Towards a carbon-neutral university: Assessing the recreational value of a university forest and the tradeoffs with other ecosystem services

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Introduction

Climate change has become one of the six sustainability problems amongst deforestation, loss of biodiversity, population growth, poverty and scarcity of drinking water (Schaltegger&Csutora 2012).In 2015, the Paris-Agreementwas reached to limit the temperature rise to 1.50C from pre-industrial level. To realize this,investments and concerted actions towards low carbon futureare crucial. As such, many academic institutions worldwide are becoming aware of their carbon footprint and are voluntarily moving towards low carbon pathways to become carbon neutral.

Ernst-Moritz-Arndt University Greifswald (EMAU) inNorth-East Germany also planned to become carbon neutral and sought several carbon reduction measures to neutralize it's carbon footprint(~8,900 CO2etyear-1) arising from three major emission sectors viz. electricity, heating and officialtravels. Almost half of the carbon footprint was reducedthroughthe use of renewable energies, energy efficiency measuresandenvironmental friendly mobility. In order to compensateunavoidable emissions,the EMAU sought carbon offset measureon its own forests. For historical reasons, the EMAU owns and manages ~3,000 hectare forestsscattered around Greifswald,which offer a possibility to enact local carbon offset strategies. The carbon offset necessitatesimplementation of an improved forest management compared to a business as usual management to enhance and sustain the carbon sink. The improvedmanagement,e.g. by changing rotation lengths, tree-species composition or intensity of thinning operations mightinfluenceforest development over time and lead totradeoffs and synergies between forest ecosystem services.Several studies showed tradeoffs and synergies between biodiversity, carbon sequestration, timber production and forest recreation across different forest types and management regimes (Duncker et al. 2012, Edwards et al. 2012).The public preferences on Polish forests showed that older stands with vertical layering, irregularly spaced trees and higher number of tree-species were preferred (Giergiczny et al. 2015)Therefore, understanding tradeoffs and synergies to address multiple benefits for anoptimal forest management strategyis a key challenge for forest managers and decision makers.

In our research, we aim to assess tradeoffs and synergies between major forest ecosystem services for designing a decision support tool that provides anoptimal forest management strategy to offsetunavoidable carbon emissions of the EMAU

(Figure). As tradeoffs between forest recreation and carbon offsetting were largely unknown for the EMAU forests due to lack of informationon public preferences, it was necessary to conduct visitor monitoring and recreational preferencesurveys. Here, we mainly highlighton recreational value of the EMAU owned forests with following specific objectives:

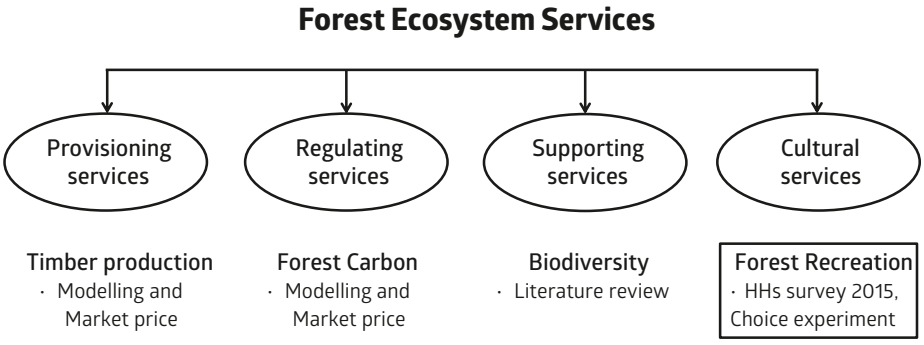
1. Monitoring visitors atEldena forest, owned by EMAU, and
2. Modeling recreational preferences of people living in Greifswald based on marginal utility of forest attributes under different managements.

Visitor monitoring

Eldena forest, a nature reserve(~411 ha) since 1961 is one of the most frequented forestsnear Greifswald. There was no official visitor data until 2015, when we carried out a first visitor survey. Manual visitor counting was conductedat seven major forest entrances on randomly chosen days,i.e. working days, weekends, public and school holidays. The visitorswere counted between 9amand7pmfrom May-Nov 2015. Simultaneously, for automaticvisitor counting, an eco-counter was installed in one of the most frequented entrances (Jan-Dec 2015) and three infra-red cameras at other entrances.

The manually countedvisitor data from all entrances wasfirst extrapolated to 24 hours by adding-up the percentage visits for the missing hours between7 pmand8 am. Thereafter, a good or bad weather day was predicted for a year fromdaily temperature, sunshine hours and precipitation data of Greifswald. Then, four day type categories were defined depending on i) good and bad weather, and ii) holidays/ weekend and working daysforyearly extrapolation (Job et al. 2009), which estimated ~76,000 visitor days to Eldena forest in 2015.

There was12% deviation on total visits using the manual and automatic counting methods;this might be due to over/under estimation duringextrapolation.Thus, we report a threshold between 66,800 -76,000 visitor days to Eldenain 2015.



Source: Own draft adapted from United Nations Millennium Ecosystem Assessment, 2005

Figure 1. *Assessing tradeoffs andsynergies between major forest ecosystem services at EMAU forests.*

Modeling forest preferences

An online household survey was conducted in Oct-Nov 2015 where ~11% of the Greifswald population wasapproached through a stratified random sampling based on the election areas and population data. A choice experiment was used for modelling forest recreation preferences as it has advantages over the contingent valuation method (Boxall et al. 1996). Two versions of the experiment were developed withdifferent payment vehicles, i.e. travel distance and travel cost.Each design hadsix attributes withrespective levelsas below:

1. Forest type: even-age young, even-age old, uneven-age;
2. Deadwood amount: low, medium, high;
3. Deadwood structure: only lying, standing and lying;
4. Carbon:low, medium, high;
5. Biodiversity:low, medium, high;
6. Travel distance (km): 2.5, 5, 7.5, 10, 15, 20 or Travel cost (Euro): 0.75, 1.5, 2.25, 3, 4.5, 6.

Altogetherthere were 36 choice sets and each respondent faced one block withsix choice sets.Furthermore,responses on environmental attitudes, recreational behavior and socio-economic characteristics were collected.

The choice experiment was restricted tothose who indicated to visit forestsfor recreation;there were262 completed responses for the distance and 236 for the cost questionnaire versions. A preliminary analysis usingmultinomial logit models showed that the results were as expected for different forest attributes. The marginal utility of uneven-aged forest, high carbon and high biodiversity were positive and significant for both versions, whereas the travel distance and travel cost were negative and significant, indicating that there is less likelihood to visit a forest if distance or cost increases.

Conclusion

Anyforest carbon offset strategy for enhancing the carbon sink should take into account tradeoffs of offsetting the carbon with other forest ecosystem services. A decision support tool that integrates multiple forest ecosystem services including visitor's recreational preferences could provide wider acceptance and help forest managers in making careful compromises between the forest services and to choose an optimal forest management to achieve a win-win situation.

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