

Perceptions of cyclists and hikers of biodiversity on the Lekdijk

Project group 3E
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1 Introduction

1.1 General introduction

The global temperature is rising; droughts, more extreme weather and other climate events are all examples of how climate change can influence the current way of living (Stott, 2016). This is also the case in the Netherlands, and more specifically on the Utrecht Heuvelrug. Due to more extreme weather, it is expected that the Lek will process more water in the future. Therefore, it would be necessary to increase the protection against flooding, such as heightening the Lekdijk, the redesign of flood plains, and increasing the biodiversity.

A higher biodiversity along the dikes has several positive effects on mental health and nature; research has shown that a higher biodiversity promotes mental health and well-being (Marselle et al, 2019). However, according to multiple studies, further research on biodiversity and mental health is needed (Pongsiri & Roman, 2007; Sandifer et al, 2015). Moreover, increasing biodiversity can lead to a more stable ecosystem productivity (Isbell et al, 2015). In addition to this, many other services are provided by biodiversity as well. Ecosystem services are defined as 'a function of complex interactions among species and their abiotic environment' (Fisher et al, 2009). Furthermore, biodiversity contributes to ecosystem services such as 'conservation of species, flood regulation, carbon sequestration or agricultural productivity' (Mace et al, 2012). In conclusion, a high biodiversity is important for providing ecosystem services.

It is necessary to keep the biodiversity intact as far as possible. However, studies have shown that the biodiversity in the Netherlands is descending rapidly. While the mean species abundance was still 40% in 1900, it decreased to around 15% in 2010, which means that 'the populations of species are on average 15% of the near natural state' (Planbureau voor de Leefomgeving, 2014). In order to stop biodiversity decline, nature restoration is an option. This is already happening on the Lekdijk, where plants are managed in a way in order to support high plant diversity.

Furthermore, the aim of this paper is to find out if there is a difference between the perception of males and females, and hikers and cyclists in a biodiverse area. Up until now, there has been little research on the perceptions of ecosystem services and biodiversity of a dike. Moreover, the research that explored the different perceptions often did not take gender or type of recreation into account, even though this can be useful information when designing a dike. The intention of this report is to fill that research gap of perception of ecosystem services and type of recreation and gender.

1.2 Research question and subquestions

To investigate the perceptions of people of biodiversity on the Lekdijk the overarching research question is:

How do people perceive the ecosystem services provided by biodiversity of the Lekdijk?

The perceptions of biodiversity of certain groups on the Lekdijk will be specified with the following questions:

1. How do males and females perceive the ecosystem services provided by biodiversity of the Lekdijk differently?
2. How do cyclists and hikers perceive the ecosystem services provided by biodiversity of the Lekdijk differently?

2 Literature review

Turner-Effort conducted a survey in 1997 displaying the amount of knowledge and concern there was around the concept of biodiversity at the time in the Chicago area. The surveyees were asked how familiar they were with the term and about how important they think it is to society, among other questions. Although the data is more than 20 years old, this survey is of great use to find out how the concern for biodiversity varies between different age groups, genders, levels of education and occupations. The results mainly showed that there was a strong positive correlation between concern for biodiversity and level of education. Moreover, it showed that around 90% of the surveyees that were familiar with the concept responded that biodiversity is important to preserve and that the government should fund its studying.

A more recent survey conducted in Norway in 2016 by Kaltenborn et al. studied the perceptions of the general population towards biodiversity loss. One conclusion to be drawn was that biodiversity loss is an issue that negatively affects the relation between people and the natural environment, and that a useful way to strengthen the concern and the action taken against biodiversity loss would be to increase the emphasis on aesthetic, cultural and emotional aspects of biodiversity.

Biodiversity can thus be appreciated from many different perspectives. Gobster (1996) proposed a switch in the appreciation of biodiversity from an aesthetic point of view to an efficient and appropriate management point of view. This is of importance to our project as it highlights that people very often give importance to biodiversity because of its aesthetic value, which influences their decisions in many ways.

Linked to the previous study by Gobster, another survey was conducted in 2003 by Heer, Rusterholz and Baur, which assessed the perception and the knowledge of the state, functions and biodiversity of forest sites in northwestern Switzerland among hikers and mountain bikers. Both groups (which enjoyed nature for its aesthetic and recreational values) showed a general awareness of the negative impacts of recreational activities on the biodiversity of these forests.

People perceive ecosystems differently as they have different interests in them. Thus, people assess ecosystems based on the services these can provide to them. These services are identified by the Millennium Ecosystem Assessment in the Ecosystem Services Framework (2003), which can be seen in the following figure:

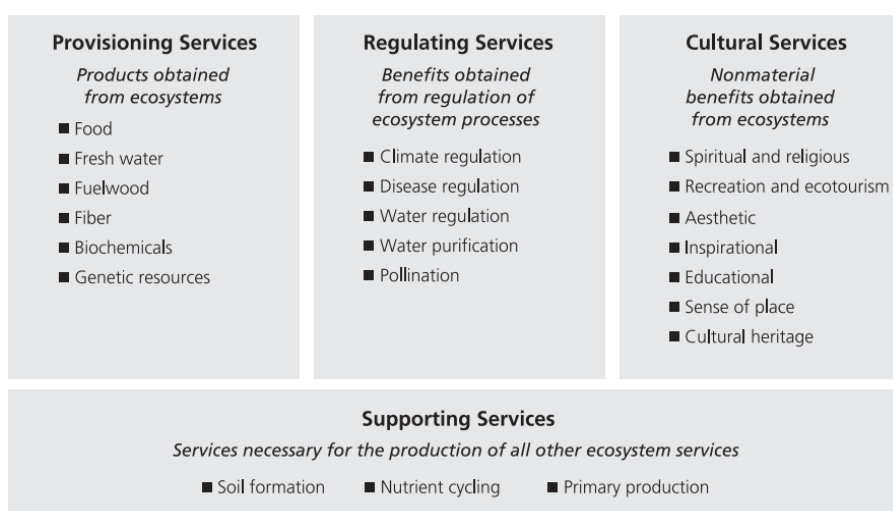


Figure 1: Ecosystem services framework. Source: Millennium Ecosystem Assessment (2003)

This framework can help narrow down the complex relations between different parts of ecosystems, and their relations to human well-being.

A study realized in 2013 in Northern Spain by Casado-Arzuaga, Madariaga, and Onaindia aimed at understanding user preferences regarding ecosystem services and their management in a certain area. It is useful to understand what the general population expects and appreciates in biodiverse areas so the natural proliferation of these areas can go hand to hand with human well-being. The results highlighted once again that people differ widely in perceptions and demands for ecosystem services. This is greatly useful for our research, as it highlights the need to comprehend people's different perceptions of biodiversity.

Based on the previous literature, this conceptual framework has been created to elaborate our study:

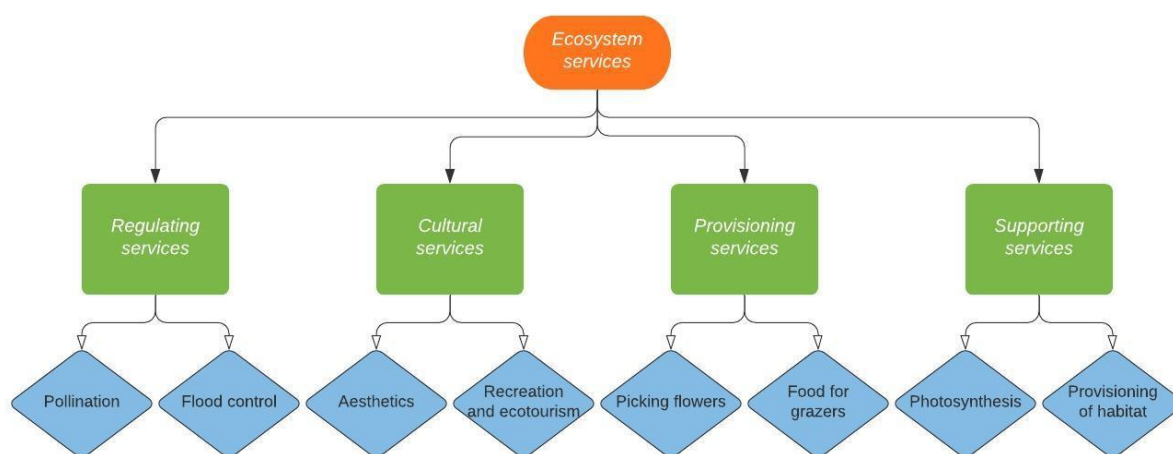







Figure 2: conceptual framework

The ecosystem services framework proposed by the Millennium Ecosystem Assessment (2003) has been used. According to this framework, there are four types of ecosystem services: regulating, cultural, provisioning and supporting.

The examples shown in the survey will be particular examples of ecosystem services in the Lekdijk ecosystem area. Examples of provisioning ecosystem services are the fact that people on the Lekdijk can pick more flowers with increasing biodiversity and that there is higher quality food for the cattle on the dike. The regulating ecosystem services on the Lekdijk are for example improved flood defense from a stronger dike by increased biodiversity and more pollination. More biodiversity also contributes to more photosynthesis and provides a better habitat for insects and birds, which are supporting services. Cultural ecosystem services are increased aesthetics and mental health due to a more biodiverse area.

Our analytical framework shows the definitions and the pictures of the Lekdijk ecosystem services we provide in the survey, in the form of a table:

Lekdijk ecosystem service	Provided definition	Provided picture
Pollination	Plants pollinate each other every year with the help of winds and bees in order to bloom every year. Without this regulating service the biodiversity would be lost because the diverse flora would disappear.	
Flood control	Biodiversity in plants along the flood defences strengthen the dikes, therefore being a major contributor towards flood control.	
Aesthetics	The interaction between an individual and the environment, in relation to beauty. The aesthetic of nature can contribute to both physical and mental health and well-being.	
Recreation and ecotourism	The recreational pleasure people can derive from natural ecosystems, such as the Lekdijk.	
Picking flowers	A variety of flowers are growing on the Lekdijk, and therefore make a beautiful view. Many people pick these flowers, which has a positive emotional effect and improves their mood.	


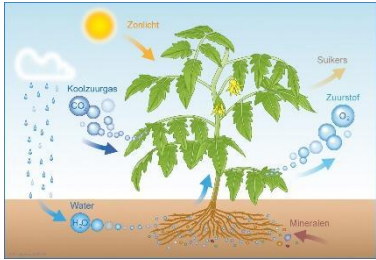

Food and space for grazers	The Lekdijk provides fields for grazing animals. This gives farm animals very much needed outdoors access, as well as food.	
Photosynthesis	The plants at the Lekdijk undergo the process of photosynthesis, meaning that they absorb sunlight, water, carbon dioxide and minerals to produce oxygen and glucose. By doing this, they provide energy for the whole ecosystem to function.	
Provisioning of habitat	The Lekdijk provides a habitat to living organisms. From this they obtain shelter, protection, and often nutritional needs.	

Figure 3: Analytical framework featuring the definitions and pictures of the Lekdijk ecosystem services used in the survey.

3 Method

3.1 Study area and design

The perceptions of biodiversity of people on the Lekdijk is a study based on social sciences as the participants were asked about their perceptions. In the study observations of males and females and hikers and bikers are compared with each other. Therefore making the study a comparative study. The survey was conducted on different locations where the HDSR has improved biodiversity. The first day, the survey was conducted on location 1 and 2 (figure 4). Location 1 is on the western Lekdijk near a nature reserve and on a crossroad. The second location (location 2) is on the eastern Lekdijk near a historical landmark. Both locations are close to the city. The second day, the survey was conducted on location 3 and 4 (figure 5). These locations are further away from the city and more remote. On the third day, the survey was conducted in locations 5 and 6 (figure 5). These are also more remote.

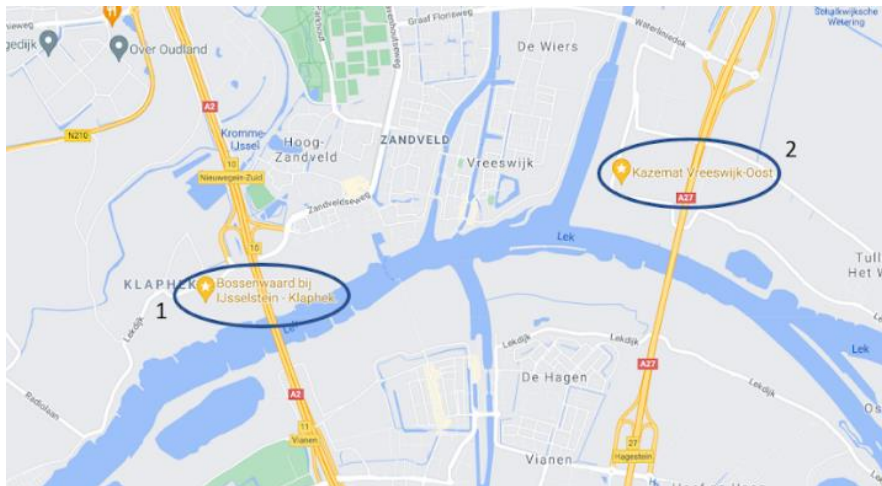


Figure 4: Map of the locations 1 and 2 (Google Maps,n.d.)

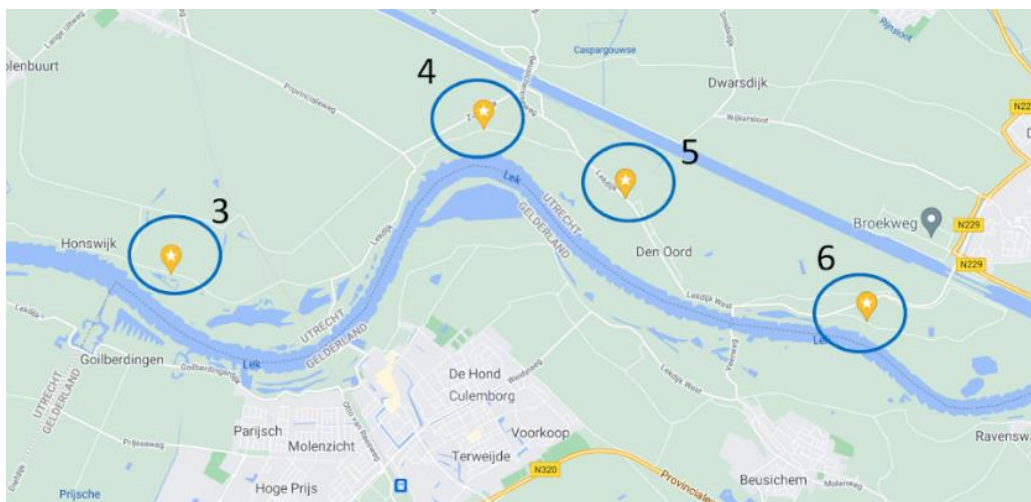


Figure 5: Map of locations 3, 4, 5 and 6 (Google Maps, n.d.)

3.2 Survey

The survey is divided into two sections. The first section with questions about the social-demographics, age and gender of the participants. This is to ensure the representativity of the questioned group. Then they were questioned whether they are cycling or hiking, and for what purpose, recreational or practical, they were using the dike. In the second section, we wanted to find out how people value the different kinds of ecosystem services. The questionnaire was supported with pictures of various ecosystem services to help the respondents visualize the services. This is a widely used technique called photo-elicitation and is relevant to our study because many participants do not immediately have a clear image of ecosystem services (Richard & Lahman, 2014., Casado-Arzuaga et al., 2013). Research shows that using pictures in research is beneficial since they are more easily recognised and processed than words (Dewan, 2015). There will be two pictures of ES per category (see analytical framework in literature review).

The participants will be asked to rank all 8 pictures from most to least important. The ranking method is used because this forces people to compare the ecosystem services. With a rating scale, the participants are less likely to compare the pictures as the questionnaire then is separate per question. A rating question is when people assign a score to each item instead of putting them in a specific order. Rating questions are more prone to satisfaction, this happens when they pick a random acceptable answer to save time. A ranking question will not cause this problem and will force

the participants to give a meaningful answer (Qualtrix, 2021). After the ranking question, they were asked to explain their choice on their first two and last two choices. The pictures were shown on a large board, so that respondents could rank them without having to touch anything or coming close to the interviewers. First, the answers of the participants were written down by a group member or by the participant itself and later filled into google forms. This way, the survey was conducted in a safe way considering the COVID-19 measures from the government. The questions are added in appendix 1: questionnaire.

3.3 Analysis

In total 83 surveys were conducted. 50 female (60,2%) and 33 male (39,8%) participated. Furthermore, the groups of bikers and hikers were 52 (62,7%) and 31 (37,3%) respectively. For the analysis, the first step was to compare the average appreciation of all respondents of the different ecosystem services. Therefore, the ranking scores had to be turned around so that a score of 8 corresponds to the most important ecosystem service and not the least important one. In this way, the data represents the weight of the services instead of the rank. After that, the overall average of each ecosystem could be calculated, together with the standard deviation. This was done to give a clear image of which ecosystem service was most and least appreciated.

The ecosystem services were then assigned to their specific category (see analytical framework in literature review) and added up. This way, the differences between male and female respondents and cyclists and hikers for each category could be tested. The data of the categories was put into histograms to determine whether it was normally distributed or not. A Shapiro Wilk test was applied to the data to further determine this. After that, the Mann Whitney U test was used to analyze whether there was a significant difference between both genders and activities regarding the categories provisioning, cultural and regulating. This test was used because it is appropriate to compare the difference of two independent groups when the variable is continuous or ordinal and not normally distributed (MacFarland & Yates, 2016). In this case, the variable is continuous and the data is not normally distributed. The two groups that are compared (the two genders and activities) are independent of each other. For analyzing the category supporting ecosystem services, a t-test was applied since that data was normally distributed (MacFarland & Yates, 2016).

The qualitative data, the reasoning for the top 2 and bottom 2, will be analysed deductive and inductive. When comparing data inductively, observations were generalized and put into a theory (Thomas, 2006). During the analysis of the qualitative data, it was realized that not all the participants had filled in the top 2 and bottom 2.

4 Results

4.1 Closed questions

When looking at the overall results of the average appreciation of the ecosystem services, a few things stand out. Firstly, flood control is the highest rated ecosystem service (average is 6,6) and picking flowers the lowest rated ecosystem service (average is 1,57). Furthermore, participants indicate that they find pollination and provision of habitat also important (averages are 5,65 and 5,28 respectively). Secondly, the standard deviation is, with an average 1,8, quite high. For an overview of

the specific means and standard deviations, see figure 12 in appendix 3A.

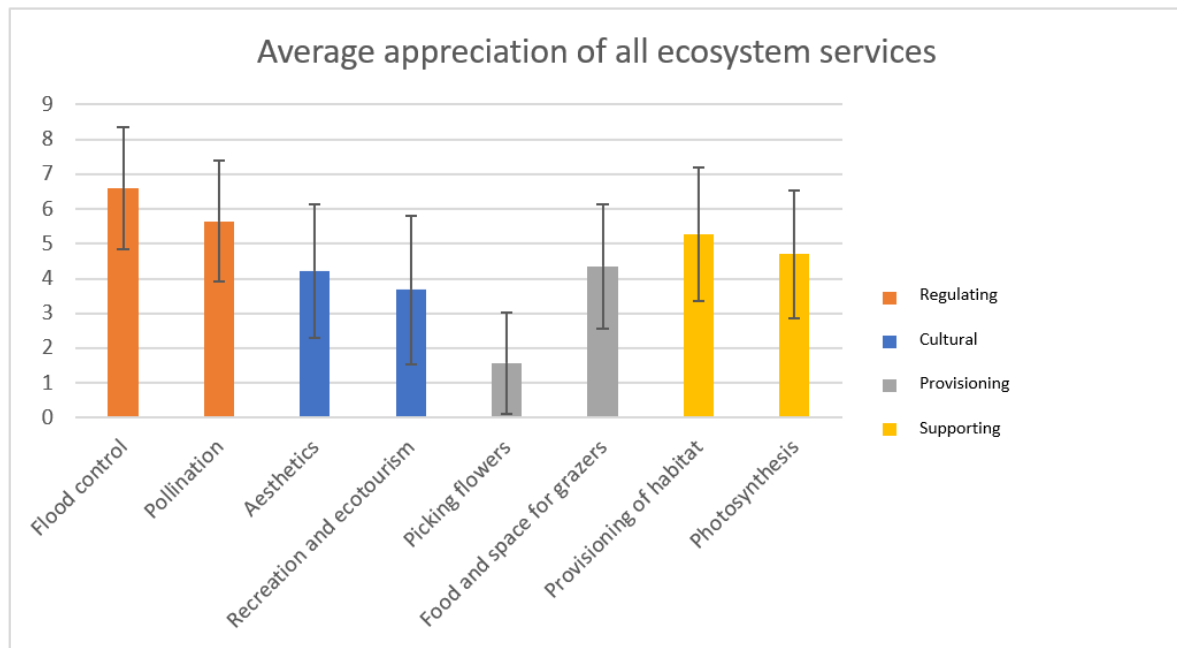


Figure 6: The average appreciation of the ecosystem services. 8 is highest, 0 is lowest. The error bars show the standard deviation.

The performed Shapiro Wilk test showed that the categories regulating, provisioning and cultural have a significance of 0,000 which is smaller than 0,05, meaning that this data is not normally distributed. The category supporting services has a significance of 0,062, which means that this data is normally distributed since $0,062 > 0,05$.

4.1.1 Gender

Figure 7 shows the outcomes of the Mann-Whitney U test (used for the first three categories) and the T-test (used for the supporting ecosystem service) for the independent variable gender. The categories regulating and provisioning show a significance lower than 0,05. This indicates that there is a significant difference between males and females regarding their perception of regulating and provisioning ecosystem services. It seems that females rank regulating ecosystem services higher than males and males rank provisioning ecosystem services higher than females.

	Average male (N =33)	Average female (N=50)	Mann-Whitney U value/ t-value	Significance
Regulating	11,45± 2,91	12,78 ± 1,89	609	0,042
Cultural	8,42 ± 3,06	7,54 ± 2,79	680	0,172
Provisioning	6,6 ± 2,3	5,46 ± 1,9	586,5	0,025
Supporting	9,6 ± 2,69	10,16 ± 2,6	0,936	0,352

Figure 7: The averages per category with their standard deviation and the significance for the variable

gender.

Figure 8 and 9 show the boxplots for these categories, which include the means and standard deviation. It not only shows the difference between the genders but it also shows that there is a bigger spread of rating data in the male group.

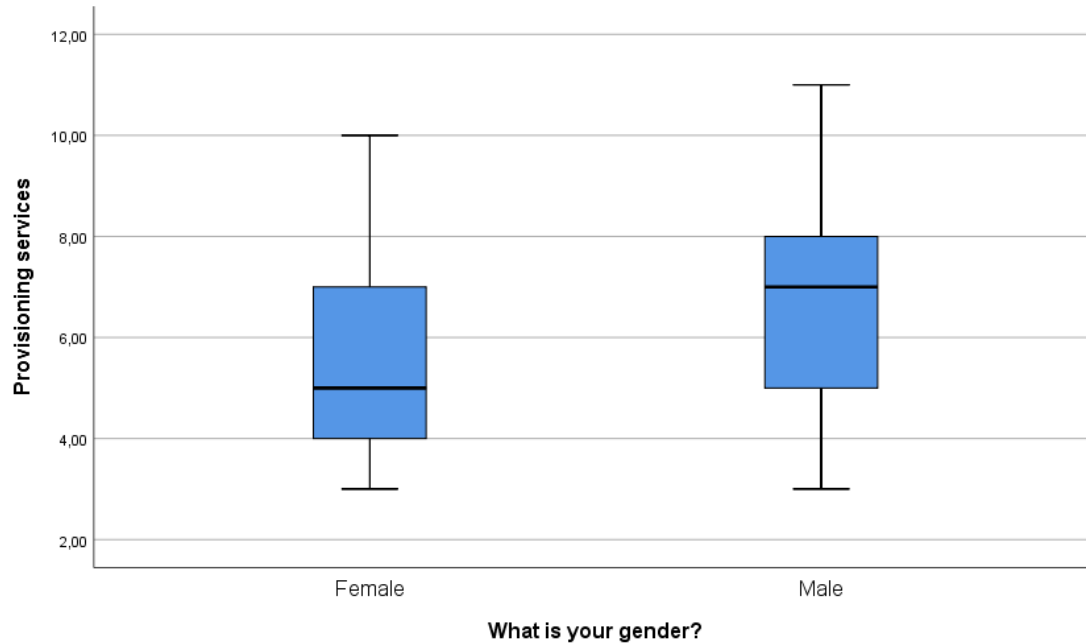


Figure 8: Boxplots of the provisioning services per gender

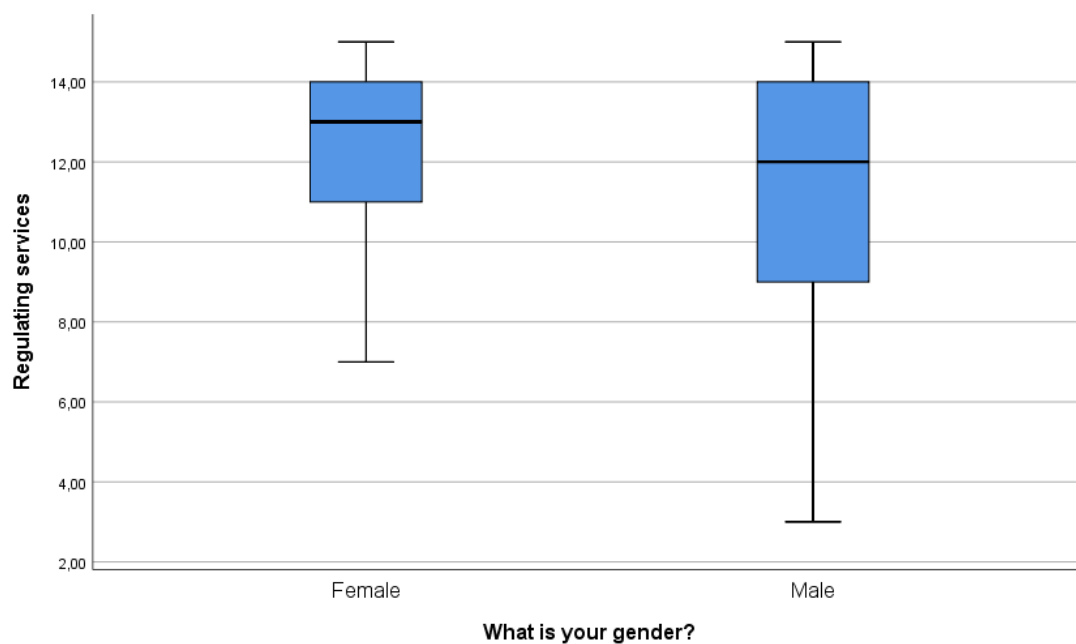


Figure 9: Boxplots of the regulating services per gender

4.1.2 Activity

Figure 10 shows the results of the statistical test for all categories regarding the independent variable activity. The table of activity shows no significant differences between the hikers and cyclists. The remaining boxplots can be found in appendix 3C.

	Average cyclists (N=33)	Average hikers (N=50)	Mann-Whitney U value/ t-value	Significance
Regulating	12,06 ± 2,65	12,58 ± 1,96	744,5	0,558
Cultural	8,08 ± 3,04	7,58 ± 2,71	739,5	0,526
Provisioning	6,08 ± 2,08	5,65 ± 2,24	687	0,256
Supporting	9,81 ± 2,57	10,17 ± 2,79	-0,591	0,556

Figure 10: The averages per category with their standard deviation and the significance for the variable activity.

4.2 Open questions

4.2.1 Inductive analysis

This table shows the reasons stated by the interviewees explaining their choice of valuing certain ecosystems to a higher or lower degree, followed by the number of participants that stated this reason:

	Reasons for importance (times stated)	Reasons for less importance (times stated)
Flood control	Safety against floods (36), protecting biodiversity (9), memories of past floods (5).	Low perceived flood risk (3).
Pollination	Important for keeping all biodiversity alive (15), important for bees (5).	-
Provisioning of a habitat	Needed space for wild animals (15), pleasure from seeing wildlife (3).	Lack of empathy for animals (2), not many animals found on the dike (2).
Photosynthesis	Sustaining the whole ecosystem (7), oxygen production (3), importance against climate change (2).	Not perceived as important for a dike (4), not experienced on the dike (2).
Food and space for grazers	Keeping the place tidy and not wild (4), well-being of grazers (2), importance for farm industry (2).	Grazers can be at other places (7), grazers negatively affect biodiversity (2).
Aesthetics	Pleasure from enjoying the landscape (9).	Not considered a priority (12).

Recreation & ecotourism	Pleasure from enjoying the place (7), importance for tourism (1).	Makes the place too crowded and is bad for biodiversity (8), not considered a priority (7).
Picking flowers	Important for people that pick flowers (1).	Not considered a priority (35), negatively affects biodiversity and aesthetics (22).

Figure 11: reasons for importance or less importance of the different ecosystem services as stated by the interviewees. Next to the stated reasons appears the count of the times each reason was mentioned. No data was found for less importance for pollination, as this was never stated as a last option.

As can be seen in figure 11, flood control (which was the most valued ecosystem service) is most appreciated by the safety it provides, in many cases because respondents remembered a flood that happened in the area in 1995. The second most valued service, pollination, is most valued because of its function in maintaining the whole ecosystem's biodiversity. The services that were valued to a lesser extent were recreation & ecotourism and picking flowers. The first one was considered less important because it was not a priority for the respondents and because it makes the place too crowded. Picking flowers was mostly not valued because the respondents did not practice this activity themselves, and some of them considered it to harm the ecosystem and the aesthetics of the dike.

5 Discussion

Our research was initially intended to explore how the ecosystem services that are provided by the biodiversity of the Lekdijk were perceived by hikers and cyclists. This research included specifically if there was a difference in perception for bikers and hikers, and additionally the difference in perception between male and female.

5.1 Discussion of results

One thing that became clear when conducting the surveys was that flood control was found to be the most important ecosystem service overall. In the inductive analysis we can see that is because people prioritize their safety and want to be protected from potential floods. As one study has found out, to prioritize protection against floods over other things is very common for the dutch. With housing prices even being higher in areas that are less prone to floods. (Bosker et al, 2014) This indicates that people perceive floods as an imminent risk in the Netherlands despite there being a relatively low risk. As with the current protective measures it is estimated that the area where we conducted the surveys only has a probability of about 1 in 2000 of flooding. (Pieterse et al, 2009)

The fact that pollination, provisioning of a habitat and photosynthesis were ranked second, third and indicated that the regulating and provisioning services were found to be most important. As the participants stated, they prioritized biodiversity, the wellbeing of wild animals and the countering of climate change. Other literature cites that this outcome is partly in line with two known hypotheses when researching perceptions of ecosystem services. Some research suggests that rural residents tend to prioritize provisioning services, as they are in some way dependent on it. While other research suggests that rural residents are more likely to mention regulating and cultural services, because some residents have a better understanding of the ecological importance of the environment. (Lhoest et al, 2019) That picking flowers was the least important regulating ecosystem

fits in well with the fact that provisioning and regulating services were found to be most important. As people valued the services of the plants more when they were still functioning in the ecosystem, as is stated in the analytical research. This suggests that the participants were likely to possess some ecological knowledge on the importance of the ecosystem services.

Our first sub question we tried to answer was 'How do men and women perceive the ecosystem services provided by biodiversity of the Lekdijk differently?'. After reviewing our results from the survey, we can conclude that there is indeed a significant difference between male and female. We found that especially the perception of the regulating and the provisioning ecosystem services showed different results between the two groups, as males valued provisioning services higher than females, and females valued the regulating ecosystem services higher. These results are partly aligned with other research on the perception of ecosystem services and gender.

One study that explored the perception of cultural ecosystem services by local people in Germany, found that females do value regulating ecosystem services higher than males, which is in line with the results we found with our surveys. However, the same research also found that females perceived provisioning ecosystem services more strongly than males (Yang et al, 2018). This is the opposite of our findings, as we found that males perceive the provisioning services more strongly than females.

Another study that addressed the socio-cultural preferences towards ecosystem services has found that men are more likely to perceive provisioning services, while women are more likely to perceive regulating services (Martín-López et al, 2012). These results are entirely in line with our findings.

The differences in perception of ecosystem services between males and females could be explained in multiple ways. One possible cause of this difference is the combination of different factors, such as educational inequality, religion and access to information (Yang et al, 2018). Especially the educational inequality might be a big factor in the different perceptions, since many of the interviewees were elderly and thus the women often have a lower education level than the men (Volksgezondheid en Zorg, 2018).

The second subquestion our research included was whether there would be a difference between the perceptions of hikers and cyclists. The outcomes of the surveys showed no significant difference of the perception between the hikers and cyclists. A study on how the presence of the red deer positively or negatively affected their activity whilst visiting the Cansiglio forest in Italy showed that mountain bikers tend to have a less positive experience from the deer than people participating in hiking like activities. This difference in gradient of being affected by an supporting ecosystem service (provisioning an habitat) is different from the findings of our research. (Drabkova et al. 2013)

5.2 Limitations of the study

One of the first things that can be noticed when looking at the results is that around two thirds of the participants are in the area for cycling. This is not an even distribution for hikers and cyclists, therefore making it less reliable to compare the two. This uneven distribution is even more uneven for recreational and practical use of the Lekdijk area. Here we can see that more than eighty percent of the interviewees were there for recreational use. This makes it basically impossible to conduct a correct comparison. In addition to this, looking back at the way the questions were framed and the results, it might have given different outcomes if we used the words 'residents' and 'tourists' instead of 'recreational' and 'practical'.

The distribution of attendees in age also showed major unevenness in its distribution, as the largest part of our attendees falls in the category 60+ or higher. This can lead to a biased perception in our results, as younger people might prioritize different ecosystem services than people at a higher age. As an Italian study on the social perceptions on the perceptions of forest management pointed out, younger people had significantly different reasons for visiting and appreciating the forest area. (Paletto et al. 2013)

Furthermore, some of the locations we had picked as our testing area provided insufficient participants. For example, doing surveys at location 5 there were null participants in 1,5 hours so we had to move locations. We then moved to a parking lot nearby, where there were several hikers. Something that would have been hard to find at some plots on the Lekdijk, as they may be too isolated for people to hike there.

Another point of discussion is the fact that many of the participants were not alone, but in a group of two. This could have led to a biased opinion of some of the participants, as their partner may have mentioned an argument for an ecosystem service that they would not have thought of if they were alone. This can be seen in the results of the surveys, where the given answers of people who were in a pair often showed little to no difference than the answers of their partner.

6 Conclusion

After conducting interviews to 83 bikers and hikers at several locations along the Lekdijk, this research has identified which ecosystem services are appreciated the most around the area.

This study found that the service that is most valued by the Lekdijk's residents and visitors is flood control, followed by pollination, provisioning of habitat, and photosynthesis. The next most chosen options were food and space for grazers, aesthetics, recreation and ecotourism, and the last place was for picking flowers. The reason for a strong appreciation for flood prevention services is mainly safety against floods, as many interviewees made a comment on memories they had on past floods and their consequences (mainly the Lekdijk flood of 1995). Excluding the first option of flood control, a strong tendency can be seen favouring ecosystem services that benefit nature; these services (e.g. pollination) have been chosen more than other services like recreation, that bring benefits just to humans.

By grouping these services into four categories (like has been proposed by the Millennium Ecosystem Assessment's framework), it can be concluded that regulating services have the most value for people on the Lekdijk, followed by supporting services. Provisioning and cultural ecosystem services share the last place, which supports the observation that some Lekdijk visitors may value natural services more than social ones.

After searching for differences between the most valued services for males and females and for hikers and cyclists, the following relations have been found: regulating services are valued significantly more by females than by males, while the contrary has been found regarding provisioning services.

Providing this research to HDSR (Hoogheemraadschap De Stichtse Rijnlanden) will allow them to improve certain aspects about how they manage biodiversity on the dikes (these results could be

generalized to other dikes, beyond just the Lekdijk, by applying the information regarding which ecosystem services are most appreciated by dike visitors). This research will provide knowledge to policy makers and governing bodies to improve biodiversity on the dikes by enhancing the aspects that are appreciated the most by its visitors and residents. Biodiversity should be improved regarding especially the most appreciated aspects of the dike's biodiversity. For example, regarding the aspect of flood protection, more biodiversity should be added that strengthens the dikes while also providing informative signs that advertise to the dike's visitors what is being done.

One aspect that can be further researched is the difference in how the biodiversity is valued between hikers and bikers, as not enough participants have been interviewed to find a significant difference. Another interesting aspect to research is the difference in these perceptions between locals and visitors.

According to the conducted interviews, what is most valued from the Lekdijk's biodiversity is mainly flood protection and natural services like provisioning of a habitat. Other visitors of the Lekdijk also find biodiversity important because of the good looking landscape and recreation it provides. Enhancing these aspects in a proper way could lead to benefits regarding natural and social aspects, improving altogether the experience of the dike's visitors, the health of its ecosystems, and the level of safety it provides.

7 Relevance

The survey that we have conducted on how different people perceive the biodiversity on the Lekdijk has been highly relevant in our research. [D1(1)] The Lekdijk is a man-made object that is built in order to protect people living in the area. However, today it has a much larger purpose. For example, it serves as an excellent place for biodiversity to thrive, which leads to people visiting Lekdijk in order to enjoy this piece of nature. In this research we will ask different types of visitors of the area how they perceive the biodiversity. This will give us an overview of whether cyclists, hikers, practical or recreational users have different or similar views of the area.

Not only has conducting the survey contributed to the research question of people's perception on the biodiversity of the Lekdijk, it will also contribute towards the research on overarching topic: sustainable water management. For example, one of the subtopics that ties well together is Biodiversity along the flood defenses of the Lek River. In this subtopic the research should point out how biodiverse the flood defences are along the Lekdijk, and how this may have changed. The research on the perceptions of biodiversity along the Lekdijk would have no meaning if there was no information on the actual state of the biodiversity along this stretch of land. This entanglement of research goes both ways, as the knowledge on the biodiversity of an area has more value when it is known how it is perceived.

When visiting the Lekdijk area it is very noticeable that the area is intertwined with farmers. The people that have certain perceptions about biodiversity undoubtedly also have a perception of local agriculture. It would be interesting to find out how people perceive the agricultural activity in the Lekdijk area, especially in connection to farmers and droughts. As the changing climate could make this a more apparent problem.

Although our research on the perceptions on biodiversity will result in an answer on how the local biodiversity is perceived, interdisciplinary research is needed in order to place our findings into context. First of all, ecological research will have to be conducted in order to find out what the actual

biodiversity of the Lekdijk is. Comparing the results of these researches will make it clear how realistic the perceptions of the people interviewed are. Besides, research will have to be conducted in order to find out the importance of biodiversity near the Lekdijk. This could be biodiversity in flora or fauna.

Our results, combined with further interdisciplinary research can help municipalities and land administrators better understand the perceptions of people visiting their terrain. This could lead to them making changes to the biodiversity of the Lekdijk. This understanding of perceptions of biodiversity could therefore lead to a more sought after visit to the Lekdijk by cyclists and hikers. If the results indicate that there is an absence of correct information on biodiversity the land administrators could make an effort to educate the visitors.

8 Reference list

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9 Appendix

9.1 Appendix 1: Questionnaire

Introduction

Hello, we are students at the University of Utrecht and we are conducting research on the perceptions of biodiversity of the Lekdijk area, and we would like to ask if you would like to fill in this questionnaire.

In this survey we will ask some questions related to ecosystem services. An ecosystem service is a positive service provided to humans by a healthy, functioning ecosystem.

Filling out this questionnaire will take approximately ten minutes of your time. We would greatly appreciate it if you could take this time out of your day to help us.

When filling in this questionnaire you give us consent to store and analyze this data. The process of data analysis will be done anonymously, and therefore cannot be traced back to you when we work the data. Do you give us permission for that? You can at any point in the questionnaire decide to not participate.

Thank you for your participation.

Section 1

1. What is your gender?

- Man
- Female
- Prefer not to say

2. What is your age?

- 0-18
- 19-30
- 31-45
- 46-60
- 60+

3. For what purpose are you on the Lekdijk?

- Cycling
- Hiking
- Other, please specify _____

4. For what purpose are you on the Lekdijk?

- Recreational
- Practical

Section 2

Rank these pictures representing different ecosystem services of the Lekdijk from most to least important:

5.Flood control (overstromingspreventie)



Biodiversity in plants along the flood defences strengthen the dikes, therefore being a major contributor towards flood control.

De biodiversiteit van planten langs de waterkeringen versterkt de dijken, en draagt daarom veel bij aan de bescherming tegen overstromingen.

6.Recreation and ecotourism (recreatie en ecotoerisme)



The recreational pleasure people can derive from natural ecosystems, such as the Lekdijk.

Het recreatieve genot dat mensen kunnen ontleen aan natuurlijke ecosystemen zoals de Lekdijk.

7.Pollination (bestuiving)



Plants pollinate each other every year with the help of winds and bees in order to bloom every year. Without this regulating service the biodiversity would be lost because the diverse flora would disappear.

Om elk jaar te bloeien, bestuiven planten elkaar jaarlijks met behulp van de wind en bijen. Zonder deze regulerende ecosysteemdiensten zou de biodiversiteit verloren gaan, aangezien de diverse flora zou verdwijnen.

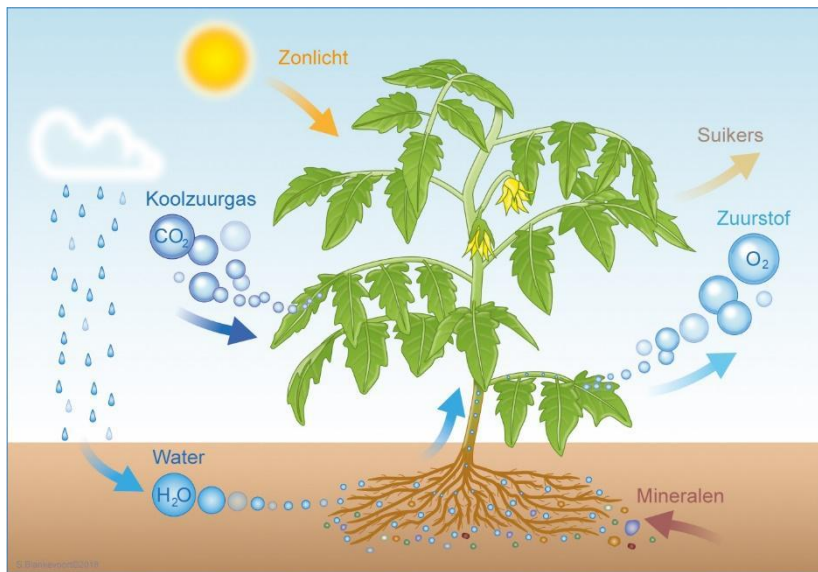
8.Food and space for grazers (voedsel en ruimte voor grazers)



The Lekdijk provides fields for grazing animals. This gives farm animals very much needed outdoors access, as well as food.

De Lekdijk voorziet grazende dieren met velden. Dit geeft boerderijdieren niet alleen ruimte in de buitenlucht, maar ook voedsel.

9.Photosynthesis (fotosynthese)



The plants at the Lekdijk undergo the process of photosynthesis, meaning that they absorb sunlight, water, carbon dioxide and minerals to produce oxygen and glucose. By doing this, they provide energy for the whole ecosystem to function.

De planten op de Lekdijk ondergaan het proces van fotosynthese. Dit houdt in dat planten zonlicht, water, koolstofdioxide en mineralen opnemen, en zuurstof en glucose produceren. Door dit te doen, zorgen planten voor energie om het hele ecosysteem te laten functioneren.

10.Aesthetics (esthetiek)



The interaction between an individual and the environment, in relation to beauty. The aesthetic of nature can contribute to both physical and mental health and well-being.

De interactie tussen een individu en het milieu, in relatie tot schoonheid. De esthetiek van de natuur kan bijdragen aan zowel lichamelijke als mentale gezondheid en welzijn.

11.Provisioning of habitat (voorzien van een habitat)



The Lekdijk provides a habitat to living organisms. From this they obtain shelter, protection, and often nutritional needs.

De Lekdijk voorziet organismen van een leefgebied. Hierin vinden ze beschutting, bescherming en vaak de benodigde voedingsmiddelen.

12.Picking flowers (bloemen plukken)



A variety of flowers are growing on the Lekdijk, and therefore make a beautiful view. Many people pick these flowers, which has a positive emotional effect and improves their mood.

Een verschillend aantal bloemen groeit op de Lekdijk, en zorgen voor een prachtig uitzicht. Veel mensen plukken deze bloemen, dit heeft een positief emotioneel effect heeft en kan ervoor zorgen dat hun humeur verbeterd.

13. Explain why you chose this as your top 2.

14. Explain why you chose this as your bottom 2.

9.2 Appendix 2: Data sheet for into the field

This is the sheet that will be printed out for every participant and be brought to the field. In this sheet, the answers will be filled out.

Section 1

1. Wat is je geslacht?

- Man
- Vrouw
- Zeg ik liever niet

2. Wat is je leeftijd? _____

3. Welke activiteit ben je aan het doen vandaag?

- Fietsen
- Wandelen
- Anders, namelijk _____

4. Voor welk doel ben je op de Lekdijk?

- Recreatie
- Praktisch

Section 2

	1	2	3	4	5	6	7	8
5. Overstromingspreventie								
6. Recreatie en ecotoerisme								
7. Bestuiving								
8. Voedsel en ruimte voor grazers								
9. Fotosynthese								
10. Esthetiek								
11. Voorzien van een habitat								
12. Bloemen plukken								

13. Leg uit waarom je deze concepten als top 2 hebt gedaan.

14. Leg uit waarom je deze concepten als onderste 2 hebt gedaan.

Introductie

Hallo, wij studeren aan de Universiteit van Utrecht en wij doen onderzoek naar hoe mensen de biodiversiteit van het gebied rondom de Lekdijk waarnemen. Wij zouden dan ook graag aan u willen vragen of u ons zou willen helpen door middel van het invullen van deze enquête.

In deze vragenlijst zullen wij verschillende vragen gaan stellen over de diensten van ecosystemen. Diensten van ecosystemen zijn de voordelen die geleverd worden aan mensen door gezonde, goed functionerende ecosystemen.

Het invullen van deze enquête zal ongeveer tien minuten in beslag nemen. We zouden het enorm waarderen als u ons deze tijd zal geven.

Bij het invullen van deze vragenlijst geeft u ons automatisch toestemming om deze data op te slaan en te verwerken. De data zal anoniem verwerkt worden, waardoor de data niet meer terug getraceerd kan worden wanneer wij deze gebruiken. Gaat u hiermee akkoord? U kunt op elk gewild moment stoppen met het deelnemen aan het onderzoek.

Uitleg per ecosysteemdienst

5. Overstromingspreventie

De biodiversiteit van planten langs de waterkeringen versterkt de dijken, en draagt daarom veel bij aan de bestrijding van overstromingen.

6. Recreatie en ecotoerisme

Het recreatieve genot dat mensen kunnen ontleen aan natuurlijke ecosystemen zoals de Lekdijk.

7. Bestuiving

Om elk jaar te bloeien, bestuiven planten elkaar jaarlijks met behulp van de wind en bijen. Zonder deze regulerende ecosysteemdiensten zou de biodiversiteit verloren gaan, aangezien de diverse flora zou verdwijnen.

8. Voedsel en ruimte voor grazers

De Lekdijk voorziet grazende dieren met velden. Dit geeft boerderijdieren niet alleen ruimte in de buitenlucht, maar ook voedsel.

9. Fotosynthese

De planten op de Lekdijk ondergaan het proces van fotosynthese. Dit houdt in dat planten zonlicht, water, koolstofdioxide en mineralen opnemen, en zuurstof en glucose produceren. Door dit te doen, zorgen planten voor energie om het hele ecosysteem te laten functioneren.

10. Esthetiek

De interactie tussen een individu en het milieu, in relatie tot schoonheid. De esthetiek van de natuur kan bijdragen aan zowel lichamelijke als mentale gezondheid en welzijn.

11. Voorzien van een habitat

De Lekdijk voorziet organismen van een leefgebied. Hierin vinden ze beschutting, bescherming en vaak de benodigde voedingsmiddelen.

12. Bloemen plukken

Een verschillend aantal bloemen groeit op de Lekdijk, en zorgen voor een prachtig uitzicht. Veel mensen plukken deze bloemen, dit heeft een positief emotioneel effect en kan ervoor zorgen dat hun humeur verbeterd.

9.3 Appendix 3: Results and analysis

In this appendix, the specific data results and analysis can be found. First, there is an overview of all the different ecosystem services and then they are sorted per category.

9.3.1 Average and standard deviation of the ecosystem services

	Flood control	Pollination	Aesthetics	Recreation and ecotourism	Picking flowers	Food and space for grazers	Provisioning of habitat	Photosynthesis
Average	6,60	5,65	4,22	3,67	1,57	4,35	5,28	4,70
Standard deviation	1,77	1,73	1,93	2,13	1,44	1,79	1,91	1,84

Figure 12: The mean and standard deviation of all the ecosystem services

9.3.2 Shapiro Wilk test of all categories

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Regulating services	,155	82	,000	,894	82	,000
Cultural services	,144	82	,000	,928	82	,000
Provisioning services	,174	82	,000	,934	82	,000
Supporting services	,107	82	,021	,971	82	,062

a. Lilliefors Significance Correction

Figure 13: The test of Shapiro-Wilk of all the ecosystem service categories. If $p > 0,05$ the variable is normally distributed.

9.3.3 Histogram and boxplots per ecosystem service category

Regulating ecosystem services

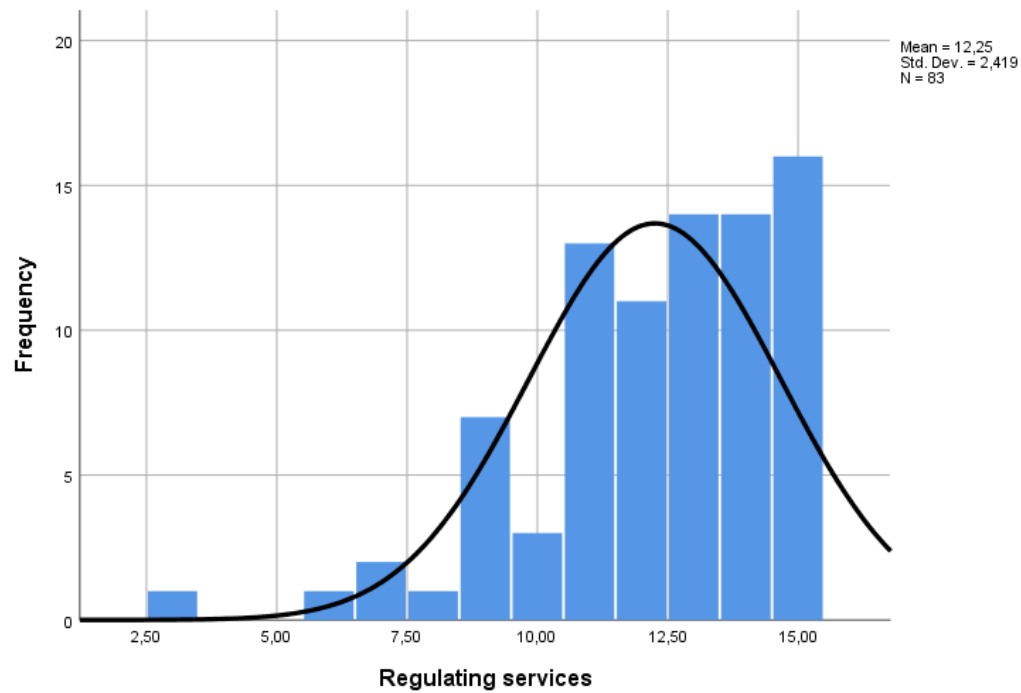


Figure 14: Histogram of the regulating ecosystem service

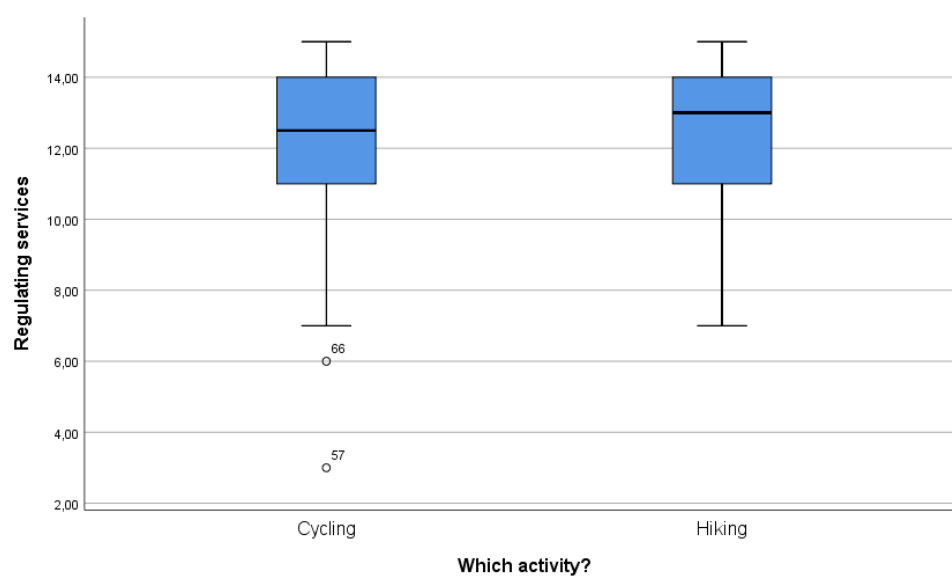


Figure 15: Boxplot of the regulating service per activity

Supporting ecosystem service

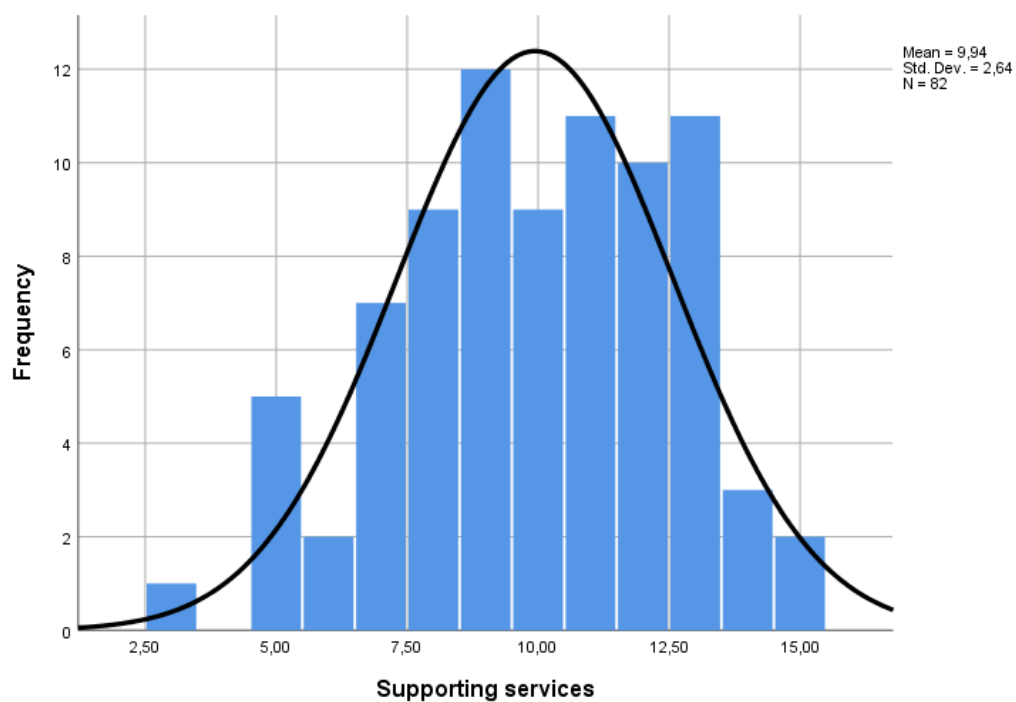


Figure 14: Histogram of the supporting ecosystem service

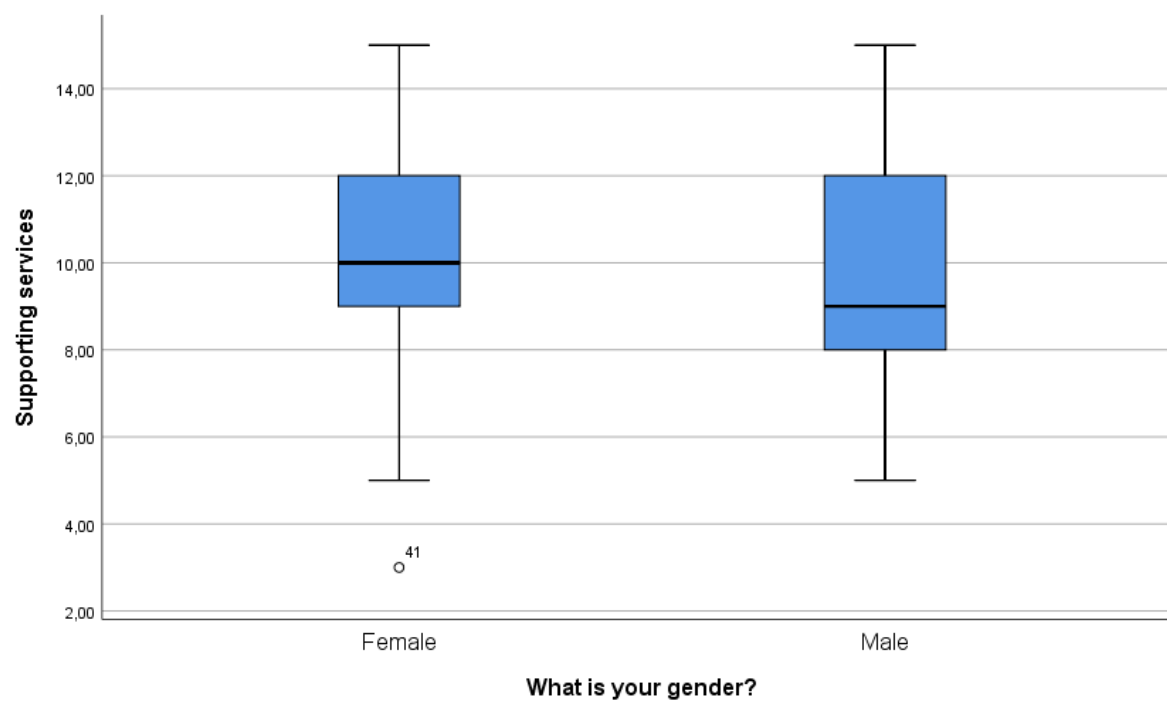


Figure 15: Boxplot of the supporting service per gender

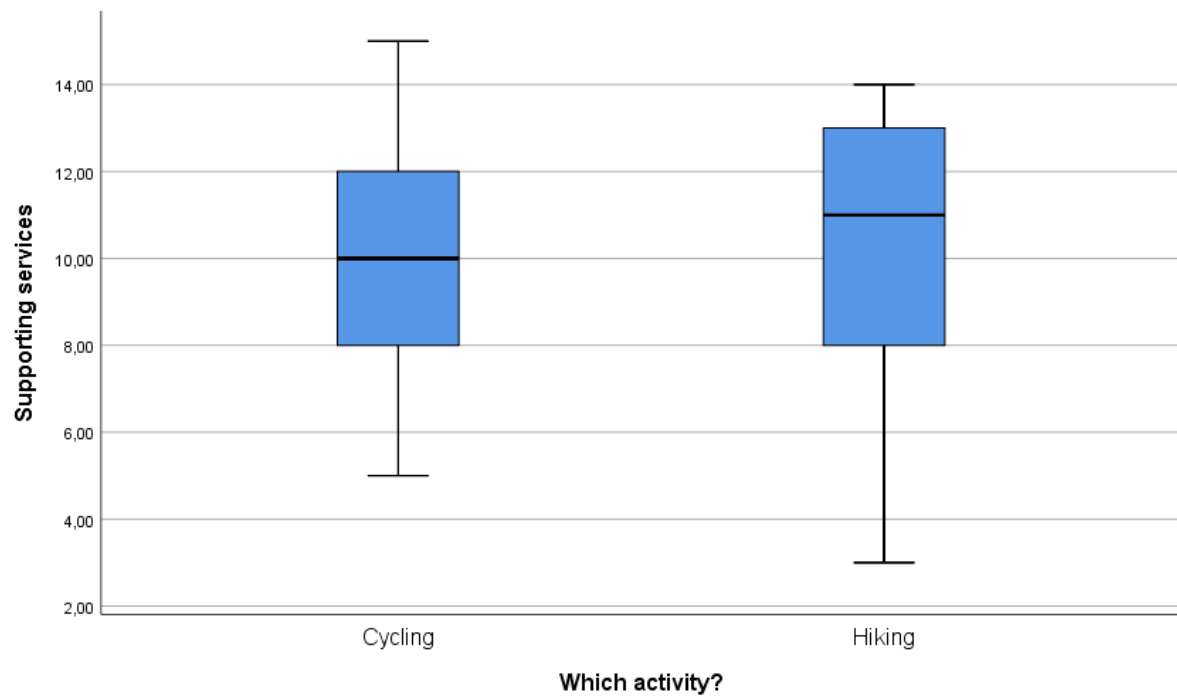


Figure 16: Boxplot of the supporting service per activity

Cultural ecosystem services

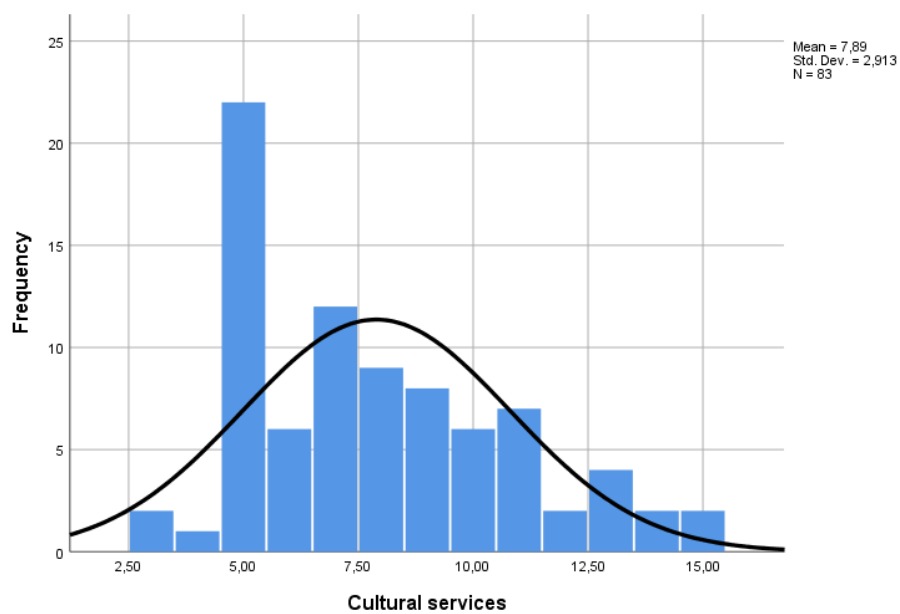


Figure 17: Histogram of the cultural ecosystem service

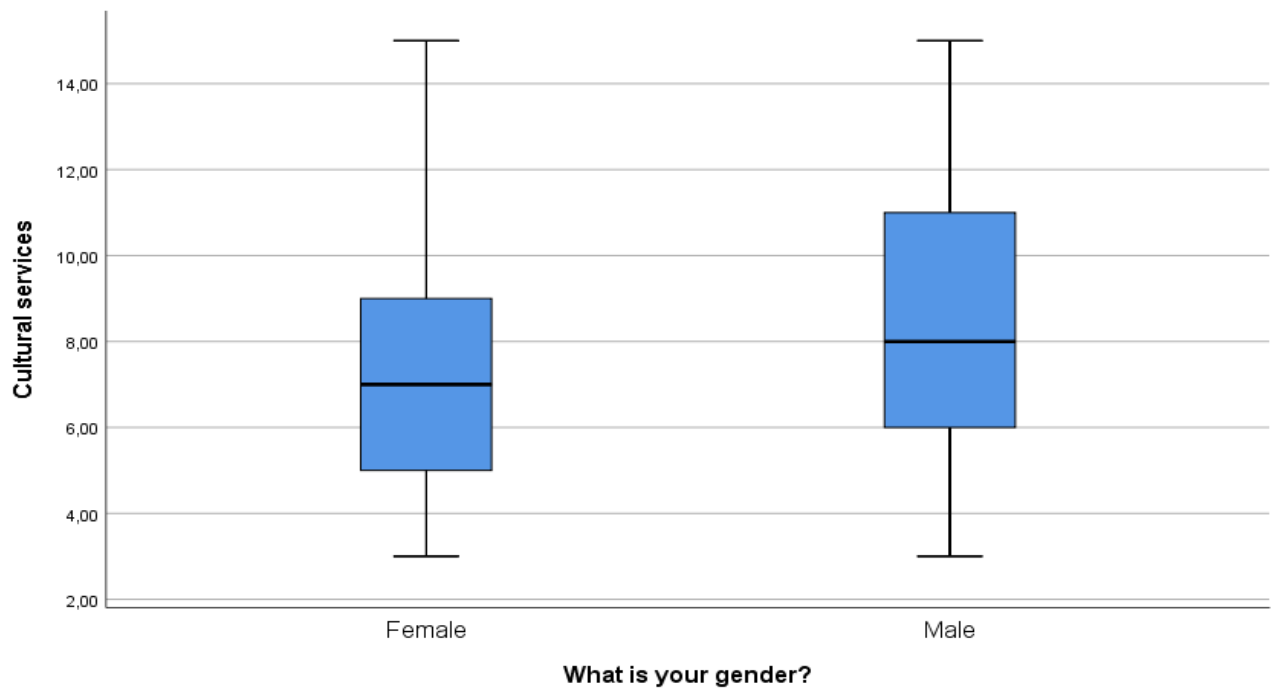


Figure 18: Boxplot of the cultural service per gender

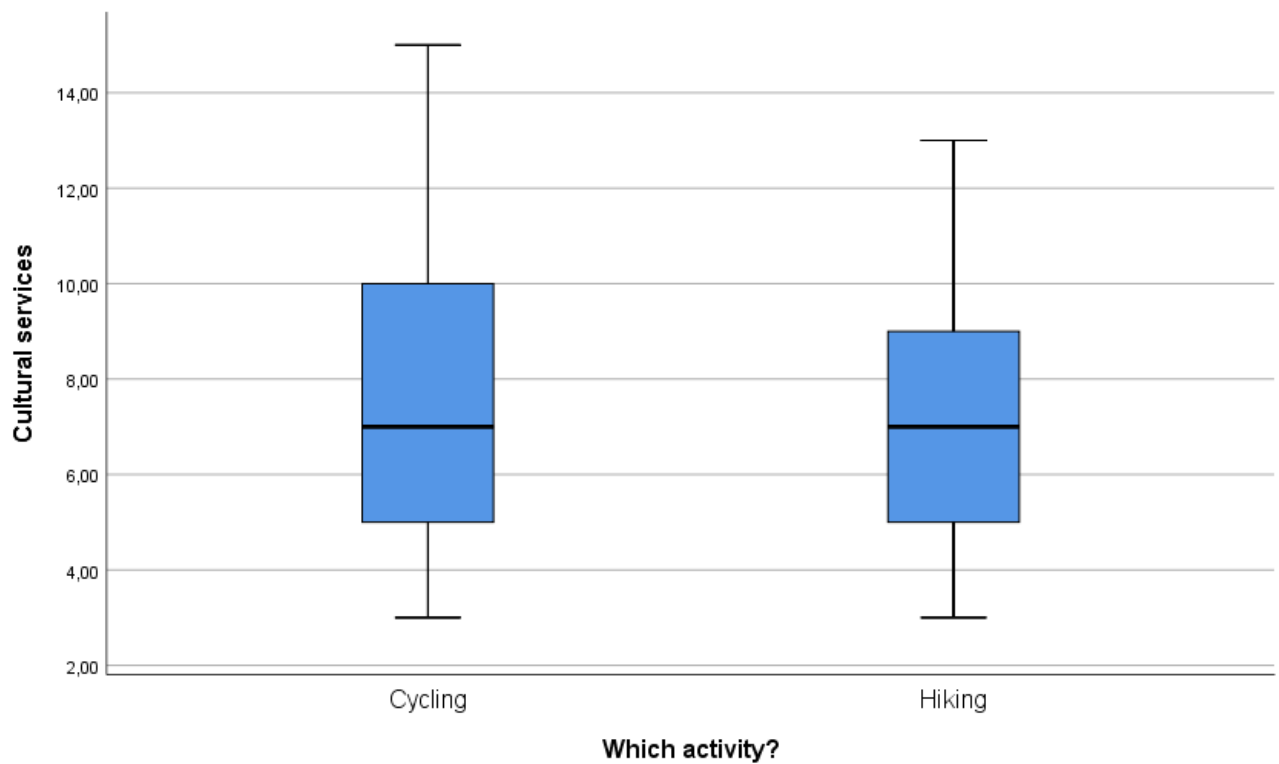


Figure 19: Boxplot of the cultural service per activity

Provisioning ecosystem services

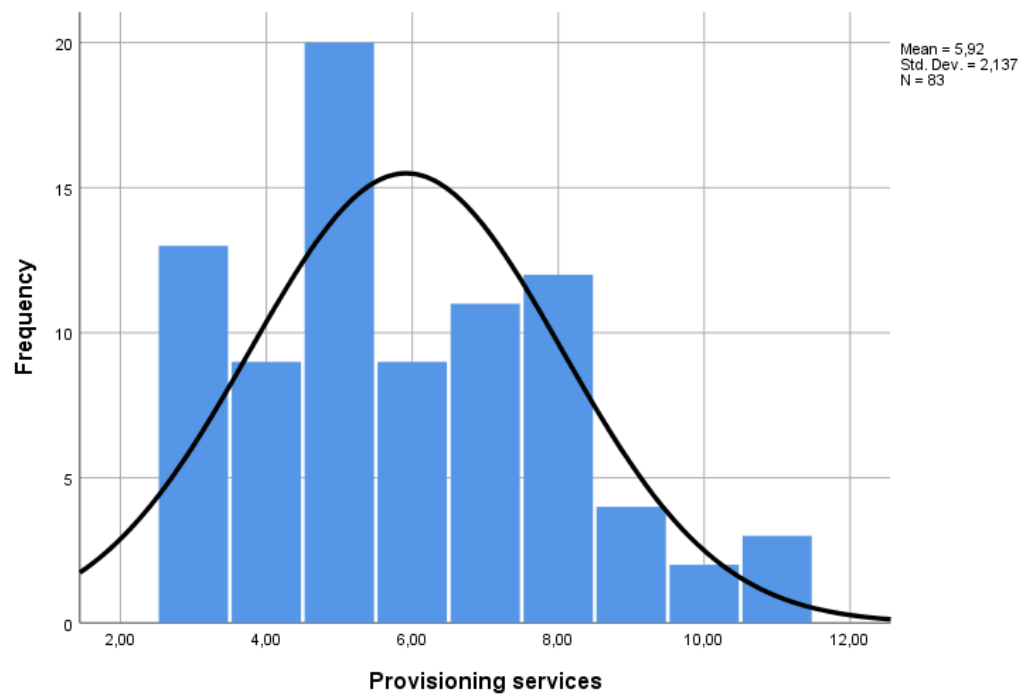


Figure 20: Histogram of the provisioning ecosystem service

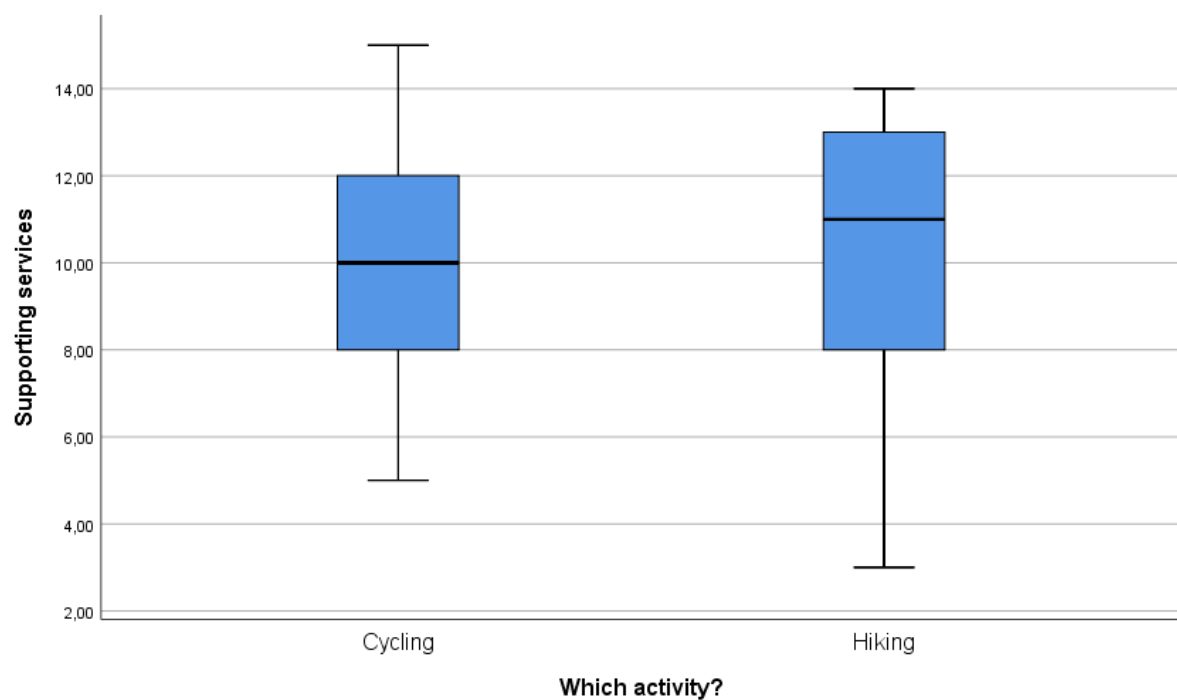


Figure 21: Boxplot of the supporting service per activity