have quite recently been abandoned and have not yet become forested. These pastures are now undergoing natural reforestation with mixed forest. The government is considering planting forests (spruce plantations) on these pastures. The forests would sequester carbon but would also reduce biodiversity and change the landscape aesthetics. We designed a survey to elicit people's preferences for carbon-sequestering forests and other land use options, based on a qualitative study using Q-methodology and a large pilot survey.[15] It was clear from these studies that the main concerns regarding land use other than cost were combinations of land use aesthetics, biodiversity and carbon sequestration. The survey was conducted by the same professional survey firm as the oil spill survey. We obtained a sample of 731 complete responses. Following the standard introductory CV section containing general information, data and warm-up questions, respondents were presented with textual and visual information regarding the effects of different land-use options on landscape aesthetics, biodiversity[16] and carbon sequestration. The effects were evaluated using the official report on the Climate forest pilot program and expert knowledge of carbon sequestration and biodiversity (Norwegian Environmental Agency 2013; Henriksen and Hilmo 2015a, 2015b). Respondents were informed that management of the abandoned pastures would be costly for the government, while leaving the areas for natural reforestation with mixed forest would not entail any cost.

The CV scenario, which had a mix of 25% pasture, 25% spruce forest and 50% naturally reforested areas with mixed forests are presented in the Fig. 2.

As can be seen from the figure, icons and textual information were used to indicate the shares of land used for pasture, climate forest and mixed forest regrowth (top row), and the resulting biodiversity and carbon sequestration effects (rows two and three). Respondents were informed that anything other than the current situation, in which the abandoned pastures are becoming naturally reforested, would require active management, at a cost that would have to be paid by an *annual* earmarked income tax levied on all Norwegian households. People were then asked about their household WTP, indicated on a payment card consisting of 11 amounts from NOK 0 to NOK 3840, including an option to specify the exact amount if "More than 3840" and a "Don't know" option.[17] A horizontal payment card slider was used, as in Study 1.

After the WTP questions, respondents were asked to self-report on altruistic preferences, and ecological, and environmental attitudes in fifteen Likert scale statements. We collected statements on altruism (ALT), on ecological attitudes from the nature relatedness

[15] The Q-method provides the foundation for a systematic study of subjectivity in discourse analysis. It reveals perspectives in a debate using a by-person factor analysis to identify groups of people with similar perspectives (Grimsrud et al. 2020).

[16] Biodiversity was described in terms of (vascular) plants such as flowers, herbs, and grasses, as well as insect species.

[17] Both the amounts used in the bid vector and the attribute levels in the CV scenario were harmonised with a choice experiment survey, not analysed here, explaining the constant carbon sequestration in measure A.

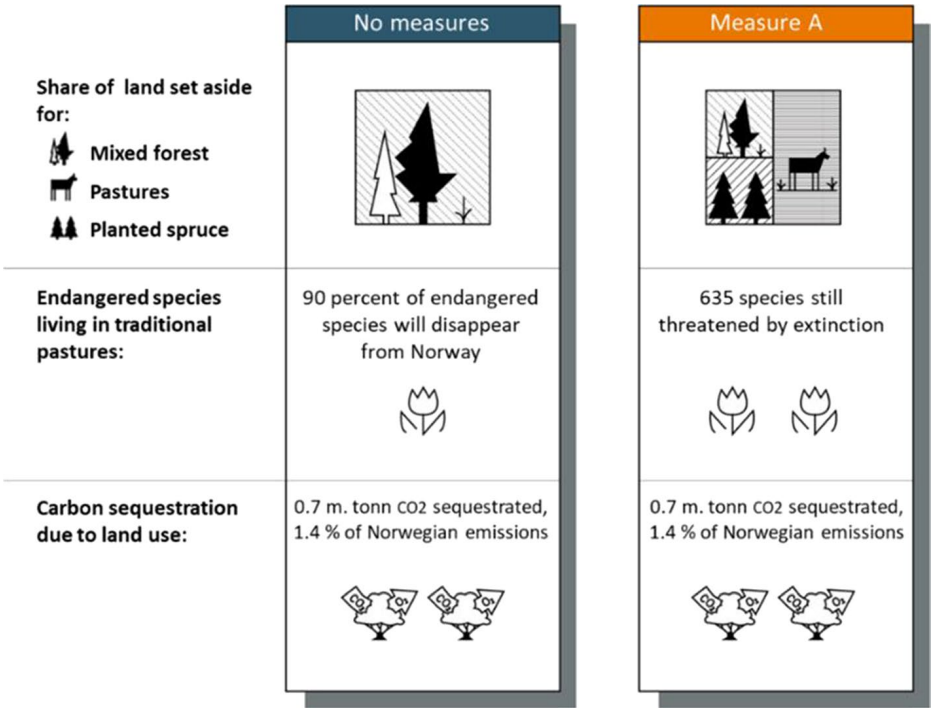


Fig. 2 Example of presentation of policy alternatives evaluated by respondents in the climate forest study

(NR) scale and on environmental attitudes from the new environmental paradigm (NEP) scale. The questions on respondents' self-reported altruism were as follows:

1. It is important for me to "be there" for friends, family, and community
2. I am willing to share with others without expecting anything back
3. I am generally a person who thinks mostly about myself

Our statements on altruism are gathered taken from the German Socio-Economic Panel study (Dur and Zoutenbier 2015; Falk et al. 2016). The first statement measures a general altruistic attitude, the second statement is related to donation behaviour, while the last statement captures general egoistic attitudes.

We drew upon seven statements from the NR scale to measure ecological attitudes through cognitive, affective, and experiential connections with the natural environment. The NR scale measures contact with nature and the personality construct of subjective connection with nature and is found to predict sustainable attitudes and behaviours (Zelenski and Nisbet 2014). The NEP scale (Dunlap et al. 2000) is much used in survey research, for instance on perceptions and response to climate change (Whitmarsh 2008). We use the Whitmarsh (2008) shortened version of Dunlap's original NEP scale. Whitmarsh (2008) evaluated the shortened scale through principal components analysis and found it to be reliable for measuring environmental consciousness (Whitmarsh 2008). Table 7 in Appendix 1 presents the questions and the distribution of answers.

4 Results

4.1 Donating Respondents' Willingness to Pay Across Two CV Surveys

We start by testing our first hypothesis that past donations predict higher stated WTP across CV surveys at the extensive and intensive margin when we control for individual characteristics. Correlations between donation behaviour in a different decision context and WTP in CV surveys could be explained by both an increased likelihood of donator respondents stating a positive WTP (the extensive margin), and by donating respondents having a higher stated WTP (the intensive margin).

To examine whether the donators are more inclined to state a positive WTP, we estimated probit models where the independent variable was equal to one for those who had a positive WTP and otherwise zero.

In Study 1 on oil spills, respondents were asked for their WTP to implement measures for avoiding small, medium, large, and very large oil spills. To utilise the four WTP questions per respondent as a panel dataset, we applied random effects probit and random effects interval regression models. We used "small oil spill" as the baseline category and included dummies for medium (M), large (L), and very large (XL) oil spills. We also interacted the donation dummy with the dummies for medium, large, and very large oil spills to check for scope sensitivity among donators and non-donators. In Study 2, we utilised the richer dataset on donations and ran three regressions of donations on WTP. We included a dummy on donating respondents to analyse WTP at the intensive and the extensive margin. Further, we analysed the effect of the number of donations on WTP and analysed the share of credits donated on WTP. We included a control variable for the number of spending decisions the respondents have made during the five-year period across the four models on the Study 2 data. We had only one WTP question available for analysis and therefore applied the probit and interval regression models. We included socio-demographic controls (income, age, gender, married and number of children). To account for non-normal distributions in WTP the dependent variable was set as the natural logarithm of the end-points of the respondents' WTP interval. Table 4 presents the regression results.

The results partially confirm our first hypothesis that past donations predict higher stated WTPs in CV surveys when we control for individual characteristics. The probit models indicate that respondents who have donated to a charity at least once are not significantly more inclined to state a positive WTP than other respondents.[18] Thus, past donations seem to have little effect on WTP at the extensive margin. On the other hand, past donations seem to have a substantial and significant effect on WTP at the intensive margin. The interval regression models indicate that respondents who have donated to a charity at least once and have positive WTP, are stating a significantly higher WTP than other respondents. The estimated coefficients on *Donated* of 0.40 and 0.89 in Table 4 imply that these respondents state about 50% and 140% higher WTP than other respondents when controlling for sociodemographic variables.[19] We do not find any sign of scope insensitivity among donators, both non-donators and donators significantly increase their WTP when the size of the

[18] We also ran probit models using Number of donations made and Share of credits donated on probability on Pr(WTP > 0) with very similar insignificant results as when using Donated (once or more).

[19] In a log-linear model the dummy coefficient must be transfomed to get the percentage impact on the dependent variable. In this case, the transformations of the dummy variable coefficients when going from zero to one are as follows: $\exp(0.40)-1=49\%$ and $\exp(0.89)-1=143\%$.

Table 4 Estimation results. Factors explaining positive WTP and log WTP

Dependent variable (regression model)	Study 1 Oil spill protection		Study 2 Climate forest impacts			
	Pr (WTP > 0) (Random probit)	WTP (> 0) (Random interval)	Pr (WTP > 0) (Probit)	WTP (> 0) (Interval)	WTP (> 0) (Interval)	WTP (> 0) (Interval)
Donated (once or more)	0.83	0.40***	−0.07	0.89***		
	(0.56)	(0.09)	(0.22)	(0.18)		
Number of donations					0.39***	
					(0.07)	
Share of credits donated						1.00***
						(0.20)
Number of spending decisions			−0.02	−0.03	−0.05	−0.03
			(0.05)	(0.04)	(0.04)	(0.04)
Medium loss	0.28	0.23***				
	(0.21)	(0.02)				
Large loss	0.52**	0.53***				
	(0.23)	(0.02)				
Very large loss	0.64***	0.75***				
	(0.24)	(0.02)				
M*Donated	−0.12	−0.01				
	(0.78)	(0.04)				
L*Donated	0.39	−0.03				
	(1.02)	(0.04)				
XL*Donated	−0.09	−0.02				
	(0.90)	(0.05)				
Income	−0.00	0.00*	0.04*	0.04**	0.04**	0.04**
	(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)
Age (per 10 years)	0.00	0.00**	0.04	0.09**	0.11**	0.09*
	(0.01)	(0.00)	(0.06)	(0.05)	(0.05)	(0.05)
Male	−0.74***	−0.23***	−0.07	−0.15	−0.17	−0.17

Table 4 (continued)

Dependent variable (regression model)	Study 1 Oil spill protection		Study 2 Climate forest impacts			
	Pr (WTP > 0) (Random probit)	WTP (> 0) (Random interval)	Pr (WTP > 0) (Probit)	WTP (> 0) (Interval)	WTP (> 0) (Interval)	WTP (> 0) (Interval)
	(0.22)	(0.06)	(0.15)	(0.13)	(0.12)	(0.13)
Married	−0.02	−0.11	−0.03	−0.08	−0.10	−0.07
	(0.28)	(0.07)	(0.18)	(0.15)	(0.15)	(0.15)
Household size	−0.03	0.01	−0.15*	−0.04	−0.03	−0.04
	(0.11)	(0.03)	(0.09)	(0.08)	(0.08)	(0.08)
Higher education	0.63***	0.04	−0.30*	0.24*	0.27**	0.24*
	(0.22)	(0.06)	(0.17)	(0.13)	(0.14)	(0.14)
Constant	6.58***	6.22***	1.46***	5.37***	5.35***	5.41***
	(0.58)	(0.15)	(0.44)	(0.38)	(0.38)	(0.39)
Log likelihood	−380.3	−15,914	−179.8	−1199.5	−1203.5	−1203.8
Pseudo R-squared	0.02	0.07	0.01	0.02	0.02	0.02
N	7480	7325	612	462	462	462

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. Model estimated using STATA xtprbit, xtintreg and intreg commands. Higher education is defined as holding a bachelor, master or PhD degree. Standard errors in brackets

prevented oil spill increase in Study 1. When we regress the "number of donations made" on mean WTP, we find that an extra donation decision increases the WTP by coefficient of 0.39. The Share of credits donated increases the WTP by coefficient of 1. Both coefficients are significant, while the model fit is similar across the models. These results imply that the intensity of donations, meaning the more often donated and the higher share donated, increase the WTP at the intensive margin. The results across the two studies are also robust to including the respondents without donation data as non-donators.

The results imply a significant correlation between survey coin spending and valuation estimates in the CV surveys. In the first study on oil spill protection, the estimated mean WTP for avoiding small oil spill among non-donating respondents is NOK 1200 per household per year, while the estimated mean WTP for donating respondents is significantly higher at NOK 1800 (t-value = 4.11).[20] In the second survey on climate forest impacts, we find an estimated mean WTP for non-donating respondents of NOK 735, while the estimated mean WTP for donating respondents is significantly higher at NOK 1265 (t-value = 4.14).[21]

Donation behaviours are not well explained by typically observed socio-demographic characteristics. However, the donating respondents may still differ from other respondents in terms of other latent characteristics not typically observed by researchers, as found by De Oliveira et al. (2011).

4.2 Donating Respondents are Different from Self-reported Altruists

Before we test our second hypothesis, that past donations are significantly and positively associated with WTP when we control for self-reported altruism as well as other attitudes and individual characteristics, we explore whether past donators differ from self-reported altruists and other respondents in terms of characteristics, interests, and attitudes.

To categorise respondents in terms of self-reported altruism, we combine the three questions from Study 2 on climate forest impacts on altruism as displayed in Table 7 in Appendix 1. We define respondents as self-reported altruist if they answer "strongly agree" to at least two out of the three altruism questions and at least "agree" to a third question.[22] This categorises 177 respondents in our sample as self-reported altruists, of whom 29 are also donators, while 49 donators are not defined as self-reported altruists.

In Table 5 we compare self-reported altruists, donators, and self-reported altruistic donators in terms of characteristics, interests, and attitudes.

Donators (Group 3) and self-reported altruists (Group 1) differ significantly in several aspects. Donators (Group 3) are:

- significantly older,
- more often female,
- less interested in the economy,
- state a lower degree of nature relatedness,
- earn less money,

[20] One-sided two-sample t-test with unequal variances.

[21] One-sided two-sample t-test with unequal variances.

[22] The third altruism (ALT3) question was recoded to move in the same directions in terms of altruism as the two first. Some of the NR and NEP questions (NR3, NEP1, NEP4 and NEP5) were also recoded to go in the same directions as other items.

Table 5 Characteristics, interests, and attitudes among past donators and self-reported altruists divided into three mutually exclusive groups

	Self-reported altruist, not donator	Donator and self-reported altruist	Donator, not self-reported altruist	Diff	Diff	Diff
	Group 1	Group 2	Group 3	(2)-(1)	(3)-(1)	(3)-(2)
Age	54.3	57.6	60.6	3.25	6.29**	3.04
Male	52%	55%	35%	3%	−17%**	−20%*
Married	57%	55%	51%	−2%	−6%	−4%
Household size	2.44	2.10	1.98	−0.33*	−0.46***	−0.13
Higher education	68%	59%	72%	−10%	4%	13%
Household inc	820	658	707	−162**	−113*	49
Interested in						
Charitable work	43%	62%	53%	20%*	11%	−9%
History and culture	53%	62%	51%	9%	−2%	−11%
Food and wine	61%	52%	51%	−9%	−10%	−1%
Politics	55%	55%	53%	0%	−2%	−2%
Economy	51%	31%	28%	−20%**	−23%***	−3%
Outdoor recreation	37%	31%	30%	−6%	−7%	−1%
Attitudes						
Altruism	3.78	3.75	3.08	−0.03	−0.70***	−0.67***
Nature relatedness	3.27	3.24	3.06	−0.03	−0.21***	−0.18*
Env. consciousness	3.18	3.31	3.26	0.12	0.08	−0.05
N	148	29	43			

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Two sampled t-test with unequal variances. Higher education is defined as holding a Bachelor's, Masters' or PhD degree

– live in smaller households,

compared to self-reported altruists in Group 1. Interestingly, donators (Group 3) are significantly more often female than donators who also self-report as being altruistic (Group 2). Donating self-reported altruists (Group 2) differ significantly in a few aspects from other self-reported altruists (Group 1). Donating self-reported altruists in Group 2 are:

– more interested in charitable work,
– less interested in the economy,
– earn less money,
– live in smaller households,

compared to self-reported altruists in Group 1.

The fact that donating respondents (Groups 2 and 3) are significantly less interested in the economy than the others, a result we also see in Table 2, could indicate lower marginal utility of private consumption. Logically, lower marginal utility of private consumption should result in a higher WTP for public goods through increased taxes, *ceteris paribus*. To analyse whether past donations and self-reported altruism, nature relatedness and

environmental consciousness predict WTP in SP we need to apply a structural equation model (SEM) to account for measurement issues when dealing with latent attitudes.

4.3 The Donating Respondents' WTP When Controlling for Attitudes

This section tests our second hypothesis that past donations are significantly and positively associated with WTP when we control for self-reported altruism as well as other attitudes and individual characteristics.

We apply a SEM to analyse how donating respondents, observable characteristics and latent altruistic, ecological, and environmental attitudes are related to WTP in Study 2 on climate forest impacts. SEM allows for large numbers of variables to be reduced to smaller numbers of latent variables through confirmatory factor analysis and handles the measurement error estimating these latent variables. The three statements on altruism, four statements on ecological attitudes and six attitudes on environmental consciousness are measuring the latent factors of altruism, nature relatedness and environmental consciousness among respondents. Instead of including all indicators directly in the regression model, the SEM sums the indicators' shared variance into the associated latent variable. The variance that the indicators do not share is assumed to be measurement error and is therefore excluded from the latent variable. We ran a SEM to include the latent factors as controls when examining the donators' WTP; see the diagram in Fig. 3.

Observed variables are depicted as squares, while unobservable variables are shown as ellipses. Directed arrows designate regression coefficients, and bidirectional arrows signify covariances. The latent variables are assumed to affect the indicators and log(WTP) and to be correlated. We estimate the following SEM:

$$\begin{aligned} \log(\mathrm{WTP}) = {} & \beta_1 \mathrm{donation\ \ behaviour} \\ & + \beta_2 \mathrm{stated\ \ altruism} \\ & + \beta_3\, \mathrm{stated\ \ nature\ \ relatedness} \\ & + \beta_4 \mathrm{stated\ \ envir.consciousness} + \varepsilon_1, \end{aligned} \tag{3}$$

where latent variables in (3) are measured using the indicators presented in Fig. 3. The question formulations and distributions for indicators *altr1-altr3*, *nr4-nr7* and *nep1-nep7* are presented in Appendix 1. Parameters are estimated using numerical optimisation comparing the sample covariance matrices and the estimated covariance matrices. The most widely used optimisation method is the maximum likelihood (ML) approach, but ML relies on a multivariate normality assumption which is violated when indicators are categorical. We take into account the categorical nature of our indicators and the dependent variable and estimate the parameters using the diagonally weighted least squares model (Satorra and Bentler 1994).[23] The parameters of the model to be estimated include the structural parameters and factor loadings relating observed indicators to latent variables, the measurement-error variances, the variances of the latent exogenous variables, and measurement-error covariances.

We ran two models. In Model 1, we included a dummy for the respondents who donated and controlled for the latent attitudes, as visualised in Fig. 3, while in Model 2 we also

[23] Due to few answers in one of the four categories across the indicators, we collapse the smallest categories and reduce to three categories.

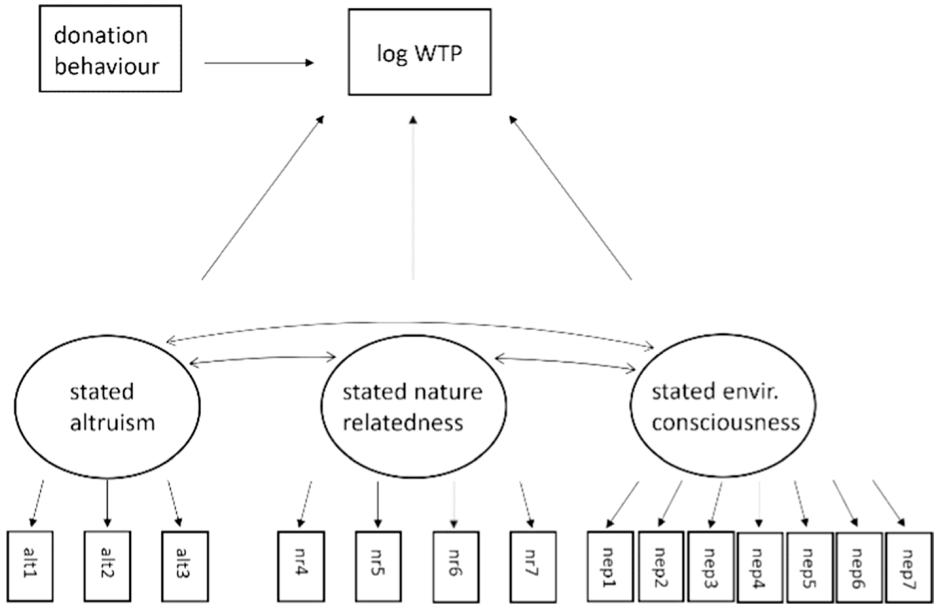


Fig. 3 The structural equation model

included respondent characteristics as control variables. We used the log of the mid-points of the payment card cost amounts as the WTP variable, and we allowed error terms between the latent variables to be correlated. We omitted *nr1-nr3* due to loading factors of less than 0.5. If the loading factor is less than 0.5, the variance due to measurement error is larger than the variance captured by the factor, which makes the validity of the indicators and the factor questionable (Fornell and Larcker 1981). The factor loadings are presented in Table 8 in Appendix 2. Table 6 presents the results of the two regressions.

The results confirm our second hypothesis, that past donations are significantly and positively associated with WTP also when we control for self-reported altruism as well as other attitudes and individual characteristics.

Model 1 returns a positive and significant coefficient of 0.562 for the dummy on respondents who have donated at least once, when controlling for latent altruistic, ecological, and environmental attitudes. When we include control variables in Model 2, the dummy for donating respondents decreases to 0.521 and remains significant at the 1% level. Stated nature relatedness and age also significantly increase WTP. To evaluate the models, we use the Comparative Fit Index (CFI) and the Root-Mean-Square Error of Approximation (RMSEA). The fit statistics of both models indicate a good fit.[24, 25]

[24] The CFI should be greater than 0.9, ideally above 0.95, whereas RMSEA should be less than 0.06 and 0.08, respectively (Hu and Bentler 1999).

[25] We have also run models where we test for indirect effects from past donations to altruism and the other way around. These links are insignificant and model fits are reduced.

Table 6 Study 2—Climate forest impacts. Factors and attitudes explaining WTP. Structural equation model, non-standardised coefficients

	Dependent variable: log WTP	
	Model 1	Model 2
Donated	0.569***	0.521***
	(0.148)	(0.158)
Log income		0.121
(per hundred thousand NOK)		(0.137)
Age		0.009**
(per year)		(0.005)
Male		−0.068
		(0.113)
Married		−0.194
		(0.139)
Household size		−0.046
		(0.061)
Higher education		0.021
		(0.136)
Stated altruism	0.095	0.110
	(0.106)	(0.117)
Stated nature relatedness	0.332**	0.337**
	(0.129)	(0.277)
Stated environmental consciousness	−0.096	−0.067
	(0.106)	(0.158)
CFI (robust)	0.978	0.981
RMSEA (robust)	0.051	0.036
N	416	350

**$p < 0.05$; ***$p < 0.01$.

WTP is the natural logarithm of the midpoint of the respondents' chosen payment value on the payment card and the next higher value. The highest category WTP is the highest value on the payment card. The models are estimated using the lavaan package in the R program. Higher education is defined as holding a Bachelor's, Masters' or PhD degree from a college or university. Standard errors are in brackets

5 Discussion and Conclusions

We examine the association between past donations and stated WTP in two (unrelated) CV surveys with different respondents: (1) protection of coastal ecosystem services from damage due to oil spills, and (2) impacts of climate forest planting. Our results partially confirm our first hypothesis. The respondents who have donated to a charity at least once are not significantly more inclined to state a positive WTP than other respondents in any of the studies. Thus, we find little evidence of past donations to have an effect on WTP at the extensive margin. On the other hand, past donations have substantial and significant effects on WTP at the intensive margin. Past donations predict higher stated mean WTP across CV surveys when controlling for individual characteristics. The donators in Study 1 are sensitive to scope, they significantly increase their WTP when the size of the prevented oil spill increases. This could indicate that donators in our data are motivated by pure altruism

and not warm glow due to self-signalling. Although this seems reassuring in terms of the validity of this survey and CV studies in general, we cannot conclude on the basis of these results, since the warm glow motive still might be present in donators' WTP (Chilton and Hutchinson 2000). Further, we find that the intensity of donations, meaning the more often respondents have donated and the higher share they have donated, increase the WTP at the intensive margin in Study 2.

Our results support the hypothesis that altruistic behaviour in one decision domain is a good predictor of altruistic behaviour also in other domains. Several authors argue that prosocial behaviour is persistent across decision domains (e.g., Franzen and Pointner 2013; De Oliveira et al. 2011; Carpenter and Myers 2010; Landry et al. 2010; Yeomans and Al-Ubaydli 2018).

De Oliveira et al. (2011) find that no observable socio-demographic variable is significantly related to a latent generosity index constructed through factor analysis. They argue that this is due to the existence of "a giving type" trait and that their index contains new information not available using observable characteristics. De Oliveira et al. (2011) find that individuals who give to one organisation, give more than average to other organisations. We find, like De Oliveira et al. (2011), that donators' WTP amounts are not well explained by observable individual characteristics, but seem to correlate with latent altruistic preferences, in this case not fully captured up by self-reported altruism. Our results seem to contradict Galizzi and Navarro-Martinez (2019) and Ross and Nisbett (2011) who find that individuals' prosocial behaviour is unpredictable across decision domains.

Given that past donation behaviour is a good predictor of higher mean WTP at the intensive margin, it is surprising that past donations fail to predict higher propensity to state a positive WTP at the extensive margin, especially since stating a positive WTP resembles the donation decision. One reason for the missing association might be due to data issues; relatively few zero WTP responses and relatively few donators give too little variation to isolate the positive effect in the data. The Donator variable in Study 1 have a positive coefficient at 0.8, close to significant at the 10% level, which might indicate that there is a true but undetected positive association. However, further investigations remain to be done on how the difference in the respondents' motivations for a stating positive WTP and stating a higher mean WTP could be related to motivations associated with past donations.

Our results confirm our second hypothesis. We find past donations to predict higher mean WTP when controlling for self-reported altruism as well as other attitudes and individual characteristics.

Our results suggest that measures of self-reported altruism do not capture all respondents' preferences for contributing. Some donators do not consider themselves altruistic, some donators might be motivated by warm glow, while other donators might be very humble or overly self-critical when answering personal questions, saying that they are not altruistic when others would find them altruistic. Interestingly, we find that female donators are less likely to self-report as being altruistic. This is in line with women being more self-critical than men in general (Collins 1996).

At the same time, our result might indicate that warm glow preferences bias the WTP in CV upwards. If the donating respondents get a positive warm glow feeling from stating higher WTP in SP surveys, they will bias the mean WTP for the environmental good even in incentive-compatible surveys if they do not get a corresponding warm glow feeling when they pay their taxes.

Several studies find indications that some donators are motivated by warm glow preferences (e.g., Falk et al. 2020). Hartmann et al. (2017) find that stated warm glow has a stronger influence on WTP than stated altruistic attitudes and stated environmental

attitudes and argue that warm glow helps explain why individuals lacking altruistic values still engage in seemingly altruistic prosocial behaviour, a finding shown by Cialdini et al. (1997). Although warm glow in SP has been a topic of some interest, it has not played a major role in the literature on CV over the last decade (Bishop 2018). One reason could be the problem of separating legitimate pure and paternalistic altruistic values from the illegitimate values stemming from the warm glow of giving. As Francois de La Rochefoucauld (1791) said: "Virtues are lost in self-interests as rivers are lost in the sea". Isolating, measuring, and controlling for warm glow in SP is difficult to say the least.

We find that donators are significantly less interested in the economy than other respondents, which may indicate a lower marginal utility of money among donators. This would logically imply a higher WTP, *ceteris paribus*. Thus, a lower marginal utility of money could explain both donations and higher WTP in SP surveys, independently of altruism and warm glow preferences.

If we trust that prosocial behaviours are consistent across several decision domains, there might be new links to explore between charity donation to raise environmental engagement. As past donations to charities increase WTP for ecosystem services in our study, past donations to a charity might also indicate a willingness to engage in environmental and conservation projects too. As pointed out by De Oliveira et al. (2011), our results support list-sharing from charities towards organisations who need not share their mission per se, which is supported by Aruga (2020) who finds an association between altruism and environmental awareness. Related to this, Nelson et al. (2019) find that tourists are more willing to donate to bundled conservation issues rather than isolated issues when they explore real voluntary payments for conservation on a popular island (Nelson et al. 2019).

Future research should examine how past pro-social behaviour can be utilised to increase commitment to improve public goods and reduce public bads. Insights on why people give to charities, who they are, and how and when to approach them could be helpful to engage people in conservation and environmental issues too. Future research should also examine altruistic and warm glow preferences in welfare economics and CV studies. Combining data on (past) real donation behaviour with stated preference surveys can open new avenues for tests of altruism in preference elicitation. If donation history is not available, a possible solution would be to include a dictator game with charities as recipients in SP surveys (Umer et al. 2022). We suggest investigating whether there is a substantial difference between the motivations when choosing to state a positive WTP at the extensive margin and choosing the level of WTP at the intensive margin. Giving in the dictator game with charity as recipients provides rich information on the intensive and extensive margins of donations, which might be helpful in this regard. Different types of dictator games may also be adopted to reveal various motives such as pure and impure altruism. Giving in the standard anonymous dictator game indicates pure prosocial tendencies, whereas making donation decisions when anonymity or economic incentives are diluted may reflect impure motivations such as social desirability motivations (Engel 2011). To sum up, combining insights from experimental and behavioural economics and SP surveys could shed light on the influence of different altruistic motives affecting valuation surveys, with important consequences for estimating valid and reliable welfare measures for cost–benefit analysis.

6 Appendix 1: Self-reported Altruistic, Ecological, and Environmental Attitudes

Higher WTP among donating respondents could stem from altruism, ecological or environmental attitudes. Pro-ecological and pro-environmental attitudes are expected to increase WTP for measures that improve environmental quality. Altruism is also expected to increase WTP through paternalism, meaning caring for some but not all aspects of others' utility (Johansson and Kriström 2021), and warm glow of giving.

We have collected respondents' altruism and their ecological, and environmental attitudes in fifteen Likert scale statements. We collected three statements on altruism, seven statements on ecological attitudes from the nature-relatedness (NR) scale and six statements on environmental attitudes from the new environmental paradigm (NEP) scale. Table 7 presents the distribution of answers.

Our statements on altruism are gathered from the German Socio-Economic Panel study (Dur and Zoutenbier 2015; Falk et al. 2016). The first statement measures a general altruistic attitude, whether respondents agree that it is important to "be there" for others, which almost everybody agrees on, while half of the respondents strongly agree. The ALT2 statement is related to donation behaviour, asking whether respondents are willing to give without expecting anything back. Fewer respondents strongly agree with this statement, which should indicate respondents' interest in donating to charities and organisations, capturing the pure altruistic feeling of helping others become better off, while also capturing the warm glow feeling of giving. The last statement, ALT3, captures general egoistic attitudes, so if respondents strongly disagree, they might be

Table 7 Likert scale percentages on strength of agreement with statements from 1(strongly disagree) to 4 (strongly agree)

	Questions	1 (%)	2 (%)	3 (%)	4 (%)
alt1	It is important for me to "be there" for friends, family and community	0	3	49	48
alt2	I am willing to share with others without expecting anything back	1	3	63	33
alt3	I am generally a person who thinks mostly about myself	27	59	13	1
nr1	I enjoy being in the open air, even in bad weather	4	20	50	25
nr2	I enjoy digging into the soil and getting dirt on your hands	9	30	45	17
nr3	I don't often go into nature	28	45	22	5
nr4	I think about how my actions affect the environment	1	14	64	21
nr5	Environmental protection generally creates a better world for me and my children	1	4	55	40
nr6	Environmental protection is useful for my health	1	5	61	34
nr7	A clean environment gives me better recreational opportunities	1	2	54	43
nep1	People have the right to change the natural environment to suit their own needs	22	48	28	2
nep2	Humans abuse the planet	1	8	51	40
nep3	Plants and animals have the same right as humans to exist	2	15	51	32
nep4	Nature is strong enough to tackle modern industrial nations	24	57	17	3
nep5	Humans are meant to rule the rest of nature	28	45	23	4
nep6	Nature's balance is delicate and can easily end up in disregard	1	5	57	37

1 = Strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

considered altruistic. We combine these three statements to control for respondents' altruistic attitudes.

We draw upon seven statements from the NR scale to measure ecological attitudes through cognitive, affective, and experiential connections with the natural environment. The NR scale measures contact with nature and the personality construct of subjective connection with nature and is found to predict sustainable attitudes and behaviours (Zelenski and Nisbet 2014).

The NEP scale (Dunlap et al. 2000) is much used in survey research, for instance on perceptions and response to climate change (Whitmarsh 2008). We use Whitmarsh (2008) shortened version of Dunlap's original NEP scale.

7 Appendix 2: The Measurement Model Loading Factors

Construct validity is the extent to which indicators of a latent variable measure what they are supposed to measure. Construct validity addresses the degree of agreement of indicators hypothesised to measure a latent variable, and multiple indicators of the same latent variable should be highly correlated and correlated relatively uniformly, and should stem from a single latent variable, not two or more variables. The size of the standardised factor loadings is often used to evaluate validity (Bagozzi and Yi 2012) (Table 8).

The rule of thumb is that the standardised factor loadings should exceed 0.5, and ideally 0.7 for the indicators to be highly and relatively uniformly correlated (Hair et al. 2014). Each standardized loading is above 0.5 in the measurement models, which indicates convergent validity. We would like to thank Ståle Navrud, Kristin Magnussen and Øyvind N. Handberg for contributions to the oil spill and climate forest surveys, respectively. We would also like to thank Berit Halvorsen, Arild Angelsen, Michela Faccioli and two anonymous reviewers for their valuable feedback to the paper.

Table 8 Standardised factor loadings of measurement models

	Stated altruism	Stated nature relatedness	Stated environmental consciousness
alt1	0.607		
alt2	0.891		
alt3	0.517		
nr4		0.679	
nr5		0.951	
nr6		0.952	
nr7		0.783	
nep1			0.511
nep2			0.753
nep3			0.617
nep4			0.773
nep5			0.681
nep6			0.662

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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Appendix

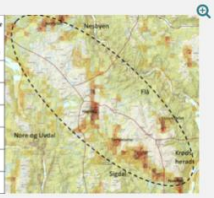
Valuation questions in the conducted survey

(data used in paper II and paper III)

RECREATIONAL HOMES IN THE NOREFJELL AREA

The table below gives an overview of the number of recreational homes in the Norefjell area today. Darker brown represents a higher density of recreational homes on the map. The circle indicates the Norefjell area.

Kommune	Fritidsboliger i Norefjellområdet	Fritidsboliger i hele kommunen (inklusive Norefjellområdet)
Krødsherad	800	1 700
Sigdal	3 250	5 050
Flå	1 050	2 200
Nore og Uvdal	500	3 950
Nesbyen	1 900	3 600
Sum	**7 500**	**16 450**



Are there more or fewer recreational homes in the Norefjell area than you thought?

Press the picture to enlarge

- More recreational homes
- Less recreational homes
- More or less as I thought
- Don't know

NØRSK GALLUP

This area in Flå is one of the dark brown areas on the map - i.e. an area with a high density of recreational homes.

Press the picture to enlarge

NØRSK GALLUP

Do you think the construction of recreational homes in the Norefjell area should continue, and if so in what way?

Yes, only by densifying the current recreational home areas
Yes, only by developing new recreational home areas
Yes, both when densifying and developing new recreational home areas
No, no more recreational homes should be built
Don't know

NORSK GALLUP

RECREATION HOME BUILDING ABOVE THE TREE LIMIT

The construction of recreational homes in the Norefjell area will take place below 1,000 meters above sea level. This means that it can be built both above and below the tree line.

To what extent do you agree or disagree that recreational home construction above the tree line should be allowed?

Press the picture to enlarge

Press or move the marker to submit an answer

1/1

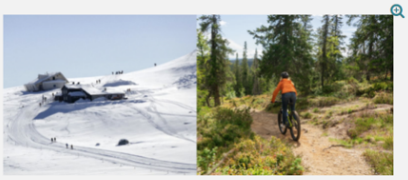
1 Totally disagree 2 3 4 5 Totally agree

Vet ikke

NORSK GALLUP

THE CONSTRUCTION OF RECREATIONAL HOMES AFFECTS RECREATION

The Norefjell area has an extensive network of paths and ski slopes and is a much-visited mountain area. Recreational areas below the tree line can be developed. Increased construction of recreational homes will increase the number of hikers and create a need to adapt the network of paths and trails.



How do you assess the path and trail network use in the Norefjell area today?

Press the picture to enlarge

1 Not at all too many people

2

3

4

5 Way too many people

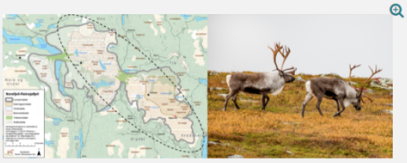
Don't know

NORSK GALLUP

THE CONSTRUCTION OF RECREATIONAL HOMES AFFECTS WILD REINDEER

Almost the entire European reindeer population of 25,000 animals lives in 24 management areas in southern Norway. One of these is the Norefjell area, where 570 wild reindeer live.

The construction of recreational homes and other human activity, especially near the calving and migration zones, could challenge the continued existence of the wild reindeer population in this area.



Have you ever seen wild reindeer in this area?

Press the picture to enlarge

- Yes
- No, but I have seen in other areas
- No, I have never seen wild reindeer
- Don't know

NORSK GALLUP

We now want to survey people's opinions on possible further recreational home development in the Norefjell area over the next 20 years. The survey is aimed at the local population and recreational home owners. Both the desired level of development and willingness to pay will be reported to the authorities.

NORSK GALLUP

DESIRED DEVELOPMENT LEVEL

Here you see three imagined development alternatives for the Norefjell area up to 2040. Consider that the SMALL DEVELOPMENT option includes projects that have already started and that it is the smallest recreational home development. You can assume that infrastructure and access roads will be upgraded in line with the size of each development option.

	LARGE DEVELOPMENT	MEDIUM DEVELOPMENT	SMALL DEVELOPMENT
Recreational home density in 2040			
Total recreational homes in 2040	14,000 recreational homes	11,000 recreational homes	8,000 recreational homes
Growth until 2040	6,500 new recreational homes / 85% growth	3,500 new recreational homes / 45% growth	500 new recreational homes / 5% growth
Development	Over and under the tree line	Under the tree line	Under the tree line
Growth in hikers in 2040	100% more hikers 	60% more hikers 	20% more hikers 
Recreation above the tree line	Upgrading of current paths and expanding trail network	Upgrading of current paths	Paths as today
Recreation below the tree line	Large development in recreation areas	Some development in recreation areas	Little development in recreation areas
The wild reindeer population in 2040	Carrying capacity very strongly threatened	Carrying capacity strongly threatened	Carrying capacity somewhat threatened

Press the picture to enlarge

How do you rate the three options? Rank the alternatives, where 1 is most preferred and 3 is least preferred

- Large development
- Medium development
- Small development
- Have no opinion about preferred development

What are recreation and the wild reindeer in the Norefjell area worth to you?
READ CAREFULLY BEFORE YOU CLICK ON: The municipalities are planning large recreational home developments in the Norefjell area. Viken county, on the other hand, wants to reduce the development of recreational homes to safeguard recreation and wild reindeer for residents of Viken and Oslo. The fewer recreational homes are built in the municipality, the less the municipalities' income will be. Increased municipal tax for residents and cabin owners can cover the loss of income and preserve wild reindeer and recreation. Whether and how much municipal tax should have to increase is uncertain at this point.

We would like to know what safeguarding outdoor life and wild reindeer in the Norefjell area is worth to your household. If the amount households are willing to pay exceeds the loss of income from reduced cottage development, the development will be reduced, and your tax will increase.

NORSK GALLUP

READ CAREFULLY: LARGE DEVELOPMENT is planned by the municipalities. You have stated that you prefer the SMALL DEVELOPMENT option.

Consider what it would be worth to your household if SMALL DEVELOPMENT were decided instead, see the table below.

	LARGE DEVELOPMENT	MEDIUM DEVELOPMENT	SMALL DEVELOPMENT
Recreational home density in 2040			
Total recreational homes in 2040	14,000 recreational homes	11,000 recreational homes	8,000 recreational homes
Growth until 2040	6,500 new recreational homes / 85% growth	3,500 new recreational homes / 45% growth	500 new recreational homes / 5% growth
Development	Over and under the tree line	Under the tree line	Under the tree line
Growth in hikers in 2040	100% more hikers	60% more hikers	20% more hikers
Recreation above the tree line	Upgrading of current paths and expanding trail network		Paths as today
Recreation below the tree line	Large development in recreation areas	Some development in recreation areas	Little development in recreation areas
The wild reindeer population in 2040	Carrying capacity very strongly threatened	Carrying capacity strongly threatened	Carrying capacity somewhat threatened

CLICK ON TO ANSWER
Press the picture to enlarge

NORSK GALLUP

WILLINGNESS TO PAY

Imagine that the tax increase will be binding and equal for households who resides or have a recreational home in the municipality: How much, if anything, are you and your household absolutely certain to be willing to pay yearly from year 2022 until 2040 so that alternative LITTLE DEVELOPMENT will be realised instead of LARGE DEVELOPMENT?

Increased tax (in kroner) per household per year from 2022 until 2040
Press or move the marker to submit answer

1/1

0 75 200 500 900 1400 2700 3800 5100 7000 10000 More than 12000

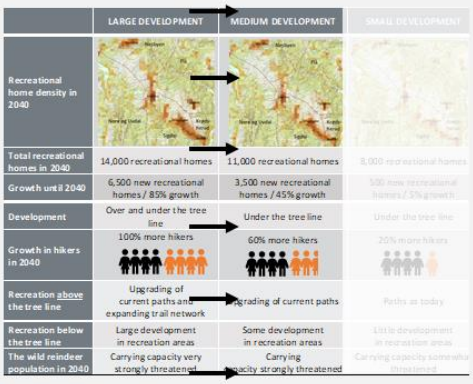
Do not know

NORSK GALLUP

You have answered above that your household is not willing to pay anything to avoid large development, or you have answered, "Don't know". What is the most important reason why you do not have or want to state your willingness to pay?

- My household cannot afford to pay for this
- It is not my household's responsibility to pay for the municipalities' reduced income
- The tax level is already high enough
- What I say will not affect which option is chosen
- I feel it is not correct to weigh the environment in money
- It was too difficult to come up with an amount
- I don't want to pay until I know what it costs
- Other, please specify:
- Don't know

READ CAREFULLY: LARGE DEVELOPMENT is planned by the municipalities. If SMALL DEVELOPMENT option was not possible, what are you willing to pay for MEDIUM DEVELOPMENT



	LARGE DEVELOPMENT	MEDIUM DEVELOPMENT	SMALL DEVELOPMENT
Recreational home density in 2040			
Total recreational homes in 2040	14,000 recreational homes	11,000 recreational homes	8,000 recreational homes
Growth until 2040	6,500 new recreational homes / 85% growth	3,500 new recreational homes / 45% growth	500 new recreational homes / 5% growth
Development	Over and under the tree line	Under the tree line	Under the tree line
Growth in hikers in 2040	100% more hikers	60% more hikers	20% more hikers
Recreation above the tree line	Upgrading of current paths and expanding trail network	Upgrading of current paths	Paths as today
Recreation below the tree line	Large development in recreation areas	Some development in recreation areas	Little development in recreation areas
The wild reindeer population in 2040	Carrying capacity very strongly threatened	Carrying capacity strongly threatened	Carrying capacity somewhat threatened

CLICK ON TO ANSWER

Press the picture to enlarge

NORSK GALLUP

WILLINGNESS TO PAY

Imagine that the tax increase will be binding and equal for households who resides or have a recreational home in the municipality: How much, if anything, are you and your household absolutely certain to be willing to pay yearly from year 2022 until 2040 so that alternative MEDIUM DEVELOPMENT will be realised instead of LARGE DEVELOPMENT?

Increased tax (in kroner) per household per year from 2022 until 2040

Press or move the marker to submit answer

1/1

0 75 200 500 900 1400 2700 3800 5100 7000 10000 More than 12000

Do not know

NORSK GALLUP

You have answered above that your household is not willing to pay anything to avoid large development, or you have answered, "Don't know". What is the most important reason why you do not have or want to state your willingness to pay?

- My household cannot afford to pay for this
- It is not my household's responsibility to pay for the municipalities' reduced income
- The tax level is already high enough
- What I say will not affect which option is chosen
- I feel it is not correct to weigh the environment in money
- It was too difficult to come up with an amount
- I don't want to pay until I know what it costs
- Other, please specify:
- Don't know

ARE YOU SURE ABOUT THE AMOUNT YOU HAVE CHOSEN?
Here you can see the extra tax you stated you would certainly want to pay annually from 2022 to 2040 to reduce the development of holiday homes in the Norefjell area. Some states higher amounts than they actually want to pay.
Press another amount if you want to change. If not, move on.
From LARGE DEVELOPMENT to LITTLE DEVELOPMENT: 25 KR

0
25
75
100
200
300
500
700
900
1100
1400
1800
2200
2700
3200
3800
4400
5100
5800
7000
8500
10000
12000
Mer enn 12000

ARE YOU SURE ABOUT THE AMOUNT YOU HAVE CHOSEN?
Here you can see the extra tax you stated you would certainly want to pay annually from 2022 to 2040 to reduce the development of holiday homes in the Norefjell area. Some states higher amounts than they actually want to pay.
Press another amount if you want to change. If not, move on.
From LARGE DEVELOPMENT to SMALL DEVELOPMENT: 25 KR

0
25
75
100
200
300
500
700
900
1100
1400
1800
2200
2700
3200
3800
4400
5100
5800
7000
8500
10000
12000
Mer enn 12000

NØRSK GALLUP

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Endre Kildal Iversen was born in Tromsø in 1985 and grew up in Bergen. He holds a BSc. Degree in Economics from the University of Bergen and an MSc. Degree in Economics from the University of Oslo. His research interests include environmental valuation, economic psychology, tourism economics and applied welfare economics.

The thesis consists of an introduction and four independent papers. There are two key motivations for the thesis. Since land use changes are identified as the most critical threat to biodiversity (IPBES, 2019), the first motivation is to use stated preference methods to value ecosystem services and inform land use policies. The first and second papers find substantial nonmarket values associated with changes in ecosystem services due to land use changes. If decision-makers consider the magnitude of these values in their trade-offs between climate, biodiversity and market impacts, public policies should be altered. Agricultural policies should be designed to preserve species-rich semi-natural pastures. Tourism development in Norwegian mountain areas should be restricted to protect landscapes, wildlife, and recreation.

The second motivation is to help to improve the validity and the use of stated preference estimates by refining the understanding of preference formation and heterogeneity. Psychological concepts and richer models of the choice process provide more information than the standard economic framework. The third paper finds place attachment to enhance the understanding of trade-offs between economic development and environmental goods and the spatial distribution of preferences towards environmental goods. The fourth paper finds that studies analysing the effect of altruism on values have underestimated the challenges of measuring altruism by self-reporting and that respondents' past donations are associated with higher values, also after controlling for stated measures of altruism.

Professor Ståle Navrud was Endre's main supervisor. Henrik Lindhjem, Kristine Grimsrud and Vic Adamowicz were co-supervisors.

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