Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

133

: Assessing ecosystem services and threats in rapidly changing landscapes: the case of southwest Slovenia

Vasja Leban
University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia,
vasja.leban@bf.uni-lj.si

Lidija Zadnik Stirn
University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia,
lidija.zadnik@bf.uni-lj.si

Špela Pezdevšek Malovrh
University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia,
spela.pezdevsek.malovrh@bf.uni-lj.si

: ABSTRACT

This study examines the demand for ecosystem services (ESs), focusing on the perceptions of local residents in the southwest of Slovenia. Perceived changes in ESs over time and threats to the natural environment were also investigated. A survey of adult residents was conducted in spring 2021 to collect data on ES perceptions and use. The results show the most important ES, their spatial distribution and changing attitudes towards ES. Perceived threats include local threats such as illegal waste dumping, groundwater contamination and forest fires. The study concludes with implications for managing perceived local threats and conserving ES to meet societal needs.

: KEYWORDS

Ecosystem services, land use change, landscape, participatory GIS, questionnaire

: 1 INTRODUCTION

In recent decades, societal demand for ecosystem services (ESs) in Europe has increased and heterogenized. Winkel et al. (2022) report that forest owners and managers perceive that demand for forest ESs increased or strongly increased, especially for regulating and cultural ESs. There is a supply-demand risk of ESs due to human activities (Wang et al., 2021), suggesting that a lack of monitoring the supply of and demand for ESs could lead to negative ES budgets. Because the supply of ESs remains relatively constant in time, the increased demand could lead to uncertainty in the future use of ESs (Stürck et al., 2015). If the demand assessment methodology does

not consider people's perceptions, a risk exists that the mismatch between ESs supply and demand will be overlooked (Zoderer et al., 2019). ESs supply changes over time, but with different dynamics and impacts than changes of ESs demand (see also Renard et al., 2015), and this could potentially lead to a change in attitudes towards ES relative to other ESs.

The activities and measures of the European Green Deal and related policies may also affect the supply of and demand for ESs (e.g., Green Deal ..., 2023). Alternatively, trade-offs could arise from different, competing ESs uses. For example, a decision to increase the share of field's biomass yield might lead to decreased inspirational and aesthetic values (Rolo et al., 2021). An important role for recognition of (forest) ESs is attributed to various stakeholders on different levels and from different sectors (Sandhu et al., 2008; Winkel et al., 2022), including local residents. The call for more enabling bottom-up participation has also been the motivation for this study. Additionally, we wanted to explore the main perceived threats to environment in the Mediterranean context. Deforestation, forest fires and urban development and other human activities are often quoted to be the main threats to Mediterranean forests (e.g., Anaya-Romero et al., 2016). With this given background, the aim of this study is to assess the demand for ESs, perceived changes of ESs and perceived threats to the natural environment from the perspective of local residents. For this study we set the following research questions:

- What are the key ESs and what is their spatial distribution in the study area?
- How do local residents perceive qualitative/quantitative changes of different ESs over time?
- What are the perceived threats to the natural environment?

2 METHODS

The study was conducted in southwest Slovenia and encompasses five municipalities, namely Sežana, Divača, Komen, Hrpelje-Kozina and Miren-Kostanjevica. The study area is an example of rapidly changing landscapes towards naturalness. This happened firstly due to artificial planting of pine trees in the 19th century, and secondly due to land abandonment and the consequent succession. The proximity to Italy made the area diverse in demographic, socio-economic and cultural terms. Moreover, the area is often referred as one of the biodiversity hotspots with more than 40 different tree species. Forest account for 64.4% of the area, followed by meadows with 17.3% and agricultural land with 7.5%. Since most of the area lies on limestone, water is mainly found below ground, resulting in only 0.1% above ground water surfaces.

A survey of adult residents was conducted in spring 2021 to discover the characteristics of the demand and use of ESs. The calculated survey sample was 379 units (population 29,940, 95% confidence interval and 5% margin of error). Due to the expected response rate of 38% of the questionnaires, the sample size was increased to 1,000 units. The number of units sampled was proportional to the number of residents in each municipality, and units were randomly selected. Respondents received a letter inviting them to participate in the survey, the objective of the survey, and the link to the online questionnaire. One week before the questionnaire was deactivated, we sent them a

Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

135

thank-you letter and a reminder for respondents who did not have time to submit their answers.

The questionnaire encompassed questions about perceived benefits and use of ES, perceived condition of the natural environment, and demographics. The work of Baró at al. (2016), Schmidt at al. (2017), Wang at al. (2017) and Rodríguez-Morales at al. (2020) served as inspiration for the questions. Some questions were interactive, requiring respondents to delineate an area of ES they use on a given map. Survey data were organized into a single database using MS Excel 2019® and statistically analysed using JASP v0.14.1. Spatial data were manipulated using ArcGIS PRO 3.0 (Esri®) software. Spearman's rank correlation coefficient was used to determine the strength of the correlation between variables.

3 RESULTS

The number of respondents who started answering the questionnaire was 170. Of these units, 126 respondents answered the questionnaire entirely. That is 12.6% of the entire sample and 44.8% of the expected sample of 379 units. The average age of respondents was 50.7 years, ranging between 19 and 82 years. The percentage of female respondents was 49.0%. Most respondents reported living in a rural area (73.6%), some in urban centres (16.8%) and other in suburbs (9.6%). Respondents had a relatively high level of education, with 57.3% having a university degree. More than a quarter (26.0%) of respondents were retired, 62.6% were employed, 5.7% unemployed and 5.7% students. Most respondents (73.9%) had a monthly income up to 1,500 €, and 10.1% of respondents had more than 3,000 €. Of all respondents, 33.1% were forest owners with an average forest area of 3.43 ha.

The results show that the natural and semi-natural environment in the area supports most of the a priori listed ES. Except for ES hunting and ES erosion control, the ESs are quite well represented and distributed. Since respondent were not asked to rate the importance of each ES for them, the following results show the frequencies of responses. Figure 1 shows a tree diagram of respondents' selected ES; the bigger the cell size, the more respondents selected a particular ES. Landscape aesthetics was selected by 90.3% of respondents, followed by recreation (81.5%) and wild plants food (79.0%). Other four ESs were selected by more than half of the respondents, namely climate regulation, crops, wood, and flora observation.
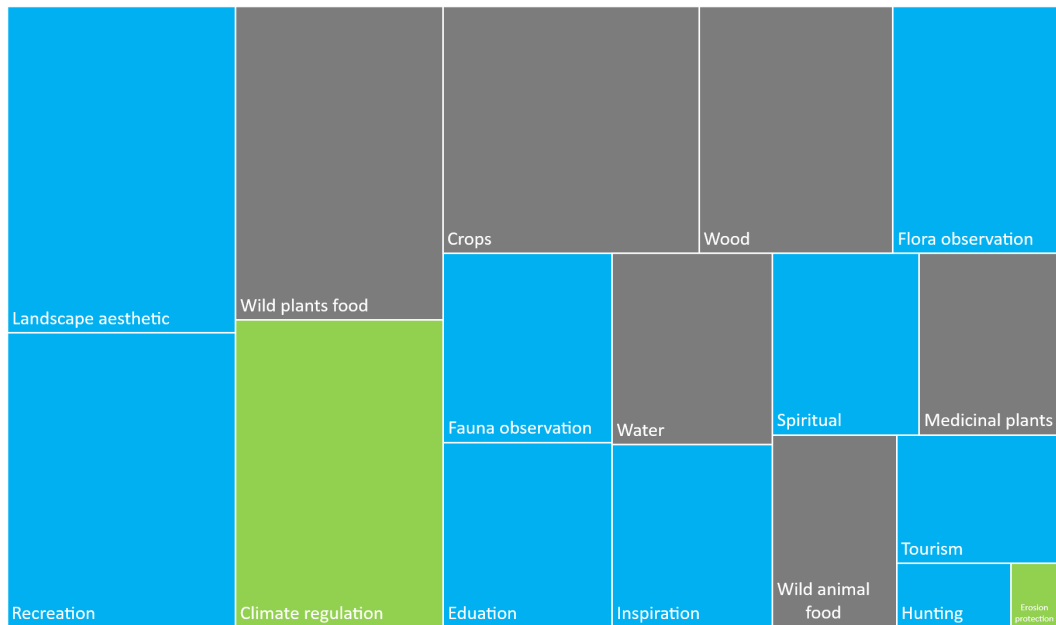
Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

136

Figure 1. Tree diagram of ESs selected by respondents.

Each respondent selected eight ESs on average, while most respondents selected eleven ESs. Most respondents (58.1%) selected between 5 and 10 ESs. The correlation table reveals that a strong correlation exists (r_s=0.616, p<0.001) between ES flora observation and fauna observation. Medium correlation exists between ES hunting and wild animal food (r_s=0.488, p<0.001), ES tourism and medicinal plants (r_s=0.474, p<0.001), ES climate regulation and recreation (r_s=0.437, p<0.001), ES inspiration and education (r_s=0.428, p<0.001), ES wild plants food and flora observation (r_s=0.405, p<0.001), and ES tourism and wild animal food (r_s=0.394, p<0.001). Although ES was recognized by many respondents, landscape aesthetics had no important correlations with other ESs, except for a low correlation with ES climate regulation (r_s=0.215, p=0.017). Only one relationship was found to be negative, although not statistically significant, and that was between ES crops and landscape aesthetics (r_s=-0.116, p=0.198).

The graphical representation was done through respondents' mapping the ESs they receive. For each selected ES, they were asked to draw one or more polygons on a map where they obtain the ES from. Of the 122 valid responses, 961 polygons were drawn, 57 polygons on average per each ES. The visualisations below were created based on the kernel density feature in ArcGIS PRO. The average size of polygons varied among ESs, with ES inspirational being the larger (18,710.70 ha), and ES recreation the smallest (2,442.96 ha). As shown in Figure 2, some ESs are spatially dispersed, while others are aggregated, indicating their tendency to be less or more specialised in terms of actual use or benefits to respondents. ES spiritual, hunting, erosion protection are strictly confined to a smaller central area with less dispersion.in contrast, ES climate regulation, landscape aesthetics, water and recreation are widely dispersed and found almost throughout the region. The main centres for ESs recreation and landscape aesthetics are scattered, but with a centre north of Sežana – the biggest town in the study area. ES tourism tends to be concentrated near the main tourist centres, such as the Lipica stud farm and the Škocjan caves.
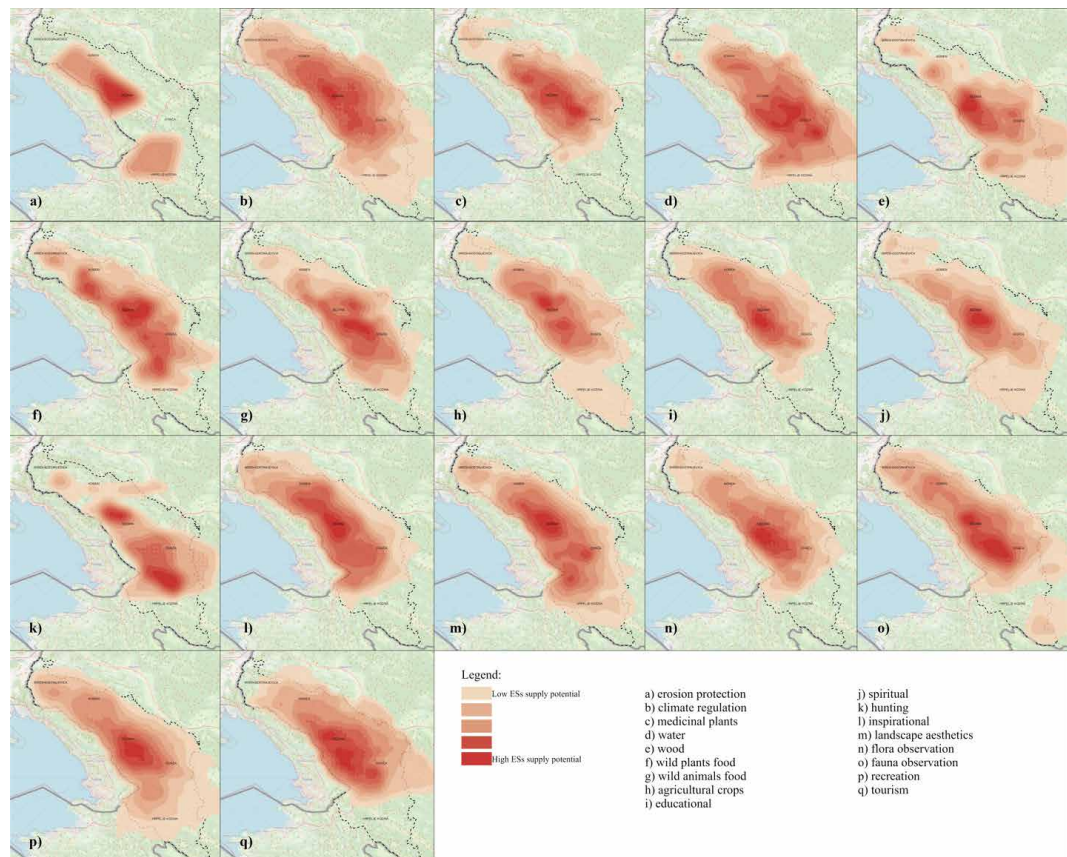
Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

137

Figure 2. Kernel density maps of seventeen ESs.

The next question asked about perceived changes in the quantity or quality of ESs over the past decade. Respondents were asked to rate the changes on a 5-point Likert scale from (1) *deterioration* to (5) *improvement*. Trend was calculated as the average deviation up or down from the (3) *no change* value. In general, the greatest positive changes were perceived for ES tourism, followed by ESs recreation, spiritual and inspiration. The greatest negative changes were perceived for ES wood, wild plants food and hunting. In all cases, the evaluation results were above average, indicating that the quality or quantity of each ES has improved. However, responses for four ESs diverged towards worsening, meaning that a downward trend was noted for these ESs. On the other hand, respondents perceived no change at all for six ESs and an upward trend was noted for seven ESs.

Residents who perceived positive changes in ES recreation, also perceived positive changes of ES tourism (r_s=0.686, p<0.001) and hunting (r_s=0.728, p=0.063). Similar high correlations were also found between ESs hunting and wild animal food (r_s=0.829, p<0.001), ESs flora observation and medicinal plants (r_s=0.589, p<0.001), ESs medicinal plants and inspirational (r_s=0.641, p<0.001) and others. Perceived threats to the natural environment and ESs provision were also measured on a scale from 1 (strongly disagree) to 5 (strongly agree). The greatest perceived threats to the natural environment and ESs provision were illegal dumping, groundwater contamination and wildfires. Respondents perceived impacts of agriculture, wildlife and tourism as less influential.

Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

138

4 DISCUSSION AND CONCLUSION

This study highlights the demand for ESs, ES changes and perceived threats to natural environment from the perspective of local residents. Residents derive the greatest benefits from ESs landscape aesthetics, recreation, wild plant food, climate regulation and crops. The least demand is expressed for ESs erosion protection and hunting. The results suggest that the remoteness of (forest) areas or their inaccessibility reduce the potential demand for these ESs. Our results indicate that recreation occurs primarily near urban and agricultural areas, while landscape aesthetics is mainly sought in remote and more forested areas. In addition, other landscape elements (e.g., characteristic plants), remoteness, and perceived wilderness influence demand for these ESs. These findings are consistent with other relevant studies, such as e.g., Kaligarič and Ivajnšič (2014), Rolo et al. (2021), Sasaki et al. (2021).

Respondents generally perceived that ESs tourism, recreation, spiritual and inspiration have improved positively over the past two decades. We did not ask specifically what about the changes, but the positive result itself shows the optimism and pro-development orientation of local policies. The ESs that showed a downward trend in change (e.g., wood, wild animal food, wild plants food) require further investigation and response. These ESs belong to the provisioning ES, and they relate in one way or another to agricultural land abandonment. In the research area, there was a strong succession of old fields in the last century, which contributed to the decline of grassland and wild plant food (e.g., Kaligarič and Ivajnšič, 2014). On the other hand, the increase in forest area led to an increase in the dispersal of larger wildlife, including wolves, wild boar, and red deer, which come into conflict with existing farms (e.g., Otero et al., 2015).

The greatest perceived threats were found to be on a local scale, i.e., illegal dumping, groundwater pollution and forest fires, rather than at the "all-encompassing" and "global" level. The least threatening impacts were those from agriculture, wildlife, and mass tourism. The root cause of this attitude remains unknown and requires further investigation. At the local level, there is evidence that prioritizing threats to the natural environment should focus on the immediate threats that people directly perceive as more threatening, rather than trying to solve the "spatially undefined" global threats.

The approach taken was to assess the magnitude and perceived change of 17 ESs, which proved to be an ambitious but achievable goal. Due to the limited number of respondents (n=126), the results are limited to this specific area, but are still useful practical application by land managers and planners. Eliminating or limiting the potential negative impacts of identified threats would lead to more efficient resident well-being and friendly environment.

5 REFERENCES

// Anaya-Romero M., Muñoz-Rojas M., Ibáñez B., Marañón T. 2016. Evaluation of forest ecosystem services in Mediterranean areas. A regional case study in South Spain. Ecosystem services, 20: 82–90. https://doi.org/10.1016/j.ecoser.2016.07.002.

// Baró F., Palomo I., Zulian G., Vizcaino P., Haase D. Gómez-Baggethun E. 2016. Mapping ecosystem service capacity, flow and demand for landscape and urban planning: a case study in the Barcelona metropolitan region. Land Use Policy, 57: 405–417. https://doi.org/10.1016/j.landusepol.2016.06.006.

Deal for Green? Contribution of managerial economics, accounting, and cross-sectoral policy analysis to climate neutrality and forest management

139

// Green Deal: New guidelines for sustainable forest management and payment schemes for forest ecosystem services. 2023. https://environment.ec.europa.eu/news/green-deal-new-guidelines-sustainable-forest-management-and-payment-schemes-forest-ecosystem-2023-07-27_en (1. 8. 2023).

// Kaligarič M., Ivajnšič D. 2014. Vanishing landscape of the "classic" Karst: changed landscape identity and projections for the future. Landscape and Urban Planning, 132: 148–158. https://doi.org/10.1016/j.landurbplan.2014.09.004.

// Otero I., Marull J., Tello E., Diana G., Pons M., Coll F., Boada M. 2015. Land abandonment, landscape, and biodiversity: questioning the restorative character of the forest transition in the Mediterranean. Ecology and society, 2, 20. https://doi.org/10.5751/ES-07378-200207.

// Rodríguez-Morales B., Roces-Díaz J. V., Kelemen E., Pataki G., Díaz-Varela E. 2020. Perception of ecosystem services and disservices on a peri-urban communal forest: are landowners' and visitors' perspectives dissimilar? Ecosystem Services, 43: 12 str. https://doi.org/10.1016/j.ecoser.2020.101089.

// Rolo V., Roces-Diaz J.V., Torralba M., Kay S., Fagerholm N., Aviron S., Burgess P., Crous-Duran J., Ferreiro-Dominguez N., Graves A., Hartel T., Mantzanas K., Mosquera-Losada M.R., Palma J.H.N., Sidiropoulou A., Szerencsits E., Viaud V., Herzog F., Plieninger T., Moreno G. 2021. Mixtures of forest and agroforestry alleviate trade-offs between ecosystem services in European rural landscapes. Ecosystem Services, 50: 13 str. https://doi.org/10.1016/j.ecoser.2021.101318.

// Sandhu H.S., Wratten S.D., Cullen R., Case B. 2008. The future of farming: The value of ecosystem services in conventional and organic arable land. An experimental approach. Ecological economics, 4, 64: 835–848. https://doi.org/10.1016/j.ecolecon.2007.05.007.

// Schmidt K., Walz A., Martín-López B., Sachse R. 2017. Testing socio-cultural valuation methods of ecosystem services to explain land use preferences. Ecosystem Services, 26: 270–288. https://doi.org/10.1016/j.ecoser.2017.07.001.

// Stürck J., Schulp C.J.E., Verburg P.H. 2015. Spatio-temporal dynamics of regulating ecosystem services in Europe – the role of past and future land use change. Applied Geography, 63: 121–135. https://doi.org/10.1016/j.apgeog.2015.06.009.

// Wang B., Tang H., Xu Y. 2017. Integrating ecosystem services and human well-being into management practices: insights from a mountain-basin area, China. Ecosystem Services, 27: 58–69. https://doi.org/10.1016/j.ecoser.2017.07.018.

// Wang Z., Zhang L., Li X., Li Y., Fu B. 2021. Integrating ecosystem service supply and demand into ecological risk assessment: a comprehensive framework and case study. Landscape ecology, 10, 36: 2977–2995. https://doi.org/10.1007/s10980-021-01285-9.

// Winkel G., Lovrič M., Muys B., Katila P., Lundhede T., Pecurul M., Pettenella D., Pipart N., Plieninger T., Prokofieva I., Parra C., Pülzl H., Roitsch D., Roux J.-L., Thorsen B.J., Tyrväinen L., Torralba M., Vacik H., Weiss G., Wunder S. 2022. Governing Europe's forests for multiple ecosystem services: Opportunities, challenges, and policy options. Forest policy and economics, 145: 102849. https://doi.org/10.1016/j.forpol.2022.102849.

// Zoderer B. M., Tasser E., Carver S., Tappeiner U. 2019. Stakeholder perspectives on ecosystem service supply and ecosystem service demand bundles. Ecosystem Services, 37: 100938. https://doi.org/10.1016/j.ecoser.2019.100938.

https://doi.org/10.20315/SilvaSlovenica.0022.14