Accounting for the recreation benefits of the Flemish Natura 2000 network through landscape preferences and estimated spending

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Abstract

This paper describes the methods used to produce accounts for the recreational value of Natura 2000 areas in Flanders, Belgium. First, a biophysical account of recreation supply and demand is compiled and mapped. Demand is based on data for green visits per year per inhabitant and covers both recreation and nature-based tourism. It distinguishes local walking trips, local cycling, recreation trips with pre-transport and visits by tourists. The number of green visits is based on a combination of yearly statistics (for tourism, day trips) and irregular surveys (for local visits). The supply account is based on modelling predicted visits. The annual visits per inhabitant are attributed to ecosystems using a green visit prediction model that uses the extent and condition accounts related to availability of green-blue areas, accessibility, the attractive potential of landscapes for informal recreation (extent and condition accounts), residence and distance decay functions for different recreation types.

Potential destinations include a wide range of green infrastructure, such as parks, forests, natural and agricultural areas and blue spaces (waterside and coastal natural areas). The attractiveness of landscapes is mainly based on an empirical study (choice experiment) in Flanders on people's preferences for landscape features complemented by evidence from literature.

The monetary accounts are preliminary, as there are unsufficient data available for Flanders to estimate the total value for the wide range of recreation types (from local walking and biking to tourism). Especially, data are missing to model travel and time costs for local visits (walking and biking), that account for a large share of total visits in Flanders. It should be noted that, for most visits, apart from nature-based tourism, valuation cannot

be based on income fees or parking costs because, in Flanders, visits and parking are free.

As unsufficient data are avaible to estimate travel and time costs in detail, we used Flemish data on average expenditure per visit per recreational type as a proxy. We discuss the limits of this preliminary approach and suggest further steps.

In the results session, we discuss the implementation of the model to estimate the predicted visits to parts of the Natura2000 areas in Flanders in 2016 and 2018. As different land-uses are strongly interwoven in Flanders, these areas include a wide range of different land-uses and also areas close to residence used for local walking and biking.

The differences between 2016 and 2018 illustrate how the model of predicted visits allows us to cope with land-use changes and improved quality and attractiveness of the landscapes in Natura2000 areas.

Keywords

ecosystem service recreation, physical account, number of visits, monetary valuation

Introduction

The population density of Flanders is amongst the highest in Europe (459 persons per square km). Open green space is under increasing pressure from urban and infrastructural development. It is important to measure the value of this open space to provide information for sustainable land management and policy-making (Daniel et al. 2012, IPBES 2018). This can be done by producing accounts for the ecosystem services provided by nature areas, connecting ecosystems to socio-economic systems (Vallecillo et al. 2019). Valuation is important. However, monetary values should not be considered to provide and do not intend to estimate a complete "value of nature".

Open space for outdoor recreation is an important ecosystem service, especially in areas where open space is scarce (Andrew et al. 2011, Mourato et al. 2011, Liekens et al. 2013 ,). An important indicator of the recreational benefits of an area is the number of green visits, i.e. the visits per year to green areas (Bateman 2014). In Flanders, such an indicator did not exist. Therefore, identifying the drivers that determine the number of visits is important. Several studies have modelled visit numbers to protected areas or nature areas based on spatial variables that estimate the attractiveness of landscapes and distance and that illustrate competition between different areas to attract visitors. One widely-applied approach is to use choice models to predict recreational behaviour at the individual level (e.g. Bateman et al. 2011), other authors use data on visitor monitoring studies and GIS data to predict the characteristics driving visitor numbers (e.g. Goossen et al. 2011, Lavorel et al. 2014, Schägner et al. 2016). Recently also social media platforms are used to define the recreational attractiveness value of landscapes (e.g. Long et al. 2021).

Studies that value both natural and agricultural landscapes as recreational destinations remain scarce (Van Berkel and Verburg 2014), as most studies only focus on natural landscapes. Agriculture is sometimes described as relatively unattractive for recreation (e.g. Paracchini et al. 2014), whereas other studies and surveys indicate that agriculture may be even more important than nature and forest for informal recreation (Alterra 2014). However, there are only a limited number of studies that compare nature and agriculture (Sen et al. 2011, Vecchiato 2012, van Zanten et al. 2014). Other studies apply more generic characteristics of land use (naturalness, diversity, openness etc.) that are relevant to agriculture, as well as nature and forests (de Vries et al. 2004, Crommentuijn et al. 2007, De Valck et al. 2017). Building on these studies, we made an assessment, based for the Natura 2000 areas in Flanders by selecting the most appropriate indicators. Using these characteristiscs means that the appreciation of agriculture and natural areas can vary depending on the broader environment.

Moreover, most studies focus on a single types of recreational activity, for example, day-trips to forests and natural areas. However, literature shows that only in exceptional cases (e.g. Sen et al. 2011, Kienast et al. 2012) is it possible to build a fairly complete recreation model, including different types of recreation and landscapes, based on a single dataset. The studies that do build a complete recreation model started from a large qualitative set of data about green visits (e.g. NECR 2013) or favourite locations (Kienast et al. 2012). They used these data and a statistical analysis, based on information about land use, distances and terrain to explain the diversity in the number of visitors. This approach requires very good data.

In our study, we developed statistics to estimate the economic importance of recreation in green areas. In Flanders, no large datasets on visits to green areas exist. We demonstrated that, by following a more pragmatic approach to combine different studies and datasets, we can develop a good recreation model that covers all types of recreation (from short trips starting from home to longer trips with pre-travel and tourism). We also demonstrated that this kind of data, combined with monetary valuation data, deliver insights on how the Natura 2000 network influences these benefits.

This paper is organised as follows: in section two, we describe the case study area and the land use change in the Natura 2000 network between 2016 and 2018 that is examined in the analysis. In section three, we provide methods and data and predictors used in our models. We explain how we clustered spatial cells to landscapes and how we used the selected predictors to distribute the number of short trips, bicycle tours and short walks from home over the available green space in Flanders. We also discuss the monetary values used. The results are presented and discussed in section four and five, respectively.

Case study

Natura 2000 (N2K) is a network of core breeding and resting sites for rare and threatened species, as well as for some rare natural habitat types which are protected in their own right. It stretches across all 28 EU countries, both on land and at sea. The aim of the

network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats that are listed under the Birds Directive and the Habitats Directive.

The Flemish Natura 2000 network contains 40 areas. In each of the areas, species and habitats need to be protected and should not deteriorate further. In order to maintain the populations and habitats, some goals are set. In some cases, measures need to be taken to improve the quality of habitats, in other cases, habitats need to be expanded in order to preserve particular species. These conservation goals need to be met by 2050. In order to reach these goals, a management plan was developed. This plan explains the different steps over the years that need to be taken in order to reach the goals. Management programmes are set up for (maximum) 6 years cycles.

However, Natura 2000 is not a system of strict nature reserves from which all human activities would be excluded. While it includes strictly-protected nature reserves, most of the land remains privately owned. It reflects that, although Flanders is one of the most urbanised regions in Europe, urban land use (residential areas) seem to be strongly interwoven with green and blue areas in comparison with other western European countries (Jaeger et al. 2007). The approach to conservation and sustainable use of the Natura 2000 areas is much wider, largely centred on people working with nature rather than against it. Therefore, it is important to also take the socio-economic impact of the actions and programmes into account.

This paper builds on a study with a large scope, i.e. developing indicators and measuring and monitoring socio-economic impacts like employment, impact on different sectors and impact on ecosystem services. The methods used to account for the ecosystems services are described in Vrebos et al. (2017). In this paper, we describe the method used for the recreation services and we discuss it in more detail in relation to natural capital accounting. We calculate the change in the actual delivery of recreation benefits attributable to changes in the Natura 2000 network between 2016 and 2018.

Material and methods

Generally, the compilation of accounts in monetary terms will require the use of data in physical terms. Fig. 1 describes the different steps of the method to model both supply (upper part of the figure) and demand (lower part) for recreation.

Potential flow of nature-based recreation

The supply depends on;

1.   the amount of open green space
2.   the relative attractiveness of the landscape and
3.   the degree of accessibility and facilities for recreation.

Landscape attractiveness (2) was calculated for each cell (100 to 100 m or 1 ha) as a function of land use and features of the environment (500 m around the cell unless

otherwise specified). It took into account the amount of open green space (nature and forest, parks, agriculture and water) which is weighted, based on a score for attractiveness and accessibility.

The factors and weights to calculate attractiveness of the landscapes are mainly based on a choice experiment study among 1400 inhabitants of the Province of Antwerp, Flanders (De Valck et al. 2017). This Province has a good mixture of landscapes ranging from farmland to forest, heathland and wetlands. The study estimated preferences for different characteristics of natural and agricultural landscapes to recreate through a distance-based discrete choice experiment (Louviere et al. 2000). The attributes used in the choice experiment were naturalness, diversity and openness of the landscape, presence of water in the landscape, tranquillity in the area (noise levels), presence of sign-posted routes and level of recreation facilities. Rather than using direct costs (e.g. fee), we used home-site distance as the payment vehicle (Christie et al. 2007).

This choice experiment covered the most important elements, but not all relevant factors (based on qualitative literature and discussions with experts and in focus groups) could be included in one experiment. To consider also these other factors, for example, visual intrusion or terrain (topographical relief), we uses data from literature (Roos-Klein Lankhorst 2004, CPSS 2005, Crommentuijn et al. 2007, Maes 2012, Vecchiato 2012, Casado-Arzuaga et al. 2013, Simoens et al. 2014). Although these factors were more uncertain, it proved to be necessary to account for them, when validating the model through monitoring data in some natural areas (see Table 1)

Indicators of Attractiveness

From literature, naturalness emerges as the most important factor for attractiveness of the landscape (e.g. Crommentuijn et al. 2007, Sen et al. 2011, van Zanten et al. 2014). We implemented this by building the basic score for attractiveness on naturalness. This basic score for naturalness (2a in Figure 1) is determined as the proportion of nature, forest and water in a green area. The weighting factor was derived from the choice experiment (De Valck et al. 2017).

Secondly, most studies and assessment systems indicate that there are additional factors that increase or decrease the attractiveness (Moons et al. 2008, Verhagen et al. 2016, Soy et al. 2018). We implemented this through a system of mark-up factors or decay factors on the base score. As a result, the base score was increased as the landscape is more diverse (2b) and has water present (2c), if there were height differences (2c, relief) or cultural historical heritage (2d) was present. On the other hand, the score was lowered due to the presence of interfering elements, especially noise pollution (2g, highly linked to motorways), horizon pollution (2h, power lines and wind turbines) and heavy industry (2i).

De Valck et al. (2017) indicated that more diverse areas are 50% more likely to be visited by the respondents. This is in line with literature (e.g. Verhagen et al. 2016, Soy et al. 2018). We used the share of forest in an area to measure the landscape diversity. Areas with

water (rivers, lakes, ponds) had a 10% higher chance of being visited. This is in line with literature (Bateman 2014, van Zanten et al. 2014, Schägner et al. 2016).

The effect of the relief on visitor rates was not studied in Flanders. Nevertheless, literature showed that it is an important feature. We used a simplified indicator to assess relief and a mark-up based on the Spanish assessment system for landscapes (CPSS 2005). We acknowledge this is a rough approach, but comparison of results with and without this factor illustrated that it is important to consider it, in order to take into account some attractive hilly areas. Literature and focus groups indicated the importance of cultural heritage in the landscape. We took this into account using the presence of protected cultural patrimony as indicator (including protected landscapes, city views and monuments) and gave an up-mark based on literature (CPSS 2005).

The proximity of buildings and heavy industry in the area was seen as less attractive for an area. The effect was partly mitigated if the buildings are buffered by high greenery. We weighted the factor, based on the % of building and % of high greenery in the proximity of the areas. As there was not a specific study for Flanders available, we used the weights from the Dutch 'BelevingsGIS" (Crommentuijn et al. 2007, de Vries et al. 2007). The same approach is applied for visual intrusion related to the presence of windmills and high voltage lines.

De Valck et al. (2017) showed a clear negative effect of noise levels on the choice where recreation might occur. The weights in the study were used in our model.

Indicators of accessibility and recreational facilities

The score for facilities (3) covers path density and recreational facilities and was calculated for a larger area, covering multiple cells. To this purpose, cells were first clustered into areas (1b). This step was necessary because, in practice, larger green areas often combine different land uses and different ownership; for example, a combination of public forest and natural areas, with intermediate pieces of agricultural land or private forest. When these areas are adjacent, they were clustered into one area with different land uses. The cluster algorithm took into account the size and proportions of the different land uses, distances and barriers such as highways, roads or waterways.

We assessed the accessibility (3a) of the area, based on the presence of roads and paths throughout the area and determined per cell (100 m x 100 m) a score for path density based on the paths running through the area and paths in the proximity of the cell (within 400 m). We used the same rules for public forest, private forest and agricultural area, as we did not have very detailed information whether specific roads are really accessible for recreation or not. The score for path density was increased if sign-posted trails for walking or cycling are present (2b). The weights were again based on De Valck et al. (2017), indicating a 50% higher preference for areas with sign-posted trails.

De Valck et al. (2017) and Goossen and de Boer (2011) also showed that areas that are better equipped (e.g. toilets, benches, information panels, watch towers, visitor centres),

are preferred over less well-equipped areas for recreation. As we did not have good area-covering information about the whole set of facilities, we only gave a higher score to areas with a visitor centre (3c).

The total score for accessibility and recreational facilities (3) was normalised for Flanders to a score between 0 and 1. For larger areas, the score may differ by cell within that area because the path density may be higher in more-area subfields.

Total score for supply

The total score for the recreation supply (4) was determined per cell and is the average of the score for attractiveness of the landscape and the organisation of the area. (see Fig. 2)

Demand for recreation in green space

The total demand for recreation (7) is the sum of demand by residents and the demand by tourists. The demand of residents (5) was calculated for each cell, based on the number of residents in that cell (5b) and the average number of yearly visits per resident (5a). The demand of tourists was determined by tourist region, based on data for the number of overnight stays (6a) and the number of visits of green area per overnight stay (6b).

The average number of visits per inhabitant (5a) was derived from different surveys in Flanders on recreation and travel behaviour. The total number of visits per year per inhabitant and the division between different recreation types was based on VITO surveys (Anonymous 2009, Liekens et al. 2012, Liekens et al. 2013, De Valck et al. 2016, De Valck et al. 2017) and verified by the results of previous studies on perceptions of the natural environment (Beyst 2012), on travel behaviour (Glorieux et al. 2008, Janssens et al. 2010) and studies on day trips (Jellema and Vries 2003, WES 2014). The number of yearly visits was in line with the results for more detailed and longitudinal studies in neighbouring countries (The Netherlands (CVO/CVTO 2007, Donders and Goosen 2012, Alterra 2014) and the UK (NECR 2013).

For the interpretation, one should take into account that the average number of visits per resident is strongly dominated by a relatively small group of people who make a lot of smaller walks or bicycle trips each week. From the UK figures, we learned that half of the taken walks are with a dog (NECR 2013). We did not have comparable indicators for Flanders. As the number of dogs per capita in the UK is comparable to Flanders, we assumed that the number of walks with the dog will also have an important share in the frequent, smaller trips close to home.

The average number of visits per capita was applied to the total population. We acknowledge that the model did not properly take into account border effects (visits from inhabitants from neighbouring regions or countries and visits from Flemish people to these regions). We further acknowledge that the method did not correct for groups that do not undertake recreation that often or at all (including young children, elderly, prisoners and sick people...).

To define the number of visits by tourists (6), we took into account the number of overnight stays by tourists in the 18 tourist regions (6a) and the average number of visits to green space per overnight stay (6b) based on tourist information (Toerisme Vlaanderen 2016).

Spatial variation of supply also drives demand

The data from surveys in Flanders (Liekens et al. 2012, De Valck et al. 2017) show that, on average, residents in areas with a higher supply of green areas report more green visits per year. Therefore, to model predicted green visits to green areas, we needed a detailed map of green visits per resident that reflects this spatial variation. As we did not have enough local specific data to build such a map, we needed to model it. To this purpose, we estimated an elasticity of supply. From the Flemish data and in line with literature, we estimated an elasticity of 0.4, which means that residents living in an area with 10% more open green space than the average for Flanders, make 4% more visits per year (De Vries et al. 2004, Anonymous 2009, Siikamäki 2011, Broekx et al. 2013, Broekx et al. 2014

We applied this elasticity for local visits (walking and cycling), based on the score for supply, which takes into account both the availability and quality of the supply of green areas (4). To this end, we calculated the average supply score in a 5 km radius (for walks) and 10 km (for bicycles). We use this elasticity to build a map of green visits per year, with spatial variation, while ensuring the average remains the same.

To avoid extreme values for residents living in very green areas, a maximum of 30 local green visits per inhabitant per year was applied.

The elasticity of demand is an important feature of the model to estimate the impacts of changes over time, both in terms of land-use and quality of the landscape. It allows that the total number of visits will increase if size or quality of green areas improves. It is an essential feature to allow us to account for specific measures, especially related to the quality of the landscapes.

Biophysical assessment of nature-based recreation: actual flow

Through an allocation mechanism (8), the total number of visits demanded in a cell was assigned to the available green area around this cell, considering differences in proximity (8b), size (8a) and quality of green space supply. The allocation was done on a cellular basis via a specifically designed GDX script (Van der Meulen 2016).

The most important mechanism for allocating visits was the distance decay, which reflects that areas close by are more frequently visited than further areas. This principle is generally accepted, but in literature, different formulae are used to implement this. In accordance with de Vries et al. (2004), we used different formulae for different modes, so the distance decay is larger for slow modes of transport (walking) than for faster modes (pre-transport by car, bus, train).

The criterion size (8a) reflects that smaller areas are less attractive for far and long visits. The size of an area was determined by the cluster algorithm (1b). We used the principle that the time you can spend in an area must be at least as long as the time invested to get there.

The allocation mechanism took into account the proximity of substitutes within Flanders (other green recreation spaces), but not substitutes in the neighbouring regions.

Tourist visits were allocated, based on the available green area within the 18 touristic regions of Flanders. For each region, specific criteria were used on the size of the areas, reflecting regional differences in availability of larger areas, for example, along the coast.

The final product of the model was the expected number of visits per year per cell (1 ha) (9) with a distinction between local walking trips, local cycling, recreation trips with pre-transport and visits by tourists.

Monetary valuation

For the monetary valuation of recreation services from ecosystems in the context of natural accounting, it is recommended to make a distinction between local visits, visits with pre-transport and longer visits involving spending by visitors (tourism, day visits) (Barton et al. 2019). For the monetary account for recreation and nature-based tourism, the methodological and practical issues have been discussed at length in several reports and papers for the UK (Bateman et al. 2011, Bateman 2014, Ricardo Energy and Environment 2016, EFTEC 2017, ONS 2021) and in Barton et al. (2019).

The monetary accounts are preliminary, as there are unsufficient data available for Flanders to estimate the total value for the wide range of recreation types (from local walking and biking to tourism). Especially, data are missing to model travel and time costs for local visits (walking and biking) that account for a large share of total visits in Flanders. It should be noted that, for most visits, apart from nature-based tourism, valuation cannot be based on income fees or parking costs because, in Flanders, visits and parking are free.

To comply with accounting principles, translation into monetary terms needs to be done by using exchange values. Where payments are made by people to economic units who manage ecosystems, for example, managers of national parks, for access to ecosystems, or where payments are made to economic units who support activities in ecosystems (e.g. canoe rental businesses), connections can be made to entries in the standard national accounts (United Nations 2021). Most green visits do not involve a monetary transaction or costs. Larger trips with pre-transport (e.g. by car) involve some transportation costs or entrance fees (although the latter are very rare for Flanders natural areas). For nature-based tourism, transportation costs are important and data are available. For all these types of green visits, the opportunity costs of time during transport and the trip are relevant.

Since prices for ecosystem services are not generally observed, a range of methods have been developed for estimating them. Chapter 9 of SEEA EA White Paper describes the methods that support the derivation of prices for ecosystem services that are consistent with exchange values and, hence, can be used to provide estimates for entry into the accounts (United Nations 2021). As we did not have many alternatives, we had to choose a method where the prices are based on revealed expenditure in related goods and services (see 9.3.5. in United Nations 2021).

"The travel cost method (TCM) is commonly used in economics to estimate the value of recreational areas based on the revealed preferences of visitors to the site. A demand function for recreation is estimated by observing the actual number of trips that take place at different costs of travelling to a recreational or cultural site and assuming that people hold similar preferences with respect to visiting the site. Costs of travelling include data on the expenditure incurred by households or individuals to reach a recreational site, entrance fees and may include the opportunity cost of time to travel and visit the site. Travel cost data are ideally captured at a detailed level that considers the different features of the sites being visited and enjoyed. The area under the demand function provides a measure of the welfare value of the site i.e. including consumer surplus. For ecosystem accounting purposes, it is required to calculate the exchange value of the associated ecosystem services, generally recreation-related services. An exchange value can be estimated on the basis of the demand function using the simulated exchange value method*[1]. In the absence of estimated demand functions, exchange values can be approximated, based on aggregated travel cost data (e.g. fuel). Where travel cost data are not available, an alternative method to obtain the exchange value of recreation related services is to sum relevant consumption expenditures (e.g. using data from tourism satellite accounts)" (cited from United Nations 2021, paragraphs 9.47-9.48).

The UK, being a frontrunner in natural capital accounting, calculates yearly Natural capital accounts on recreation and tourism. They use the expenditure to travel to the natural environment and some expenditure incurred during the visit (parking fees, transport costs, vehicle running costs and admissions) to create the monetary account. In 2019, the annual flow of the natural environment was estimated to be £14 billion (2020 prices) (ONS 2021).

Additionally, the natural capital account on recreation-based benefits of ecosystems in the Netherlands is based on the consumer expenditure method (CBS 2018). They take in addition to the travel costs also other expenditure like costs for food and drinks into account. In 2018, the annual flow was estimated to be 5.8 billion euro (only recreation, no tourism, longer than 1 day). This is about 9% of the total recreational expenditure in the Netherlands.

As stated in Barton et al. (2019), the most important problem for monetary accounts is not the method, but the availability of data to use the appropriate methods.

In Flanders, no travel cost data are available. Therefore we use, following the example of the Netherlands, expenditure data from recreation and tourism studies as a proxy. We build

on different Flemish studies and data for tourism (Westtoer 2012, Toerisme Vlaanderen 2012, Nijs 2014, Toerisme Vlaanderen 2016), day trips (Toerisme Vlaanderen 2011, Huis 2012), studies for specific areas (MAS 2009) and studies in neighbouring countries (e.g. CVO/CVTO 2007). Based on these sources, the average spending for a visit was estimated €8.3 (see Table 2). Although they only make up a small share of the total number of visits (respectively 6% and 4%), day trips and tourist stays have a relatively much larger share in the expenditure. Expenditure mainly takes place in the catering and tourism sector (hotels and holiday residences). Furthermore, specific expenses are made, such as the purchase of walking or cycling maps or reimbursements for guided walks etc. These figures do not include related expenses, such as investments in binoculars, bicycles or hiking boots. The majority of the visits were short walks and local cycling tours. For these kinds of visits, far less data were available. This could be improved by also including questions on expenditure for short trips into the national surveys.

We acknowledge that the monetary accounts are preliminary and in the discussion session, we evaluate different steps to improve these accounts.

Application to the Natura 2000 sites and impact of restoration actions

We followed the same approach as described above to calculate the effect of the Natura 2000 programme of 2018 in comparison with the condition of the network in in 2016. For 2016, we use the land use map of Flanders (Poelmans et al. 2016). For 2018, we created a new land-use map using different updated GIS sources also used for the official land-use map (Agriculture registration; monitoring data of habitats etc.) and where possible, different data sources on management actions and actions on expanding habitats were integrated.

The changes that take place over a period of two years are usually not large. Nevertheless, a number of important trends could be identified, which, in the longer term, can have a major impact on the landscape and the delivery of ecosystem services. On agricultural plots, the area of grassland is decreasing, while the area of arable land is increasing. In total, the agricultural area is decreasing to the benefit of nature restoration, but also increasing urbanisation. As a result, the total surface area of open space in Natura 2000 area is still decreasing. The GIS data layers that provide the information for the delineation of urban and agricultural areas are kept systematically and in detail. As a result, we can assume that these trends actually took place within the time period of 2 years.

Given the current state of mapping the habitat changes within the nature areas, the trends in habitat types is not so clear-cut. Notwithstanding this, certain clear trends can be identified. Coniferous forest is clearly declining, partly due to conversion to deciduous forest, but also due to deforestation in favour of habitat types, such as heath.

This new land-use map was used as input for the above calculation scheme to see if the number of visits in the Natura 2000 areas would change due to increased attractiveness of the area.

The change in visits was then valued on a monetary basis using the total spending per visit and, in a next step, the added value of these visits to the touristic sector was estimated. The translation from spending to added value was done according to Weekers (2012).

Results

Biophysical account for the whole of Flanders

The results are shown in the following maps with the expected number of visits per ha for the different types of activities, classified in classes. The scale differs per map. For all maps, the same elements were important (landscape quality, organisation and size of areas, proximity to home), but the relative weight of these elements and the importance of substitutes differed. This is due to the fact that visits were divided over a different maximum distance, with a different distance decay and different criteria with respect to the minimum size of the area. For local walking, the proximity was relatively more important (Fig. 3). Residents have relatively little choice between areas to meet their demand and the map reflects partly the population densities. As local walking has more visits per resident and because the possibilities for spending these are sometimes limited, the number of visits per ha may increase strongly (high grades in the highest decile). We need to be careful in the interpretation for the areas with very high scores (highest decile) as this is rather an indicator for the scarcity of green areas to fulfil the demand rather than a large supply of the recreation service by those areas. The method also had its limitations for these situations. For example, the method did not consider adaptive behaviour for people in areas with little green space. In reality, they are likely to adapt and to replace walking trips with bicycle trips or trips with pre-transport. This remark is especially valid for walking trips. For bicycle trips (Fig. 4), this was less prominent because the number of trips per inhabitant is lower and they are spread over a larger distance. For trips with pre-transport (Fig. 5) and tourist stays (Fig. 6), the choice of where to go is larger and the focus will be on larger and more attractive areas.

The map with the total number of visits (all activities) (Fig. 7) shows that population density is an important factor for the number of visits per ha. This appears to be contradictory to the findings of surveys by residents who indicate naturalness as the most important factor. However, if we look at the number of visits, the proximity of urban centres is more important. This is consistent with findings of statistical analyses of visits, land use and proximity population, for both the UK (Bateman 2014, Sen et al. 2011, Bateman 2014) and European scale (Schägner et al. 2016, Long et al. 2021)

Results of the model for the NATURA2000-network for actions taken between 2016 and 2018

The total number of visits to Natura 2000 sites in 2016 was estimated to be 15.8 milion. Due to land-use changes and changes in habitat quality, the total number of visits increased to 17.5 million in 2018.

This is partly due to an increase in the surface area of open water that makes the areas more attractive for recreation. In addition, there is also an increase in general diversity, with an optimal ratio between the amount of forest and other greenery within a distance of 500 m. This leads to a general increase in attractiveness compared to the landscapes that lie outside the Natura 2000 network.

The monetary flow for recreation-related services for the Natura 2000 areas only (excluding nature and agricultural areas outside the Natura 2000 network) was estimated around €132 million for 2016 and €146 million in 2018. These are in line with other studies estimating the benefits of recreation and tourism in Natura 2000 areas using the total spending of visitors (Bio Intelligence service 2011).

Through the realisation of the conservation and restoration goals of the Natura 2000 management programme for 2018, the total amount of spending increased by €14 million. To estimate the economic importance of this extra spending, we use the added value derived from the tourism satellite accounting method developed in Europe. Based on Weekers (2012), spending for recreation and tourism generated a 42% added value in the touristic sector, but also in other linked sectors. This means that the extra spending due to the actions in the Natura 2000 network increases the added value for the touristic sector and other linked sectors by €5.8 milion per year.

Discussion

The methodology is novel in the sense that we made a first attempt to estimate for Flanders the total number of visits over different types of recreation (short walks with the dog, longer walks, bicycle trips, day trips and tourism) and landscapes (nature, forests, agricultural landscapes) without having access to a large dataset of visits and visitor data. We constructed a model based on specific choice experiments for Flanders and factors from literature.

Comparison with visitor data

In order to validate the method and the results, we compared the maps with attractiveness scores with maps, based on other information (e.g. expert reviews). This visual comparison confirmed that cells in natural areas with a visitor centre, areas indicated by experts as

high-value landscapes (ankerplaatsen) and areas selected by experts for the development of tourist infrastructure (for tourism in Flanders) rank higher for attractiveness. We acknowledge that the attractiveness of specific open landscapes (such as heathland and 'polders'), which are highly valued in expert models, might be underestimated in our model. The openness of the landscape, defined as no high greenery to block the view of the visitors, was taken into account in the choice experiment as an attribute, but was not significant (De Valck et al. 2017). Further research might clarify the importance of these specific kinds of open landscapes.

Second, we expected that areas with visitor centres to be located mostly in more attractive landscapes. Our maps show that these areas score double in attractiveness and that they attract three times more visitors than areas with no visitor centres.

Third, the number of visits per year was compared with some available data from visitor monitoring and estimates for specific areas (e.g. Natuurpunt 2013, Vlaeminck 2015, Kenniscentrum voor het Toerisme Limburg 2015). Overall, the model provided higher estimates of total visits compared to these other studies. One explanation may be that the model estimates a wider range of trips than other studies. Especially, short visits from nearby residents, which account for a large share of total visits in our estimate of total green visits per year and, thus, in the model, are often neglected in other studies. Other studies mainly focus on longer trips (half day to one day visits) and by people that pass by visitor centres.

The difference between our estimates and other studies is larger for very large areas (+ 500 ha). As we allocated visits on a cell resolution of 10 × 10 m, large areas can easily attract many visitors in our model. Further research is needed to evaluate if the model can be improved for large areas.

Use for Ecosystem accounting

The results may be used as a first input to set up ecosystem physical accounts, valuing the ecosystem service recreation. The SEEA EA complements the measurements of the relationship between the environment and the economy described in System of Environmental Economic Accounting- central framework, on its turn complementing the system of national accounts (SNA). The SEEA-EA has the focus of making visible the contributions of nature to the economy and people. The results show that it is possible to develop physical supply and demand accounts for recreation and nature-based tourism, starting from annual statistics on average green visits per year, tourism data and modelling predicted visits to green areas. For tourism, annual data are available. However, in order to follow up the evolution over time, more systematic data gathering is needed, especially for local walking and biking and for day trips. To this purpose, it needs to be further explored how this account can build on periodic surveys, such as the time use surveys (Statbel.be) or research programme for transportation behaviour (Janssens et al. 2020).

The study and literature (e.g. accounts for the UK) show that it is possible to develop monetary accounts, based on these detailed physical accounts and in line with SEEA EA

requirements. In this study, however, monetary accounts for Flanders are limited to a preliminary account, based on gross expenditure data for the different green visits types. These accounts can be improved by estimating more in detail the transportation and time costs, associated with each type of green visit and for different users. To follow up the evolution of these monetary accounts, most information may come from updated data to estimate green visits in detail (e.g. time spent for green visits), as well as regular updates of surveys on expenditure.

The available data for the monetary accounts are limited to streams that are partly already reflected in the SNA. Other benefits (e.g. health benefits), derived from recreation-related services of ecosystems, are not included in these numbers.

Limitations

This method was primarily developed for Flanders, using data for Flanders. We acknowledge that the model does not account properly for border effects, as we do not have comparable information for recreation facilities across the border. The model overestimates visits by Flemish people to Flemish open areas in border regions. On the other hand, local visits and day trips by residents from neighbouring regions are missing. A consistent transborder exercise is needed to account properly for both effects.

The predicted visits for each green area are a modelled proxy, that can be improved in many areas, related both to methodology and data required for the model. The model builds on detailed extent and condition acccounts to take into account (changes in) land use, vegetation, accessibility or provision of facilities, which require detailed and consistent data and maps for all areas. The methods could be improved for larger areas, especially to better estimate the impact of size of the area on attractiviness (as discussed above), as well as the importance of entry points to larger areas with facilites such as parking and information. In addition, the identification of the size of an area can be improved because Flanders has many areas with a high number of smaller, scattered green areas that, in practice, may act as one large area to attract visitors. This also requires more data on visits to specific areas, in order to validate the model predictions.

As illustrated above, an important feature of the model is the supply elasticity that allows the model to introduce spatial variation in the average number of geen visits per inhabitant per year and which allows the model to estimate more green visits if total green area or its quality improves. The elasticity of supply could be further improved and substantiated by local studies, especially to account more in detail for changes in quality of supply. Second, spatial variation should also take into account other aspects such as demography or habits. To improve these elements, more local data on green visits per year are needed, to allow us to select representative subgroups for location, age etc.

SEEA EA applies the accounting principles of the System of National Accounts 2008 (United Nations 2021). In the context of monetary valuation, the SEEA EA applies the SNA concept of exchange values. While estimates based on this value concept are useful in many contexts, there are some limitations. For example, they do not include the monetary

value of the wider social benefits of ecosystems, including their non-use values. These welfare values need other methods to measure them. The numbers in this paper are, therefore, only partly useful in, for example, cost benefit analysis and need to be complemented with other data that also measure consumer surplus (chapter 12 of United Nations 2021).

Conclusions

The model was used to estimate the recreational value of Natura 2000 areas in Flanders. This valuation exercise shows that this ecosystem service is an important element in total economic value of different land uses and landscapes especially since Flanders has a high population density and the landscapes are suitable for informal recreation (walking and biking) (Broekx et al. 2014).

The model has been used to estimate the impact of land-use changes, with varying policy objectives (promotion of recreation, biodiversity etc.). This exercise showed that a proper assessment of land use changes requires a model that accounts for and differentiates between substitution effects (shifting recreation between different competing areas) and net increase in visits, due to increased availability or better quality of the areas. The search for an optimal location for new green infrastructure needs to be balanced between the proximity of population and scarcity of already available green infrastructure. The model allowed the quantification of these effects.

The results of the physical model were also implemented in a web-based application "the nature value explorer" (Liekens et al. 2020). This application allows estimating the impact of land-use changes on regulating and cultural ecosystem services in Flanders and works with welfare measures.

The goal is to produce basic statistics about the importance of our natural capital for recreation and tourism. It can be examined to what extent these statistics can contribute to translating changes in Natura 2000 areas into costs and benefits. The ambition is to repeat calculations in a consistent manner in the future so that unambiguous trends can be derived. In addition, it is examined how benefits flow through to the various economic sectors. Third parties can derive trends, based on these accounts through simple GIS analyses. However, the spatial level of detail at which these statistics are calculated must be high enough to allow for correctly capturing the often small changes in Natura 2000 areas. It is also still unclear to what extent the impact of the Natura 2000 policy on ecosystem services can be isolated from other, often larger, general trends in Flanders.

Acknowledgements

Conflicts of interest

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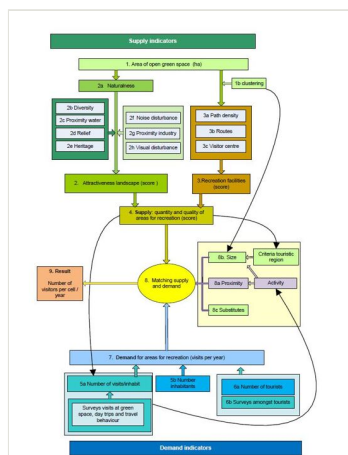
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Endnotes

[*1] Simulated Exchange Value (SEV) method. The simulated exchange value method estimates the price and the quantity that would prevail if the ecosystem service were to be traded in a hypothetical market. It thus provides a direct estimate of the value, the SEV, required for entry into the accounts, based on the exchange value concept. 9 The SEV method is applied by using results from demand functions for the relevant ecosystem service (for example, estimated using the travel cost method, discussed above or stated preference methods, discussed below). These are used to calculate the price for the ecosystem service that would occur if it were actually marketed. This

requires combining the information on the demand function with a supply function and an appropriate market structure (institutional context). Standard microeconomic methods are then used to yield the simulated price, which can be used to estimate the value of the ecosystem services. It can be applied at various degrees of complexity and using alternative market structures, but it has not been as widely applied as the methods described above (cited United Nations 2021, paragraph 97-98.
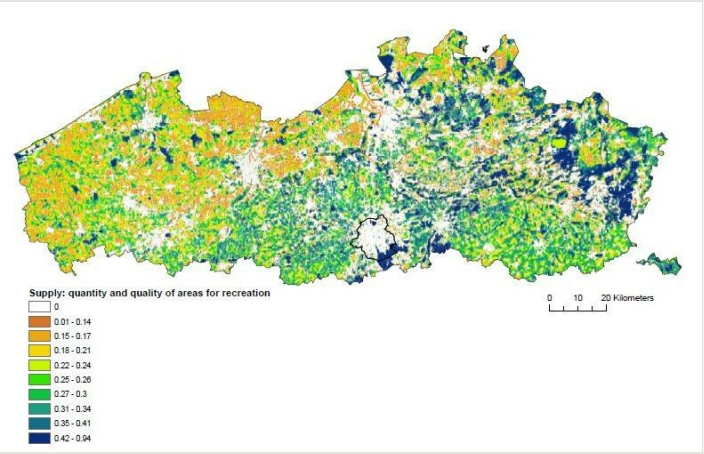
Figure 1.

Overview of methodological steps to model supply and demand for recreational visits, including tourism

Figure 2.

Quantity and quality of areas for recreation: the supply score.

Walking: Visits per ha/year

	0
	1 - 48
	49 - 96
	97 - 144
	145 - 191
	192 - 239
	240 - 287
	288 - 383
	384 - 574
	575 - 12,202

0   10   20 Kilometers
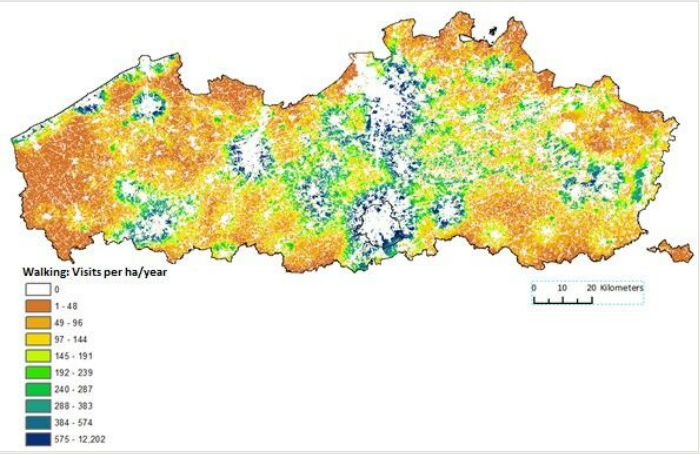
Figure 3.

Number of visits per ha.year local walking trips.

Biking: visits per ha/year

- 0
- 1 - 21
- 22 - 36
- 37 - 47
- 48 - 57
- 58 - 73
- 74 - 88
- 89 - 114
- 115 - 161
- 162 - 1,325
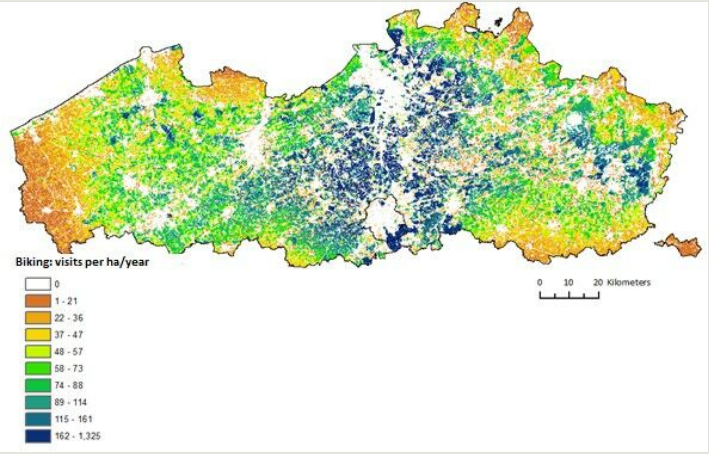
0   10   20 Kilometers

Figure 4.

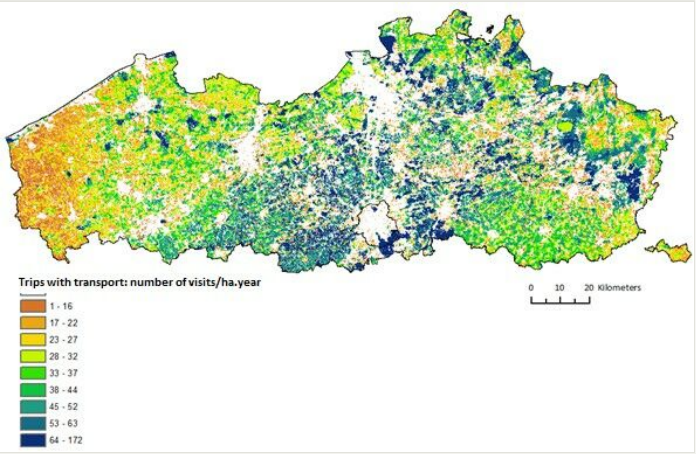Number of visits per ha.year local biking trips.

Figure 5.

Number of visits per ha.year longer trips with pre-transport such as a car.
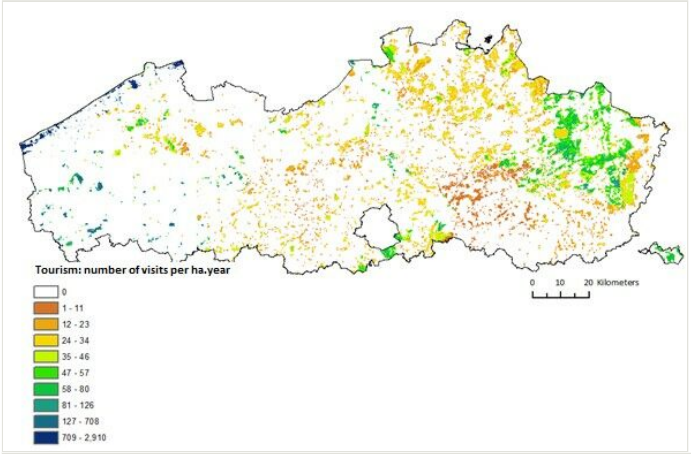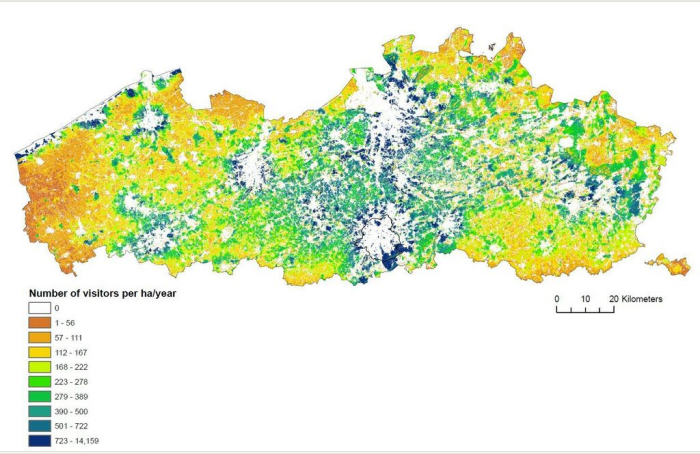
Figure 6.

Number of visits per ha.year tourist visits.

Figure 7.

Total number of visits per ha.year: all types of trips.

Table 1.

Factors De Valck et al. (2017) and sources used to calculate scores.

Indicators of attractiveness	sign	what	source
Naturalness	Basis score	proportion of nature, forest or water within green-blue areas	De Valck et al. (2017)
Diversity	+	share of forest in green-blue area	De Valck et al. (2017)
Water	+	presence of water in green area	van Zanten et al. (2014), Schägner et al. (2016), De Valck et al. (2017)
Relief	+	score if there is height difference	CPSS (2005)
Cultural heritage	+	presence of protected landscape, city views and monuments	CPSS (2005)
Proximity of buildings and heavy industry	-	% of buildings and % high green buffering sight	Crommentuijn et al. (2007), de Vries et al. (2007)
Noise	-	score based on noise levels	De Valck et al. (2017)
Accessibility and recreational factors			
Path density	Basis score	presence of roads and paths through and alongside the green-blue area	De Valck et al. (2017)
Sign-posted paths	+	presence of paths belonging to a sign-posted network	De Valck et al. (2017)
Recreational facilities	+	presence of visitor centre	Goossen and de Boer (2011), De Valck et al. (2017)

Table 2.

Average spending per visit per recreation type.

Activity	Source	Spending €/visit	Share in total vists	Share in total spending
Local walks	NPHK 2009	3	45%	16%
Local cycle tours	Prov. Antwerpen	8	45%	44%
Day trips	Tourism Flanders	18.6	6%	13%
Touristic stay	Tourism Flanders	57	4%	27%