Assessing recreational values of Danish forests to guide national plans for afforestation

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Key Message: Forests provide a range of recreational benefits and it is essential to include these benefits in decisions related to forest management and/or afforestation. The assessment of recreational values and preferences in North Zealand (DK) found that the per hectare value of recreational services provided varied significantly between different forests - from 5 200 EUR / ha / year to 14 850 EUR / ha / year for the forests with the highest per hectare value and from 200 to 320 EUR / ha for the forests with the lowest per hectare value[1]. The valuation methodology used in the Danish study offers a flexible and spatially explicit approach to assessing the recreational value of forests under different scenarios. However, it also shows that the uncertainty in the benefit estimation needs to be carefully considered and addressed.

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What is the problem?

Since 1990 the Danish Government and local authorities are pursuing an ambitious afforestation plan to double the forest area in Denmark in the next 100 years, corresponding to 4000 – 5000 ha annual increase of forest (Miljøministeriet 2002). The aim of the assessment presented in this case study is to guide the implementation of afforestation plan based on the information of recreational benefits associated with forest ecosystems to the Danish public. The competition between different land uses in Denmark is high (e.g. agriculture, industry and urban areas) and therefore assessing benefits associated with forests can help to inform decision-makers on the (socio-economically) most optimal location of new forests. The approach taken in this assessment makes it possible to estimate welfare economic effects of afforestation while taking into account the characteristics and accessibility of existing forests. It also makes it possible to assess the welfare economic effects of recreation when changing the characteristics of existing forest sites, e.g. increasing the total area, age and/or composition of forests.

Which ecosystem services were examined and how?

The assessment focused on the recreational values that forests in North Zealand region in Denmark provide to the public, i.e. cultural and recreational ecosystem services. These included, for example, the use of

[1] 2005 values

forests for recreational activities (e.g. walking, jogging, cycling, picnicking, camping or hunting) and aesthetic values. The assessment estimated which type of forests people prefer to visit, the total recreation value that different types of forests provide the public (e.g. how many visits are made to different forest sites on an annual basis.

The assessment was done by combining a *discrete choice model* based on observed data of forest visits, a *count data model* based on a nationally representative household survey and *Geographic Information System (GIS)* which enabled a high spatial resolution. Recreation value was estimated as the welfare economic value of visiting a given forest site (See Box 1). This welfare economic value indicates the value that people attach to visiting forests for recreation purposes and it was modelled based on the observed trade-off between minimising costs of travel and visiting a forest that provides a recreational experience in line with preferences of the individual. Consequently, the recreational value in this assessment was not estimated as the actual amount of money people pay to visit forests (e.g. travel costs).

The assessment was undertaken for all 52 public forests in North Zealand in Denmark, including the region of Copenhagen. Public forests in this region represent the vast majority of all forests. On-site surveys in these forests (21 days over one year) revealed the distribution of visits across the year (Jensen 2003). Combined with the information on frequency of visits, obtained from a representative national household survey by Jensen (1998), the study estimated the total number of visits.

Box 1. Discrete choice model & count data model

The discrete choice approach is based on modelling the factors that influence the decision of an individual choosing between several forests for recreation. It estimates how an individual chooses between different forest sites, under the condition that the individual chooses to go to only one site during one recreational trip. The model is based on observed behaviour of forest visitors during one year in all public forests in a region and is (in this case) modelled for the full population of the same region.

Observed behaviour is combined with a set of individual forest site characteristics such as size, diversity of tree species, diversity of age in tree stands, presence of water, topography and closeness to the coast as well as travel distance from the home of the individual to the forest. By combining the modelling of observed behaviour with the forest characteristics in a random utility framework, the discrete choice model estimates the preferences towards forest characteristics of the total population in the region and the probability of each individual of choosing a given forest.

Combining the probability of visiting a given forest and results of the count data model (i.e. a model that estimates the demand for forest recreation) the assessment evaluates the number of visits and the welfare economic value of access to individual forest sites. This approach is available for visits that were made by car and other motorised vehicles. In the case of Denmark, motorised vehicles represent approximately half of all visits to forests. The valuation can therefore be considered a conservative estimate of the recreation value of Danish forests.

Results of the assessment

In general, previous household surveys indicate that the Danish population of ca. 5 million people (at least in the 1990s) made 155 million visits for forests during one year. The 'normal' Dane (i.e. the median) visited forests 10 times per year while 16 % of the population visit forest very frequently (from once per week to daily visits). Over time, the frequency of visits has increased significantly by about 15 % for people aged 15 to 75 years. It is also known that because visits have become more frequent visitors tend to go to forests for shorter periods of time per trip and to travel less far. The shorter travel distance is clearly linked to the trend that people go less by car to forests and more often by bike or foot. Cars still represent, however, the single most preferred means of transport when visiting forests (Jensen 1998, Jensen & Koch 1997).

The assessment of recreational values and preferences in North Zealand found that the value of recreational services provided varied significantly between different forests. In the region investigated, recreational value provided by the different forests ranged 5 200 to 14 850 EUR / ha / year for the forests with the highest per hectare value while the forests with the lowest per hectare value ranged from 200 to 320 EUR / ha / year (2005 values). The assessment also found that the population has rather heterogeneous preferences towards recreational characteristics of forests. According to the study, the

main elements determining demand and preferences for recreational services include the level of accessibility to the sites (i.e. distance from home to site); characteristics of the forest sites (eg size, level of broadleaf species available, age of tree stands, presence of water, degree of open land, nature quality of surrounding areas, slope, distance to coast and species diversity); and visitor characteristics (age, ownership of car and income). Table 1 below shows how forest characteristics impact the values perceived by people. The assessment found that in most of the cases the population of North Zealand shares the same preferences towards structural characteristics of forests.

Table 1. Links between forest characteristic and public preferences for forest recreation

Forest characteristics	Preferences	
Species diversity index (Shannon)	☺/☹	Evidence of different preferences (62% prefer species diverse forests, 38% prefer non-diverse forest)
Fraction of open land in forest (%)	☹/☺	Evidence of different preferences (only 24% prefer open forests, 76% dense forest)
Fraction of trees >60 years old (%)	☺	No evidence of different preferences(preference for older trees in a forest)
Fraction of coniferous trees in forest (%)	☺/☹	Evidence of different preferences (66% prefer coniferous trees in forests, 34% prefer broadleaf trees)
Size of forest (log) (ha)	☺	No evidence of different preferences (preference for a larger forest to a smaller forest, albeit at a marginal decreasing rate)
Distance to nearest coast (log) (km)	☺	No evidence of different preferences (preference for a forest to be closer to the coast, albeit at a marginal decreasing rate)
Slope (index)	☺	No evidence of different preferences (preference for a forest with varied topography)
Fraction of water bodies in forest (%)	☺	No evidence of different preferences (preference for forests with water bodies)

By using data from an identical on-site survey conducted previously (Koch 1978, Jensen & Koch 1997), the assessment in North Zealand was able compare whether and how preferences, demand and monetary values of forest recreation over a 20 year period change (Zandersen et al. 2007a&b). The assessment found that both preferences and demand for forest recreation changed significantly over time. While the average yearly number of visits to forests increased by 15% at the national level, the number of car-borne trips to forests decreased over the period (Koch 1978, Jensen & Koch 1997). People prefer more frequent visits to forests within shorter distances and by other means of transport than cars. Consequently, forests far away from Copenhagen receive fewer visits and urban fringe forests have become more popular to visit. The preferences for some site characteristics also changed over time. Over the 20 year period the Danish population appears to have developed a more heterogeneous preference towards species diversity, openness and age of forests. In the latest survey, 62% of the population preferred species rich forests and 76% dense forest whereas 20 years ago the assessment did not find any heterogeneity for appreciating these attributes (i.e. 100% of population preferred species rich and dense forests). On the other hand, old forests were considered more attractive in the current survey (i.e. 100% compared to 82% preference 20 years ago).

Did the examination of ecosystem services generate impacts on decision-making or policies and, if so, how?

The methodology described in this case study has been used by the Danish Ministry of Environment, interested in establishing the economic rationale for public afforestation projects and in showing the case for applying economic models to assessing economic welfare effects of new projects. Seven afforestation sites across Denmark were selected by the ministry for assessment of the expected recreation value (Zandersen et al. 2007c). The sites were located on different regions with different land use typology and closeness to population centres. The evaluation of recreational values of these sites was based on a similar

model framework conducted at the national level (Termansen et al. 2004), resulting in estimated recreation values of 560 EUR / ha – 2 300 EUR / ha per site (2005 prices). The estimated values between sites varied based on the site characteristics and the availability / characteristics of alternative sites. Agriculture was in all cases the alternative land use of highest economic value, an average income of 940 EUR / ha (2005 prices). According to the estimate, in four of the seven cases afforestation for the purpose of recreation would be more optimal for society than the most likely alternative land use (i.e. agriculture). It should be noted that the methodology only accounts for car-borne recreation (ca. 50% of all forest recreation) and excludes the value all other types of ecosystem services that these forests provide. Focus in all seven afforestation cases was to locate forests in urban vicinity while protecting important drinking water resources. The three forests with per hectare values below the marginal opportunity cost of stopping agriculture were found in areas where either the urban area was very small (5000 inhabitants); the forest site relatively large (nearly 800 ha) and/or with no natural vegetation surrounding the forest. It is evident that the joined economic welfare gain of afforestation would be higher in all cases when integrating all benefits of forest ecosystems into the valuation model, e.g. maintenance of water supply, carbon sequestration and conservation of biodiversity. The model estimation has also been extended in an analysis for policy makers on spatial assessment of ecosystem services in Europe (Maes et al. forthcoming) focusing on the effects of increased urbanisation in Copenhagen on forest recreation benefits and visits.

Lessons learned

The valuation framework developed in the context of the North Zealand assessment can be applied to estimate a minimum value for new forest recreation sites in areas where afforestation has already been planned and initiated[2]. Furthermore, it can also be applied prior to starting specific afforestation projects in order to find the optimal location and characteristics of new sites or to assess whether afforestation would be beneficial on a given location, given presence and characteristics of exiting recreation sites, population and accessibility. In order for the framework to be operational, it could be further automatised and made more user-friendly for planners and policy makers, this way providing an input to the decision making process of planning the expansion of the forest area in Denmark.

The described valuation technique is fairly data intensive and requires a dataset of thoroughly observed visits to forests. However, once such data has been collected, the methodology offers a wide range of applications of direct use for informing policy making when deciding on changing management and/or structures of existing forests or when deciding on the execution of an expansive forest policy. However, given the theoretical basis of the methodology, only visits made by motorised vehicles can be included in the model. The results of the valuation should therefore be considered only as minimum value for benefits related to recreation.

Afforestation is a long term project where maximum welfare may only be reached after 40 to 80 years after the forest has been planted. However, the extrapolations of estimated benefits are often made for 10 to 50 year periods without knowledge of the long-term reliability of transfer functions, welfare estimates or determinants of welfare. Tests of benefit transfer over time and space within the investigated region clearly show that caution is warranted as transfers can lead to errors by either exaggerating or underestimating the true value of the new site. The assessment finds that, where functional transfer models are statistically equal, benefit transfer errors are minimal (-3% to +9% error) (Zandersen et al. 2007a&b). However, also models that are not statistically equal may yield acceptable transfer errors of ±20%. Updating benefit functions may help reduce errors. By updating a functional benefit transfer over time, the assessment found an improvement in average transfer errors to drop from 334% to 24%. Also, any outliers in terms of characteristics of site should be avoided in benefit transfers. In general, an indication of when it is useful to carry out benefit transfer is when the foreseen error of not including the value of ecosystem services into model supporting decision-making is larger than the error related to the use of benefit transfer

[2] The value of car-borne recreation is a minimum value of the total recreational values of forests. In order to establish a complete cost benefit analysis of afforestation projects, one would need to include the economic welfare value of clean ground water, biodiversity protection, CO2 sequestration and other ecosystem services provided by forests. These values would need to be deducted from the economic welfare value of continued agriculture to obtain a net evaluation.

(Rosenberger and Loomis 2011). Similarly, one could also compare the margin of error related to benefit transfers with the costs of conducting new valuation studies.

References

Jensen, Frank S. 1998. *Friluftsliv I det åbne land 1994/1995* [Recreation in the open land 1994/1995] Forskningsserien nr. 25. Hørsholm: Forskningscentret for Skov & Landskab.

Jensen, Frank S. 2003. *Friluftsliv i 592 skove og andre naturområder]* Recreation in 592 forest and other nature sites]. Skovbrugsserien nr. 32. Skov og Landskab, Hørsholm, 2003.

Jensen, Frank S.; Koch, N.E. 1997. *Friluftsliv i skovene 1976/77-1993/1994*. [Recreation in Forests 1976/77-1993/94]. Forskningsserien nr. 20. Hørsholm: Forskningscentret for Skov & Landskab

Koch, N.E. 1978. *Skovenes friluftsfunktion I Danmark. I. Del. Befolkningens anvendelse af landets skove.* [Forest Recreation in Denmark. Part I: The Use of the Country's Forests by the Population] Det forstlige Forsøgsvæsen i Danmark 35, 285-451.

Maes, J., Hauck, J., Paracchini, M. L., Ratamäki, O., Termansen, M., Perez-Soba, M., Kopperoinen, L., Rankinen, K., Schägner, J. P., Henrys, P., Cisowska, I., Zandersen, M., Jax, K., La Notte, A., Leikola, N., Pouta, E., Smart, S., Hasler, B., Lankia, T., Andersen, H. E., Lavalle, C., Vermaas, T., Alemu, M. H., Scholefield, P., Batista, F., Pywell, R., Hutchins, M., Blemmer, M., Fonnesbech-Wulff, A., Vanbergen, A., Münier, B., Baranzelli, C., Roy, D., Thieu, V., Zulian, G., Kuussaari, M., Thodsen, H., Alanen, E., Egoh, B., Sørensen, P. B., Braat, L., Bidoglio, G. (forthcoming). A spatial assessment of ecosystem services in Europe: The Phase II Synthesis Report. PEER report no 4.

Miljøministeriet. 2002. Danmarks Nationale Skovprogram [National Forest Programme of Denmark]. Skovog Naturstyrelsen, Copenhagen, DK.

Termansen, M., McClean, C.J., and Skov-Petersen, H. 2004. Recreational sit choice modelling using high resolution spatial data. Environment and Planning A 36: 1085-1099.

Zandersen, M., Termansen, M., and Jensen, F.S. 2007a. Evaluating approaches to predict recreation values of new forest sites. Journal of Forest Economics 13 : 103-128.

Zandersen, M., Termansen, M., and Jensen, F.S. 2007b. Testing Benefits Transfer of Forest Recreation Values over a Twenty-Year Time Horizon. Land Economics 83(3): 412-440.

Zandersen, M., Termansen, M., Jensen, F.S. and Lars Trier. 2007c. *Værdisætning af friluftsliv i offentlige skovrejsningsprojekter.* [Valuation of Recreation in Public Afforestation Projects] Dansk Skovbrugs Tidsskrift 92(2): 41-61.