

Improving Green Space and Biodiversity on University Campuses

Is the green space on campus more than just an aesthetic?

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Preface

This thesis is the completion of my Master's degree in Environment and Society Studies at the Radboud University Nijmegen, specializing in Local Environmental Change and Sustainable Cities. The topic of this thesis is green space and biodiversity on university campuses. The research for this thesis was started in Nijmegen at the Radboud University office of Occupational Health & Safety and Environment Service, due to the global pandemic the rest of the research was carried out in Maryland, United States.

I would like to thank several people who helped me throughout the thesis process. First, I want to thank my two advisors Rikke Arnouts and Guido van Gemert. Rikke was extremely helpful throughout the whole process giving me guidance on how to properly execute my research study and write an academic thesis. Guido helped get me in contact with the Dutch participants of the survey and interview. I also want to thank Guido for allowing me to intern for the Occupational Health & Safety and Environment Service. Second, I want to thank all the participants of both the interviews and the survey, without your willingness to participate I would have not been able to complete this study. Finally, I want to thank my family and friends for their support throughout the whole thesis process, in the challenging time they were there for me, believed in me, and cheered for me.

Hope you enjoy,

Noah Kalicka

Summary

Green space in urban environments is important not only to help aid in the fight against climate change, but for the betterment, safety, health, and well-being of the people inhabiting the urban environment. Another important factor for urban green space is its ability to harbor threatened or endangered species. Urban environments are more important than people may think when it comes to the conservation of flora and fauna.

This study focused on two separate university campuses. Radboud University located in Nijmegen, Netherlands, and the University of Maryland located in College Park, Maryland, United States. The topic of study was green space and biodiversity on university campuses. The study looked at the motivations of university stakeholders to invest in the development of university green space and to protect or conserve the biodiversity of that green space. The university policies related to green space and biodiversity were researched to determine if they one, related to the topics being researched, and two, to determine how effective the policies were. It also theorized the intrinsic and extrinsic value of nature to affect the motivations of the stakeholders.

The study was conducted as a comparative case study and used a mixed-methods approach. Both qualitative and quantitative methods were used to determine the results of the study. The qualitative method used was a semi-structured interview and consisted of 9 participants, 5 from Radboud University, and 4 from the University of Maryland. These interview participants were made up of key stakeholders at both universities. The quantitative method used a survey that was sent to students at both universities. The survey was meant for the students so that we could gain an understanding of how they perceive green space and biodiversity on campus, to support the thoughts of the stakeholders.

The results of the thesis were both expected and not expected. It was expected that the universities would have policies and initiatives related to sustainability objectives. It was also expected that these policies and initiatives would not be related as much to biodiversity. But it was not expected to see those policies and initiatives not relating to green space as much as hoped, an exception to this is the new Biodiversity Action Plan from Radboud University. Finally, the motivations behind the stakeholders were not expected and were interesting to find out, given more interviews the results may have shown more motivations. The stakeholders agree that it is important to develop green spaces and conserve biodiversity on campus.

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1 Introduction

The purpose of this chapter is to introduce the reader to the research. First is the research problem statement which details the issue(s) that the research is based on. Second, is the aim of the research and research questions guiding the study. Third, is the evidence about the scientific and societal relevance of this study. Finally, an overview of how the rest of the paper is laid out.

1.1 Research Problem Statement

The human population is currently in a race against themselves to change their patterns in the consumption of goods and services. We are seeing this with ozone depletion, overfilled landfills, deforestation, fossil-fuel dependency, and the loss of biodiversity (Dryzek, 2013). Many of the policies and regulations in use today act as barriers to achieving sustainable and environmental goals (Hostetler, 2011). This is no exception for the policies and regulations set in our cities, towns, and universities. Urban settlements are usually located within “highly productive and biodiverse landscapes, contain important indigenous plant communities and many rare or threatened species” (McDonnell and Hahs, 2013, pg.398). In the past however these variables were not thought of in the planning process of a new urban environment, and still today planners do not have the knowledge base to make the correct decisions on aspects such as how much green space to leave open (McDonnell and Hahs, 2013). This issue can be translated to universities and how the stakeholders determine the management and importance of the campus green spaces.

University campuses are often set within a city or on the perimeter of a city still surrounded by local communities and urban sprawl. With urban sprawl comes the decline of natural green areas and biodiversity, this leads to a decline in species richness and ecosystem services in these urban areas. Li et al. (2019) mention that planning for a green campus focuses more on technology related to renewable energy, and less on the accessibility and potential that green spaces provide for a green campus. Universities are seen as mini cities/towns and have the opportunity to develop green spaces that are not only aesthetically pleasing but provide easier access to nature and conserve biological diversity. Protecting biological diversity on campus provides many benefits; it increases and improves habitats and abundance of species, helps to grow the relationship between the university and the surrounding community, provides a new learning tool for students and staff, and can provide economic savings via environmental management (Dixon et al. 2006).

A common characteristic that is seen with universities is their concern with achieving a source of sustainable energy, using less water, and creating a quality recycling network. As Colding and Barthel (2017) state “a campus area with all its buildings and land could be considered a community within this hierarchy...providing its inhabitants a sustainable and life-enhancing environment” (pg.4). The main issue that universities are forgetting is the natural environment which their campus sits upon, and the flora and fauna that share the same space. Universities a lot of the time own the land on which the campus resides allowing them to “control the vegetation structure of their properties, these properties can influence urban biodiversity tremendously” (Elmqvist et al, 2013, pg.125). As Elmqvist (2013) has hinted universities have an advantage in making conscious decisions about their landscapes that can

positively affect biodiversity. The conservation of biodiversity falls under two points, environmental stewardship, the act of protecting nature and intrinsic value of nature, the ability for nature to both, directly and indirectly, provide a benefit to humans (Rea and Munns, 2018). In both the Netherlands and the United States, biodiversity is not yet back to a positive state. There are still factors inhibiting the increase of biodiversity as high amounts of urban sprawl are consistent throughout the countries, large agricultural practices eat up open land, and high rates of automobile traffic all mean less green space for biodiversity (Notenboom et al, 2006, pg.4-5).

University campuses should be developed with the intention of having a balance between the built environment and natural green space. Barriers to achieving improved green space and biodiversity on campus might be derived from the factors motivating stakeholders and the value that is adhered to that change. Motivating factors are different from person to person and may very well affect the negotiations between stakeholders when making decisions on green space. A motivation that I think would have an impact is economic motivation. Universities want to have an aesthetically pleasing campus that attracts more students, which would in turn increase the monetary income for the universities. The final barrier is the addition of policies and initiatives that may guide the universities in a certain direction, which also have motivations and values. Each of these is to be under consideration by the stakeholders.

Therefore, this research focuses on uncovering the motivations guiding university stakeholder decisions for improving green space and biodiversity on campus. It looks at the policies and initiatives that are important and relate to these topics. The intrinsic and extrinsic values of the motivations and policies/initiatives will be discovered. To make the study more reliable it will look at two universities from the EU and the US. This comparison was for multiple reasons. First, as part of the internship for this thesis, the main area of study was biodiversity at Radboud University. Second, as an international student from America, it made sense to compare Radboud University with an American university to determine how different the policies and stakeholder motivations are. Finally, there was this thought that Europe was more sustainable or environmentally friendly than America and that this would show within the two universities.

1.2 Research Aims & Research Questions

This research aims to understand the reasons universities are developing their green spaces. This is to determine how green spaces can be utilized in more ways than just another aesthetic of attraction. The aim will be understood by determining the motivations of the university stakeholders and the value behind those motivations. Determining the motivations and values will help to uncover which end of the reciprocal spectrum the universities are at, for-profit or investment. This aim helped to construct the following main research question:

What motivates universities in the US and EU to invest time and effort in green spaces on campus and to what extent is biodiversity conservation part of these motives?

To answer this research question, first, it is important to understand the importance of green space and biodiversity in an urban environment. Second, the relevant policies and initiatives

need to research at the institutions, which will help to determine the stakeholder and university motivations. Third, it is important to understand the importance of green space and biodiversity in an urban environment. Finally, each of these will be assessed by using a framework for university green spaces, incorporating four factors (sustainability, socio-political benefit, environmental benefit, and economic benefit) each with different values and ways to provide the benefit. This framework is used to show the intrinsic and extrinsic values associated with the policies/initiatives, and stakeholder motivations. All of this led to the creation of these sub-questions. Each of these questions focuses on an aspect of green space and biodiversity, in that way, contributing to answering the central question:

1. What are the policies for green space/biodiversity?
2. What are the motivations behind the green space/biodiversity policies?
3. How is green space and biodiversity on campus viewed intrinsically or extrinsically in the minds of the students?
4. What is the importance of biodiversity conservation on university campuses?
5. What are the differences in these policies and motivations between the US and EU?

1.3 Scientific Relevance

Over the past five decades scientists, conservationists, activists, and other parties have been in the fight to protect and conserve the Earth's biodiversity, ecosystems, and green space. Social sciences on the topic of green space and biodiversity on university campuses can be considered small compared to the larger aspect of the topic being natural environments. This research is to add to the understanding of green space, biodiversity, and decision-making in a particular built environment. Higher education institutions can contribute as much if not more waste than some towns and "can have significant environmental impacts on- and off-campus, including air and water pollution, waste, the use of hazardous chemicals and habitat degradation" (Finlay and Massey, 2012, Pg.151). This study will contribute to the scientific knowledge base of green space and biodiversity of university campuses, the motivations behind the developments, the policies that stand behind these decisions, and the key stakeholders that are developing the plans and deciding the outcomes. Hopefully, these findings can then be used on a larger scale to improve the green space and biodiversity of larger built environments.

1.4 Societal Relevance

The importance of green space and improving biodiversity goes beyond just helping to protect this planet but is an important factor for the health of human beings. Green space and biodiversity in urban environments provide many benefits to humans, and most interactions that humans have with nature are in urban environments such as cities or universities (Beninde et al. 2015, pg.590). Untouched nature or nature that has less management from humans has shown to be a positive attribute to human health (ibid). People do not want to live and interact in an environment made full of steel and concrete structures. There should be a strong integration of nature within these urban environments to provide a space for potentially threatened or

endangered species to thrive and for the betterment of human health and well-being. Universities may become role models in showing the way for improving green space and biodiversity in the built environment. This study can also be beneficial to civil society in teaching them about the importance of sustainable policy, green space, and biodiversity within the built environment.

1.5 Paper Overview

This thesis from here on out will follow this format. In chapter 2 the literature review, theoretical frameworks, and conceptual framework will be discussed. The literature review is to gain an understanding of the research topic, and the theoretical framework section explains the relevant theories for the study. The conceptual framework provides the concepts this research is based on and shows the relation with the theories. Chapter 3 is the methodology section, describing the reasoning for the case studies, and data collection. Chapter 4 analyses the data and results obtained for the cases. Finally, chapter 5 provides the conclusion and discussion for the research study.

2 Literature Review & Theoretical Framework

The first part of this chapter provides an overview of the literature that has been read for better understanding urban green space and ecosystem services, and biodiversity in the urban environment. The second part of this chapter focuses on the relevant theoretical frameworks. It introduces theories on green space. The chapter concludes with an explanation for the chosen conceptual framework and how it works in this thesis.

2.1 Literature Review

2.1.1 Green space and Ecosystem services

In many of the papers on green space that were read for this research, there was no specific definition of the term. This connects with a paper by Taylor and Hochuli 2017 where they talk about how in their research on ‘defining greenspace: multiple uses across multiple disciplines’ they came across the same issue of authors not providing any sort of definition of the term ‘green space’ or ‘greenspace’. This study is using the definition of urban green space from the World Health Organization:

For this report *“urban green spaces are considered as urban space covered by vegetation of any kind. This includes:*

- *Smaller green space features (such as street trees and roadside vegetation);*
- *Green spaces not available for public access or recreational use (such as green roofs and facades, or green space on private grounds); and*
- *Larger green spaces that provide various social and recreational functions (such as parks, playgrounds, or greenways).*

Some of these larger green space structures (such as green belts, green corridors, or urban woodlands) can actually have regional scope and provide ecological, social and recreational services to various urban communities” (World Health Organization, 2017).

The way that humans view green space will differ from person to person. Having the ability to experience a piece of nature on campus can be a way to reduce stress, and it can be a place to raise awareness for biodiversity in an urban setting (Nagase et al. 2018). This is only the tip of the iceberg on reasons for implementing green space on a university campus. Some of the green space settings a university campus can provide are grassed areas with all forms of trees, shrubs, and plants, to managed forests and cultivated gardens (Nagase et al. 2018). Types of green spaces are not limited to the ones mentioned above. As the definition suggested green roofs, recreational fields, the trees that line the campus pathways all add to the green space of the campus. Universities need to think about green space as to not limit exposure to nature for their students (Speake et al. 2013).

A university campus can be a community “within this hierarchy and sharing with the city as a whole a common interest of providing its inhabitants a sustainable and life-enhancing environment” (Colding and Barthel, 2017). Green space and nature are that environments that can provide a satisfying break, a breath of fresh air from day-to-day life, it “employs the mind

without fatigue and yet exercises it; tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system” (Lau and Yang, 2009). There is though the importance of maintenance and upkeep of the campus grounds. This is provided of course by a ground maintenance team that works behind the scenes to keep the campus beautiful. Whether a university has a large or small amount of available green space without proper maintenance the effects of reducing stress or raising a person's mood may be reduced.

Green space and nature inherently produce or provide ecosystem services. Ecosystem services can be defined as “the benefits human populations derive, directly or indirectly, from ecosystem functions” (Costanza et al. 1997). This study is going to focus primarily on cultural services, but it is important to touch on the regulation services also (these can be seen in figure 1). For students and staff at a university green space can provide many different ecosystem services. Cultural services that stick out for a university campus are recreational, aesthetic, inspirational, educational, and sense of place. Green space can provide a place for many forms of recreation. At a university it is important to provide a proper space for this service, allowing students to improve their health through activity and or their well-being from the ability to relax in a green space. A service as simple as the aesthetic of a campus can be beneficial to students. Not only the built structures on campus but the aesthetic of well-tended gardens, pathways, parks, and grassy areas on campus may have an overt effect on a student's enrollment at the university.

Inspiration is an ecosystem service that might not cross one's mind. As a student being in nature or spending time in a green space may help to clear the mind providing space for new ideas to blossom and gain a spark of inspiration. Green space and nature can provide educational service. In the most basic sense, you may discover something new about a plant or animal through observation improving your knowledge and sense of awareness of nature. On the more advanced side courses can provide field studies to help gain a more in-depth understanding of nature. Providing many different forms of green space on campus can benefit in this way. Green space can provide a sense of place for humans, this could be a feeling of home, remembrance, calmness, and many more. A sense of place can uplift one's spirit and make them feel welcome in a somewhat unknown environment. Finally, regulating services can be greatly affected by green space. Urban built environments are some of, if not the largest contributors to climate change and have other adverse effects on natural environments. Green space on university campuses may be constructed with ecosystem services like water regulation, purification, pollination, and climate regulation in mind. The direct and indirect effects of green space on a university campus can be helpful for both humans and the planet.

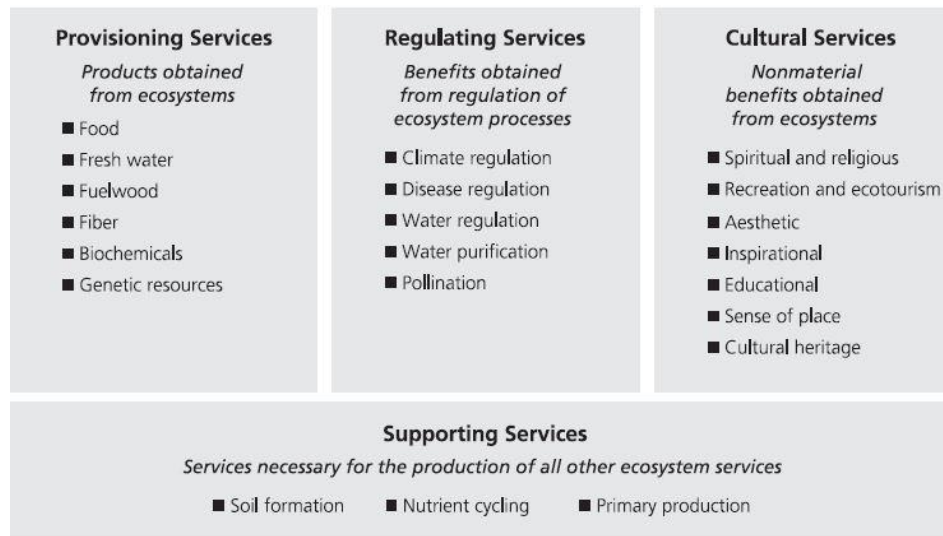


Figure 1 Millennium Ecosystem Assessment Ecosystems and Human Well-being, 2003

2.1.2 Urban biodiversity and University campuses

The term urban biodiversity might not be known to everyone. Here is a concise definition of the term:

“urban biodiversity refers to the variety of living organisms found in the ecosystems of urban areas, and it is usually measured as the number of species (and their abundance) found in a given city or area of the city” (Oliveira, 2014, pg.462).

The human-nature relationship is the concept of how we as humans understand and interact with our natural surroundings “and in practice, this personal perception of nature may affect the motivation of biodiversity conservation” (Berry et al. 2016). There is a high value placed on the conservation of biodiverse landscapes, but the value perceived for urban landscapes may be different. This is in part to how biodiversity is “viewed, perceived, measured, and valued” (Dearborn and Kark, 2010) within an urban area by the parties involved in the decision-making process. When thinking of how to develop or change a green space on a university campus biodiversity should be one of the factors they consider. Aronson et al. (2017) and Nagase et al. (2018) say “urban green space vary considerably in design, management, and biodiversity conservation value, but some of the largest intact green spaces in large cities exist on university campuses and offer diverse habitats for native and rare taxa”.

This issue of biodiversity on campuses around the world has become more of a concern for the policymakers of universities (Alshuwaikhat and Abubakar, 2008). Universities are large institutions where for decades they have been using unsustainable practices. With climate change and environmental issues on the rise, universities are starting to take initiative by changing how they think about waste, energy/emissions, and water usage. Universities should also be thinking of their campuses as a place where biodiversity can thrive, “biodiversity losses have accelerated worldwide due to overexploitation of natural resources, habitat destruction, and

climate change” (Hui et al. 2008). The green space on a university campus can be a safe place for potential endangered and threatened species of flora and fauna inhabiting those regions.

The average green space that some universities possess allows for large amounts of vegetation to be placed which can provide more native plants and animals with new habitats and make a contribution to conservation efforts (McKinney, 2002). This can also work for smaller universities or ones that are locked into the center of a major city. Ground maintenance teams, stakeholders internal and external can become creative in ways they introduce more green space into the university campus. Li et al. (2019) point out an important issue with the current practice of improving campus sustainability. She states that “it is found that research mainly aiming at the energy-efficient technology application and campus energy management lack attention to the green campus planning, such as the land-use efficiency and accessibility, especially lands of green space” (Li et al. 2019). A point to bring up is the other sustainable practices universities are implementing that could also work side by side with a green campus plan. Universities that are grouping sustainable initiatives with green campus plans should be thinking about biodiversity also.

2.2 Theoretical Frameworks

This section describes theories of intrinsic and extrinsic values of nature, and how they relate to green space and biodiversity. Reciprocity is the final theory looked at, it is depicted in two ways, first how it is viewed in the university context and then how it compares with extrinsic values.

2.2.1 Intrinsic value

The term intrinsic value can fit into different themes and places of work. There are many definitions of intrinsic value, most of which summarize the same viewpoint. It is defined here by Rea and Munns (2017) as “the concept of intrinsic value reflects the perspective that nature has value in its own right, independent of human uses”. Rea and Munns (2017) go on to say that intrinsic value can allow people to see the value nature has whether it directly or indirectly affects the person. Elliot (1992) says that the values of human beings are what create intrinsic value. In the form of green space and nature, humans are constantly delineating between nature being good for people's health and well-being, and the need for natural resources. Nature is a living breathing organism that has direct and indirect impacts on people's lives.

As stated, intrinsic value can come in many forms, when looking at green space in the urban environment two forms stick out. Subjective intrinsic value and objective intrinsic value. As described by Sandler (2012) subjective intrinsic value looks at the value of something for what it is and not what it can add to, while the objective intrinsic value is a value that “has properties or features in virtue of which it is valuable”. Both are valuable in this study. The subjective value benefits the people who frequent the green space which in turn rewards the stakeholders in their interests. The subjective intrinsic value appears phenomenologically to individuals to determine (Husserl, 1970), the value is therefore determined by individuals. The objective intrinsic value is quantifiably good. Of course, to a certain extent, the goodness of these outcomes is determined

according to axiological dispositions and is therefore determined subjectively. However, for this paper quantifiable outcomes for health, and improved biodiversity will be considered to be objective benefits.

2.2.2 Extrinsic value

The term extrinsic value of nature is stated by White (2013) as “establishing the value of biological diversity regarding something external to it, in which, then, must reside the primary intrinsic value”. The extrinsic value is then determined by the intrinsic value and the effect needs to be direct to the individual. White (2013) goes on to say that “extrinsic value of biological diversity can only exist if one posits that humans have intrinsic value or that some human condition, such as human life, well-being, freedom from suffering, happiness or spiritual satisfactions, has an intrinsic value”. This extrinsic value gained is then determined by the subjective intrinsic value portrayed by an individual looking at nature and the ecosystem services it provides.

2.2.3 Reciprocity

To begin with, the term reciprocity needs to be defined. As a base, the Merriam-Webster Dictionary defines reciprocity as “*the quality or state of being reciprocal: mutual dependence, action, or influence*” (Merriam-Webster, n.d.). This definition is straightforward and easy to understand, but others relate more directly to the ecosystem services of the environment and sustainability. The first comes from Carter (2014) who says reciprocity is the “contingent cooperative investments that are based on the cooperative returns (enforcement through partner control and/or partner choice)”. Jones and Tobin (2018), state two important relational values of reciprocity, first that “reciprocity is the exchange of goods and services to attain some kind of symmetry and mutual benefit”; and second “reciprocity is often invoked as an organizing principle and conceptualized as driven by the pursuit of self-interested actors motivated by individual utility maximization”. Reciprocity is all about gaining something in value as a return on investment. The term ‘direct reciprocity’ is the simplistic terminology of these definitions and simply means that when person A helps person B, person B then helps person A (Carter, 2014).

The reciprocity or the return is then stemming from the stakeholder’s motivations to invest in green space and biodiversity on campus. What are the investments and what are the returns? The investment is the universities improving green space and biodiversity on campus, which should improve the local ecosystem, and can improve the sustainability and environmental stewardship of the university. The return from the natural environment is the ecosystem services that urban green spaces naturally provide. These ecosystem services can include but are not limited to water flow and stormwater mitigation, temperature regulation, noise reduction, air purification, waste treatment, climate regulation, pollination, and recreational opportunities (Gomez-Baggethun and Barton, 2013).

2.2.4 Extrinsic value vs. Reciprocity

Extrinsic value and reciprocity have similar traits that are obtained from different methods. There is a need for both extrinsic value and reciprocity within this study. The extrinsic value of nature is related to the subjectivity of the intrinsic value of nature, meaning that the intrinsic value is going to produce different extrinsic values for everyone. These two terms coincide with the value of nature and the inability for there to be one without the other. The intrinsic value determines what the extrinsic value is going to be. An example is as follows, nature has a positive effect on a person's mood being the intrinsic thought of that individual, the extrinsic value or return is when they are in nature, they feel happier.

Reciprocity is looking at the return on some form of investment that will provide the same benefit for every individual. The stakeholder's investment is improving green space and biodiversity on campus, which is presumably both subjective and objective. Subjective being that the individual may be influenced by personal interest on the subject, and objective coming from the rise in environmental awareness and understanding the value of improving such aspects. The return is then improved biodiversity, better tools for education, stronger environmental mitigations, and much more. The main difference is that the return gained from intrinsic and extrinsic values of nature affects everyone differently whereas the return from investment in reciprocity affects everyone the same.

2.2.5 Conceptual framework development

The paper that introduced the idea for this thesis conceptual framework is by Azadi et al. titled *Multi-stakeholder involvement and urban green space performance*. The main aim of the paper was to “identify the main factors influencing urban green space performance” (Azadi et al., 2011). The study was conducted by reviewing urban green space projects published in international journals (Azadi et al. 2011). The information in the journals was looked at to determine how the stakeholders contributed to the performance of urban green spaces.

The conceptual framework developed had two main points, multi-stakeholder, and green space performance. Within these two sections were information Azadi et al. thought was important to acknowledge when determining how the multi-stakeholder involvement would affect green space performance. The ‘multi-stakeholder section’ was split into the internal and external factors they thought were most important in having an influence. The ‘green space performance’ was split into five guiding principles that were to be thought achievable via multi-stakeholder involvement. These five principles are *responsiveness to actual issue, sustainability, natural environmental benefit, economic benefit, and socio-political benefit*. How these benefits are viewed in their paper will be explained below:

- Responsiveness to actual issue: This is portrayed as less a benefit and more a means to achieving the set goals of the actors. This is determined via the relatability of the project to a current problem with urban green space (ibid).
- Sustainability: The sustainability of urban green space performance is directed towards the types of support that having a sustainable urban green space could

- provide. In their paper, they show sustainability as support for the natural environment, social-political, and financial (ibid).
- Natural environmental benefit: The benefits of this principle are directly related to its wording. The researchers are looking for urban green spaces to provide benefits for the environment. These include conservation and improved air and water quality (ibid).
 - Economic benefit: As the study is looking at cities, the economic benefits are directed at an increase in monetary value. The cities look at urban green space as a means of increasing taxes, property value, and boosting tourism (ibid).
 - Socio-political benefit: The socio-political benefit here is for the betterment of the people. It looks to the accessibility of green spaces in the urban environment, and the values which it provides. These values are aesthetic, scientific, human well-being, knowledge sharing, and preservation of culture (ibid).

There is a slight resemblance in the paper from Azadi et al. to this study where the main aim is to determine the motivations of stakeholders to improve green space and biodiversity on university campuses. The 'green space performance' section of the conceptual framework laid out a foundation that was able to be adapted to the green space of a university campus. Using the same headings, the information within each sub-heading was changed to better match the possible outcome of improved green space on a university campus, and to fit within this thesis. The principles used are sustainability, socio-political benefit, environmental benefit, and economic benefit. Below describes how these benefits are used in this thesis.

- Sustainability: Green space on the university campus is one of the ways these institutions can achieve their set sustainability goals. This benefit is seen here as a means of improvement for the universities. These improvements are to policies and initiatives related to green space and biodiversity. These will help to improve the sustainability of campus green spaces through environmental support, improved habitats for wildlife, each helping to improve the sustainability of the institution.
- Socio-political benefit: The improvement of green spaces and biodiversity on campus is seen from an educational viewpoint and a means of connecting students with nature. This connection is for their benefit and helps to improve health and well-being. Lastly, the improvement and creation of new green spaces are partially about campus aesthetics.
- Environmental benefit: The environmental benefits are not going to be that different from the ones presented above as these green spaces are still in an urban environment and can provide similar benefits. Protection and conservation of native flora and fauna are foremost. Secondarily, but still important are the services nature provides for the campus. These include improvement of air and water quality, better water regulation, and university carbon emissions being reduced.

- Economic benefit: These universities want to increase the amount of money they have each year. This benefit in this thesis is focusing on how the universities are achieving a higher monetary value and how green space is helping them.

The intrinsic and extrinsic values can be placed on each of these four benefits. In this research intrinsic value is placed with the sustainable and environmental benefits, and extrinsic values are placed on socio-political and economic benefits. Sustainability and environmental benefits are seen as intrinsic values because urban green spaces provide value to the universities whether it is acknowledged or not. This intrinsic value is also objective since many scientific studies agree that urban green space provides benefits in the form of ecosystem services. Socio-political and economic benefits are viewed as extrinsic for the benefit that is gained from urban green space. The extrinsic value of nature is what it provides for people, and in the cases of this thesis green space and nature provide socio-political and economic returns. This process of thought led to the creation of the conceptual frameworks below.

2.3 Conceptual Framework

Based on the theoretical frameworks, the two conceptual frameworks (figure 2/figure 3) were developed. The second conceptual framework (figure 3) is an adaptation of an existing conceptual framework developed by Azadi et al. (2011). The adaptation of the framework (figure 3) was important to fit the concepts and questions that are to be answered in this thesis.

These frameworks are an integral part of helping to guide and answer the main research question *What motivates universities in the US and EU to invest time and effort in green spaces on campus and to what extent is biodiversity conservation part of these motives?* Figure 2 represents the relevant dynamics that this research focuses on. Figure 3 is the main conceptual framework for this paper. The conceptual framework was developed to provide insight into the important benefits that green space can have for the universities. These benefits are sustainability, socio-political, environmental, and economic. Each of these four benefits is important individually while working with and improving each other. Both frameworks are for the reader to better understand the importance of stakeholders to make the decisions for improving green space and biodiversity on campus.

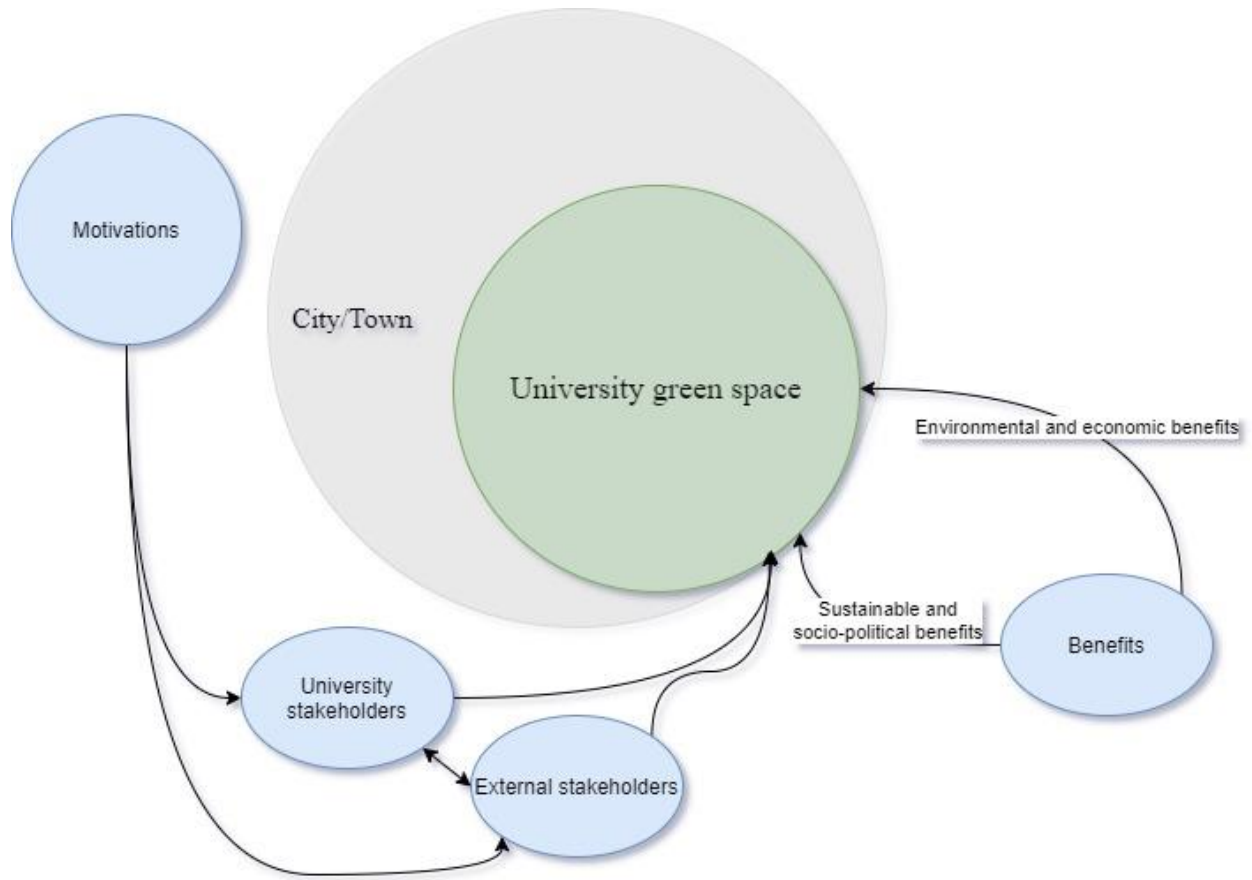
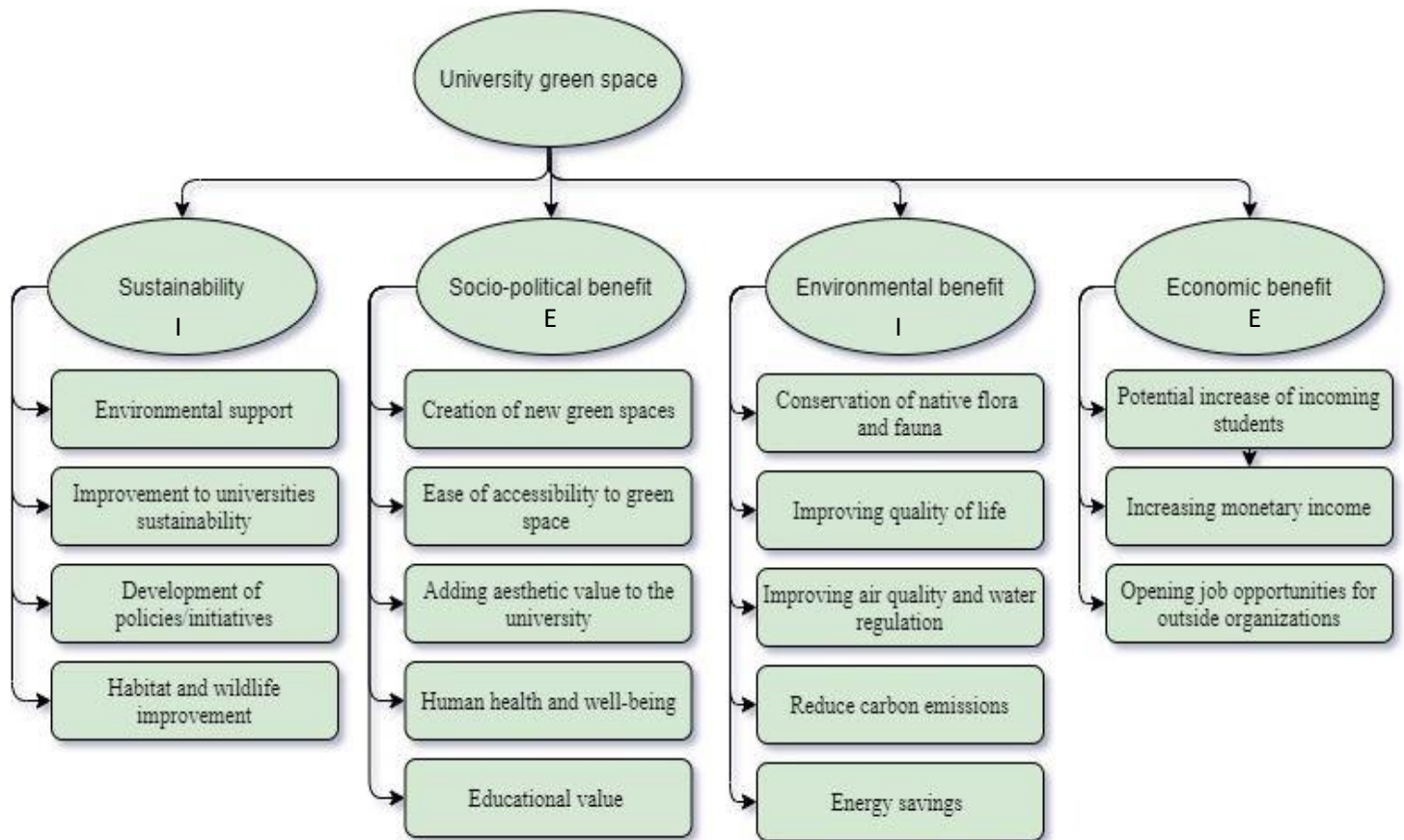


Figure 2, Entities and Dynamics conceptual framework, created by author.



I = Intrinsic Value, E = Extrinsic Value

Figure 3, Conceptual Framework adapted from Azadi et al. 2011.

3 Methodology

This chapter will elaborate on the methods used to conduct this research. First, the research philosophy will be discussed. Second, the research strategy is discussed followed by the methods used to conduct the research. Finally, the reliability and validity of the study will be discussed.

3.1 Research Philosophy

At the beginning of an academic research paper, the researcher acknowledges their beliefs stating their philosophical viewpoint. The philosophy of science is concerned with the thoughts and beliefs one has related to their research, these fall under the general philosophical branches of ontology, epistemology, and methodology of scientific research (Guba & Lincoln, 1994).

Ontology is asking what the nature of reality is, and what is known about it. Epistemology looks at the relationship between the individual with the knowledge and the ‘thing’ this individual knows about. Finally, the methodology of research is the processes and techniques used by the individual or group of people to reach the aim of the research (Guba & Lincoln, 1994). These are considered the basic tenets of what makes up a research paradigm.

The research paradigm has many definitions but can be looked at as the philosophical framework within which the study operates. There are different research paradigms for the researcher to choose from, these include Positivism, Postpositivism, and Constructivism. Positivism is seen through the lens of observation and experiment and takes a strictly empirical viewpoint and adheres strictly to a hypothetical-deductive model of reasoning. Postpositivism similarly adheres to the scientific method, while at the same time recognizing observations and experiments have fallible aspects in so far as they are observations made by human beings (Guba & Lincoln, 1994). Constructivism, moreover, presupposes that observations are totally relative, and therefore holds that there are no absolute objective truths whatsoever (Sutrisna, 2009).

In the introduction to their 1994 paper, ‘Competing Paradigms in Qualitative Research’, Guba and Lincoln state that “as efforts were made to build a case for a renewed interest in qualitative approaches, it became clear that the metaphysical assumptions undergirding the conventional paradigm (the “received view”) must be seriously questioned”. In this vein, it is not only important but crucial for the reader to understand the paradigms in which this paper operates. The research philosophy will help the reader understand the operations and parameters of the qualitative aspects of this thesis. The philosophy underlying this thesis is Postpositivism. The paper presupposes certain objectivist underpinnings, while at the same time addressing its fundamental question through a constructivist approach. This allows the paper to address a question that may not necessarily have an objective answer, while at the same time treating this question within the context of certain objective truths.

This paper employs a constructivist model to answer the main research question concerning the motivations of the stakeholders to improve green space and biodiversity on campus. Whereas it may be questionable whether or not we can arrive at a definitively objective conclusion as to what the motivations are for each of the individuals involved in the processes discussed in this paper, we can arrive at an approximate conclusion based in hermeneutic interpretations of discussions with these individuals. I, therefore, had one on one conversations

with nine individuals, four from the University of Maryland, and five from Radboud University. Furthermore, the 70 responses to the survey conducted provide additional subjective data through which to cross-reference the data ascertained from the interviews.

However, there remain certain objectivist presuppositions within this research. There is an enormous breadth of literature that speaks to the benefits of green space for humans and urban environments. This paper accordingly takes as one of its fundamental premises that green space is objectively beneficial in terms of intrinsic, extrinsic, and reciprocal value. Thus, this objectivist approach to green space in urban environments, when employed in tandem with the constructivist approach to the stakeholder's motivations to invest in green space comprises the paper's overarching post positivistic viewpoint.

3.2 Research Strategy

The research strategy for this thesis is based on qualitative methods with support coming from quantitative methods. The qualitative method of interviewing is central in the research as it is the appropriate method for helping to answer the main research question. The quantitative method in the form of a questionnaire or survey is being used to fortify the results derived from the interviewing process. Bryman (2012) states that having a research strategy acts as a guide during the research.

This research study is designed as a case study. The research will be focusing on one specific urban environment being university campuses. Case study research is "the most flexible of all research designs, allowing the researcher to retain the holistic characteristics of real-life events while investigating empirical events" (Schell, 1992). The case study will allow for a more focused look at the cases being investigated. This form of research can be beneficial in a study since it brings forth the option for the mixed methods approach as described above (Denscombe, 2003).

This case study will not be singular, instead, it will be a comparison between two universities. The two cases being looked at are Radboud University and the University of Maryland. Comparative case studies provide the opportunity to substantiate the research with the ability to compare one or more cases (Goodrick, 2014). This form of case study analyses and compares the similarities, looking for patterns both cases share, and the differences between them (ibid). Conducting the comparative case study will allow for a larger data set to be gathered strengthening the reliability and validity of the research study.

As this study focuses on the universities and the stakeholders, it was mentioned by Gultekin (2018), that there needs to be an identification of the key stakeholders, their similarities and differences, and an analysis of the relationship between the stakeholders to develop a successful outcome. Also, within this study, the role of the researcher is important (Yin, 2009). The researcher must take his/her values and assumptions into account and watch how much they influence the research. It is important to know that participants in the case study will have different personal feelings and opinions on the proposed research. All interviewees will get an introduction both before the interview and when the interview begins. The interviewees were

properly informed about the research and understand their role in the research. The survey will include a summary of the research and box will need to be marked at the beginning of the survey ensuring the participant knows what they are filling in a survey about and that they permit the use of their answers within this research.

3.3 Case selection

The research conducted was at the request of the internship supervisor at the Radboud University department for Occupational Health & Safety and Environmental service. As the research study focuses on university stakeholder motivations to develop green space and conserve biodiversity, the cases selected were universities. The first case selected was Radboud University as the results would directly benefit the university. The second case selection was the University of Maryland, this university is in the United States of America. When deciding to develop a comparative case study, the thought occurred that cultural differences could play a role in the motivations of stakeholders and the universities. For this reason, the University of Maryland was selected for the second case.

Thinking of the research objective, the potential stakeholders that could be interviewed was taken into account, as the topic of university green space involves a multitude of different departments and individuals within the hierarchy. However, the choice of stakeholders was guided by the expert knowledge on the subject matter, and direct relation to the decisions made for campus green space. This is known as ‘purposive sampling’, which is when participants are chosen for a specific intention, in this case, it was the more direct relation to the objective at hand (Bryman, 2012).

3.4 Research methods and Data collection

This section will describe the methods, data collection, and data analysis that were used to conduct this research.

3.4.1 Mixed methods

This study uses a mixed-methods approach incorporating both qualitative and quantitative methods. The qualitative method in the form of interviews is the main data source in answering the main research question of this paper. The secondary method is qualitative and uses a questionnaire or survey to gain the student's perspective on green space and biodiversity on campus. The questionnaire is integral to this study as the results act as support for the responses given by the stakeholders in the interviews. There is a definition of mixed methods by Tashakkori and Teddie (1998, p.17) and reads “studies that combine qualitative and quantitative approaches into the research methodology of a single study or multiphased study”. The mixed method can be interpreted differently from one-person to the next, but still hovers around the same ideas.

3.4.2 Data collection

In this case study, both qualitative and quantitative methods were used for collecting data. Interviews were the most important method for understanding the stakeholders. Yin (2009) says that you can target interviews to focus on the relevancy of the case study. Semi-structured interviews are conducted with key stakeholders at the universities to understand how they work with other stakeholders and what their motivations are for improving green space on campus. The interviewees will consist of participants from the ground maintenance and facilities management teams, professors, heads of departments, and outside organizations. Semi-structured interviews will be used to provide a safe and informal environment for the interviewee. The conversation will be an open discussion flowing from some predetermined questions put forth both before and during the interview. Therefore, the semi-structured interview process is to allow the participants to give his/her own opinion on the topics discussed (Clifford et al. 2016).

The selection of interviewees was decided on the basis that they had input on the projects related to green space and they had expertise on the subject of biodiversity. The ground maintenance and facilities teams will be looking after, and possibly helping with the renovations of the green spaces, while the heads of these departments and others will be working through and accepting the design and plans for the green space improvement. The professors can give insight with their expertise on the topics of environment, sustainability, and biodiversity conservation. This can be seen as valuable information for the final decision-makers on how the green space will be designed. Finally, the outside organization is the landscape design firm/company the university uses to construct the green space.

The survey is used to gain an understanding of how much the students use and value green space on campus. Also, the researcher wants to know how the students perceive green space. Is it for recreational use, to better their health and well-being, or do they think of it just as nature and nothing more? A survey is in the form of an online questionnaire that is sent out to students from both universities. This questionnaire is filled out by individuals in private. Bryman (2012) uses the term self-administered questionnaire for this form of survey. The questions on the survey are meant for easy understanding so the participants may follow with ease.

The total number of participants that were interviewed was nine. Four of the participants were from the University of Maryland and the remaining five participants were from Radboud University. The survey yielded a total of seventy responses with only twenty-one coming from Radboud University and forty-nine coming from the University of Maryland.

Table 1, Interview Information

Interviewee #	Date Interviewed	Current Position(s)	University/Organization
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I1	12/5/2020	Student, Member of Eco Team	Radboud University
I2	12/5/2020	Student, Member of Eco Team	Radboud University
I3	12/7/2020	Guest professor at the department of ecology, Member of the Biodiversity Sounding Board	Radboud University
I4	12/7/2020	Sustainability Manager for Planning and Construction	University of Maryland
I5	12/8/2020	Assistant director for Arboretum and Horticultural Services	University of Maryland
I6	12/8/2020	Director of Facilities Planning in the Department of Planning and Construction	University of Maryland
I7	12/9/2020	Professor of environmental science and technology, Assistant Dean for strategic initiatives at the College of Agriculture and Natural Resources	University of Maryland
I8	12/10/2020	Project leader at Van de Bijl & Heierman, Manages green spaces on the Radboud University campus	Radboud University, Van de Bijl & Heierman
I9	12/16/2020	Consultant on environment and sustainability for Radboud University and Radboud UMC	Radboud University, RadboudUMC

3.4.3 Coding interviews

The transcription of the interviews was completed first. To transcribe the interviews the auto transcription program Temi was used to ensure a quick and accurate final product. The researcher then listened back to the recording while following the transcription to fix any errors the program may have made. The analysis of the interviews is a form of interpretation taken from factual content. The interviews will be structured through coding, in which the researcher interprets the data by assigning labels to the information for comparison later (Thiel, 2007, pg.139). Each of the codes is grouped into sections via their similarities focusing on the data set. The coding process used the program ATLAS.ti.

3.4.4 Survey analysis

Analyzing the survey questionnaire first involves gaining an understanding of the answer's participants provided. An important part of this analysis will be separating the data between both universities, this is done by a question asking which of the two universities the participant attends. Then discarding questions that do not help the study or any questions that have large outliers will not be used. The data discovered is then used to further the case study and the results of the research. The data will be shown in graph format and will link the answers from the students with the answers from the stakeholder interviews. The sample size of the survey was not large enough to warrant any type of statistical modeling. Also, the survey data obtained from the survey is rather similar for both institutions it does not require such strong statistical analysis. Therefore, a program like SPSS was not necessary, this program would have been necessary if there had been hundreds or thousands of responses to the survey.

3.4.5 Validity

The validity of the research is based on the trustworthiness or truth value perceived by the reader in the results of the research (Noble and Smith, 2015). This true value is an understanding that there is more than one reality that exists (ibid). In the findings of this study, there will be complete transparency between the writer and the reader, clearly stating and accurately identifying the commonalities and differences between the participants of the study (ibid). The research will use triangulation which social scientists have used as an argument for validating their research (Mertens and Hesse-Biber, 2012). The validity of this research should be recognizable in the real-world setting for which it is being used for.

3.4.6 Reliability

The reliability of a study is measured from its ability to be repeated by another researcher and discover the same or near the same findings (Bryman, 2012). This is an important component of the analysis process. The reliability of the findings through transcribing and coding interviews and analyzing data from the questionnaire will enable later researchers to understand the past thoughts of the key stakeholders and participants of the questionnaire. The reliability of this

project is also a crucial step in understanding the thoughts and motivations of the stakeholders and students, and how it might be applied to other areas of the university setting.

4 Case study Radboud University and the University of Maryland

In this chapter, the two case studies will be discussed. In 4.1 the case for Radboud University is discussed, in 4.2 the case for the University of Maryland is discussed, and in 4.3 the survey and view of students at both universities are discussed.

4.1 Radboud University case description

The Radboud University is a research institute located on the outer edge of the city of Nijmegen, Netherlands. The campus is split in two, the first is the medical campus and university hospital, the other half of the campus holds all other academic and recreational buildings. The Heyendaal campus is somewhere in the range of 100 hectares or 247 acres. This compared to other schools and the University of Maryland would be considered a smaller campus. The university is set in a suburban setting surrounded by neighborhoods and local communities. This does not mean that the university takes its green space for granted. On the campus map in the below image (Image 1), you can see where the green space is spread throughout the campus. The student body of Radboud University accounts for around 23,000 students. This number includes both undergraduate and graduate students. The university over the years has implemented strategies and technologies to improve its sustainability. These include energy and water-saving



technologies, sustainable building practices, recycling, and waste management practices, sustainability in education, among others. However, only recently have these efforts been more focused on biodiversity.

Image 1, Source: Radboud University website, 2021

4.1.1 Green space and Biodiversity

The green space on the Heyendaal campus can be categorized into two distinct groups. The first grouping is curated green lawns which mainly can be seen in the university medical center area of the campus, along with smaller patches of grass scattered around the rest of the campus. The largest of these grassed areas are the sports fields and the Park Brakkenstein which are located at the southern and eastern ends of the Heyendaal campus. The second grouping is being categorized as urban forests. Urban forests are important because they hold “dynamic ecosystems that provide critical benefits to people and wildlife. Urban forests help to filter air and water, control storm water, conserve energy, and provide animal habitat and shade” (USDA, n.d.) On-campus the largest of these urban forests is in the southern part of the campus, while the smaller one surrounds Park Brakkenstein and the botanical gardens. The botanical garden is used mainly for experimental research but is open to all students and the public to enjoy. The rest of the campus is then dotted with trees/shrubs and other ornamental plants.

In the later months of 2018, the university began to investigate the urban green areas on the campus. This began when “we got the news that in the last 28 years, 75% of insects had declined or diminished. This was shocking news” (participant 9). This information was brought to light by Professor Hans de Kroon during a seminar. The purpose of this investigation was to investigate the current state of biodiversity of the campus’s green spaces. The university began by using a basic biodiversity index tool to determine the base range the campus may be within. There were also a few small field studies conducted which dealt with obtaining and analyzing insect species on the campus, but the data was very minimal. This raises the question, how can the biodiversity on campus be improved? One of the steps that need to be taken is verifying the biodiversity index. Professor Henk Siepel is leading this step along with students to verify the biodiversity index. The university has also taken steps to begin conserving and improving biodiversity through different avenues.

Beginning in 2019 Radboud University began to invest more resources into improving the biodiversity on campus. One of the first projects to be developed and implemented was the addition of varietal fruit trees in a garden around the Berchmanianum building. The assortment of fruit trees included apples, plums, pears, cherries, and medlar. When these trees become of age and start to flower and eventually fruit, they will become another source of attraction for certain insect and bird species. The university uses the term ‘hotel’ to describe man-made enclosures where native animals can gather for safety and reproductive activities. These ‘hotels’ have been made for insects, hedgehogs, stone marten, bats, and birds. They have been scattered around the campus in areas believed to have high rates of activity for the animals that use them.

The typesetter beetle has been a nuisance in the Netherlands and surrounding countries. This is no exception to the urban forests on campus. There is a large urban forest that surrounds the Berchmanianum building in the southern part of campus that has been ravaged by the typesetter beetle. The university turned to their contracted landscaping company (Van de Bijl and Heierman) for assistance with containing the situation. These beetles can impact the trees heavily, “usually the trees turn brownish, become bare and die. Sometimes the beetles take certain viruses and fungi with them when they fly from one tree to another” (RU, 2019). Despite

best efforts, the damage was already done, and many trees could not be saved, instead, they began sowing wildflowers and allowed for nature to redevelop on its own. In other areas of the campus more varieties of flowers including native and non-invasive exotic perennial, annual, and biennial species have been and continue to be sown. An example area is the meadow of wildflowers planted along the paths leading to the Berchmanianum building, “what we did was without taking more space, you just turn the same space into a more diverse flowered area, and I think it all begins with plants because plants attract and host insects” (participant 8). The university has recently completed a larger project to improve biodiversity.

In March 2021, the Radboud University completed the planting of a tiny forest on campus. This was mentioned by participant 9 during the interview on how the idea came to be. This person was introduced to the idea of a tiny forest and was so intrigued that they wanted to develop one on campus. The proper steps were taken, and with the help of Van de Bijl and Heierman the project was put through research, development, and design phases and is now part of the campus. The tiny forest is located at the entrance to Brakkenstein Park and consists of 26 tree and shrub species. All the chosen trees and shrubs are native to that region of Europe and or the Netherlands combined. Each of the species was chosen specifically for their resilience to drought and for the aid and attraction of other native species. Some of the trees and shrubs include spindle tree, alder buckthorn, field maple, small-leaved lime, sessile oak, English oak, black alder, and others. With this achievement, Radboud University will hopefully continue to develop more projects at a similar scale.

4.1.2 Policies and Initiatives

This section explains the important policies and initiatives related to green space and biodiversity and are followed by the university. These policies are both internal and external and include a biodiversity action plan, governmental policies, energy, and water policies, and two initiatives. These policies and initiatives each have direct and or indirect relations to green space and biodiversity. Each of these policies and initiatives is important to the improvement of green space and biodiversity on Radboud University’s campus.

It needs to be noted that Radboud University is a public institution and owns the land in which the campus resides. Still, the university needs to be aware of and if necessary, stay within the lines of national/regional, and municipal laws, rules, and regulations surrounding green space and biodiversity. The Radboud University Sustainability Agenda from 2016-2020 states that “the government directly influences the sustainability of Radboud University”, and “the Municipality of Nijmegen is an important partner for strengthening local sustainability” (Deneer et al, 2016). This document however does not cover any information about how the university is going to improve green space or biodiversity on the campus. The main sustainability goals it mentions are energy usage, waste reduction, water consumption, and product procurement, leaving out any discussion about green space and biodiversity.

Biodiversity Action Plan

Perhaps the most important policy Radboud University has is the development of a biodiversity action plan. It needs to be noted that this plan has not yet been fully implemented by the university and is in its final stage of development. However, it was mentioned that the text of the document should not be altered between now and the final product. Before this document being developed there was an older policy that focused on green space but was not at the level of quality to make a large enough impact. This policy document was not able to be found. The biodiversity action plan is a better representation of the prior document, it will “try to give more space to biodiversity on our campus terrain” and the policy incorporates biodiversity “and climate adaptation, and I don’t know how you call it, nature inclusive building” (Participant 9).

The biodiversity policy aims to achieve a more biodiverse campus through the development and management of the buildings and land to create a better condition for the restoration of biodiversity (Gemert et al., 2020). This policy has a link to the university climate adaptation policy. This link stems from the recent droughts, high temperatures, increased severity of storms and floods that have caused damage to the university buildings and natural environments. The policy will set measures for creating a campus that is safer, healthier, and stronger ecologically, adapting to the effects of climate change (Gemert et al, 2020). The university wants to improve the biodiversity surrounding buildings through the strategy of ‘nature inclusive building’ when constructing new or renovating older buildings on campus. These are the main ambitions of the biodiversity policy.

The policy's main “objective is to prevent further biodiversity loss and contribute to the recovery and a net biodiversity gain towards 2030” (Gemert, 2020). There are four sub-objectives the policy mentions to help achieve this goal. The four sub-objectives are:

1. Improving conditions for biodiversity

- a. The university is aiming to restore the biodiversity of the campus through improvements of the natural environment’s food and water sources, providing a safe environment for animals, and providing opportunities for successful reproduction.

2. A climate-adaptive campus

- a. The aim is to make the campus more adaptable to climate change. Strategies for improving heat stress on campus, resistance to drought, and increased measures for flooding are to be developed. This is most important for the larger forests on campus and will be looked at for other green spaces on campus.

3. Nature inclusive action and building

- a. This aims to provide nesting for certain animals and insects around or on the buildings. To stop the usage of building materials that are harmful to plants and animals ensuring their safety. Lastly, measures are to be taken that allow for nature to be incorporated within the buildings as much as possible.

4. Working on the interaction between man and nature

- a. The university wants to ensure that it is properly educating students, staff, and community members on the importance of biodiversity. Communication on the subject will stem from research at the university and projects that are being worked on. With this people can more appropriately enjoy and appreciate the nature and biodiversity of the campus.

This biodiversity policy is to be ratified by Radboud University as a ten-year plan to improve the campus biodiversity. The university must be looking at the situation from different perspectives as were mentioned in the sub-objectives. The biodiversity action plan looks to bring positive changes to the campus biodiversity improving the green space and quality of life for the students.

Government Policy

As mentioned Radboud University strives to uphold good relations with the national/regional government and local municipality by following the rules and regulations when improving green space and biodiversity. The Netherlands has both international and national legislation to protect the natural environment. In 2017 the Netherlands replaced the Nature Conservancy Act of 1998, Flora and Fauna Act, and Forestry Act with the Nature Conservation Act. With the new Nature Conservation Act in place, it is up to each province to determine their own “set rules and regulations on nature” (Nature and biodiversity, n.d.). The Netherlands has ratified the Convention on Biological Diversity and follows both the Birds Directive and Habitats Directive (Nature and biodiversity, n.d.). The university must follow the explicit rules set by the Birds Directive when native and or endemic bird species are nesting and residing anywhere on the campus. The Habitats Directive is ensuring that the university strives to protect the biodiversity of all flora and fauna on campus to the best of its ability. The last initiative is used for the connection of habitats and protection of wildlife and is the National Ecological Network. The table below (table 2) will give brief descriptions of the policies and initiatives mentioned.

Table 2, List of Dutch national and international biodiversity policies, and initiatives

Policy	Description
Nature Conservation Act	This act is in place for the protection of natural areas, protection of plants and wild animals, and the protection of the nation's forests (Nature and biodiversity, n.d.).
Convention on Biological Diversity	The Convention on Biological Diversity is a legal tool for “the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources” (UN, n.d.).
Birds Directive	The Birds Directive sets out to protect all bird species that are native and or endemic to the European Union, “covers the protections, management, and control of these species and lays down rules for their exploitation” (Directive, 2009).
Habitats Directive	The Habitats Directive aims “to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies” (Directive, 1992).
National Ecological Network	The National Ecological Network is made to link like and different nature areas together more effectively, and to also link the surrounding farmlands (Nature and biodiversity, n.d.).

4.1.3 Other policies and initiatives

This section explains the final two initiatives relating to green space and biodiversity. First, the ISO 14001 certification is explained with the Sustainable Development Goals following. Finally, it will discuss the relevance of the energy and water policies.

ISO 14001

The Radboud University was the first in the Netherlands to acquire an ISO 14001 certification. This standard “is an internationally agreed standard that sets out the requirements for an environmental management system. It helps organizations improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders” (ISO, 2015). In the 2015 update to the ISO 14001 standard, biodiversity is mentioned more prevalently as an issue of concern. Organizations and institutions can be the beginning of the solution to conserving biodiversity with research and incorporating innovative and effective tools, the ISO 14001 can be used for guidance in this area (Gallo, 2019). Radboud University is still ISO 14001 certified, having this tool with the updated biodiversity section at its disposal could prove effective for the conservation of biodiversity on the campus.

Sustainable Development Goals

The sustainable development goals are a culmination of seventeen goals developed by the United Nations to combat the world's environmental, political, and economic challenges. The goals were developed during the 2012 Sustainable Development Conference in Rio de Janeiro with the objective “to produce a set of universal goals that meet the urgent environmental, political and economic challenges facing our world” (UNDP, n.d.). Radboud University strives to contribute to reaching sustainable development goals through multidisciplinary and interdisciplinary research (RU, n.d.). These goals can be considered initiatives and within the scope of this research four of the goals related to green space and or biodiversity.

- **Goal 3 Ensure healthy lives and promote well-being for all at all ages.**
 - Green space and nature have been proven to promote the health and well-being of people. On the university’s campus having appropriate green areas where individuals can relieve stress, clear their minds, and more is vital.
- **Goal 11 make cities and human settlements inclusive, safe, resilient, and sustainable.**
 - This goal does not only relate to people and poverty but also access to open space. Cities and other urban areas such as university campuses should have ease of access to open spaces. These open spaces can be parks, flower gardens, green roofs, forest paths, and others.
- **Goal 13 take urgent action to combat climate change and its impacts.**
 - This relates to the energy policy of the university. Implementing renewable energy technologies and other sustainable practices are important steps in mitigating climate change. The trees and other vegetation in on-campus green space are beneficial in sequestering carbon dioxide helping to mitigate the effects of climate change (Ugle, 2010).

- **Goal 15 protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.**
 - This goal of course relates directly to green space and biodiversity. Biodiversity is still on the decline while “forest areas continue to decline at an alarming rate, protected areas are not concentrated in sites known for biological diversity, and species remain threatened with extinction” (UN, 2020). This provides an opportunity for urban environments (university campuses) to promote the conservation of biodiversity and develop more diverse green spaces. Enabling for the potential to harbor threatened and endangered species.

Energy Policy

Radboud University's energy policy talks about how the university will improve its energy usage and decrease the number of greenhouse gasses (CO₂) through the implementation of renewable energy systems and conservation of energy within the existing buildings on campus. The energy policy has no mention of green space and its vegetation as a means of a small percentage of energy savings. The tree canopy when placed appropriately can “greatly reduce building solar load, surface temperature increase, and an internal heat transfer” (Berry et al, 2013). This of course would be most beneficial during the warm summers allowing for the university cooling system to be used less, saving energy. This would also provide an opportunity for the university to develop new smaller green spaces near campus buildings further improving the green space of the campus. This topic of green space for energy savings deserves some form of recognition within the energy policy even though the monetary savings are to be minimal. Relating to greenhouse gas emissions, vegetation on and surrounding the campus does help to sequester x amount of greenhouse gasses per year. Trees and other vegetation are not just aesthetically pleasing but important in absorbing carbon dioxide (Dubal et al, 2013). Ugle et al (2010) goes on to say that “statistics include 40 trees will sequester one tonne of CO₂ each year”. Carbon sequestration should be a topic of inquiry for the university and can be researched to then incorporate this topic in the university’s next sustainability report.

Water Initiative

It needs to be noted that water and water management have been mentioned in other documents such as the sustainability agenda, however, a specific water base policy document was not found during the research of this study. What follows is the information obtained from Radboud University sources. Water consumption at the university has been looked at for many years to see how it can be reduced throughout the campus. The focus has been on the consumption of drinking water on campus, this has been on a positive downward trend and continues to be through close monitoring and the usage of a cooling systems approach (UVB, 2017). There is no mention of water consumption for green spaces. This may be in part due to the Netherlands receiving large amounts of rain throughout the year. Evidence shows though that for the past three years the Netherlands has been in a drought, and even though the fall and winter bring enough rain the summers are dry enough to counteract this (Siepman, 2020). This would mean

that the university uses more water for its green spaces in the summer months than it does the rest of the year. From the explanation of the newly completed tiny forest, the university is trying to combat the drought with the planting of all drought-tolerant vegetation. However, that is only within a single area the size of about a tennis court. The rest of the campus still needs to be looked at for improvements in green space water management.

4.1.4 Motivations of stakeholders

Motivations come from internal and external factors. personal interest in green space and biodiversity and awareness of the current biodiversity loss and other environmental issues have been leading motivations for the stakeholders of Radboud University to improve the green space and biodiversity on campus. Participant 8 said “well, what motivates us and me in particular, I like green space”, this is an honest thought portraying this stakeholder’s interest, and what is a common interest of the other stakeholders. The stakeholders interviewed from Radboud University all agreed that biodiversity conservation is important and needs to improve on campus. A motivating factor of this is to uphold the ‘Green City’ reputation of Nijmegen, “I am not sure if it’s also about reputation, but I guess yes. The Radboud University is in Nijmegen, and Nijmegen was the greenest city in the Netherlands” (participant 1). This is a mention of the Greenest City in Europe award received in 2018. The university wants to uphold and improve its reputation in the sustainable and environmental sector is doing so with improved green space and biodiversity conservation.

The external motivation stems from tree and tree canopy loss due to drought which has lowered the number of trees on campus, but participant 9 says the new trees “will be more robust. Ones that can handle a bit more drought. So that’s an important motivation”. The stakeholders understand and acknowledge the loss in biodiversity on campus and other environmental issues that affect it. This motivation is formed from their awareness of the issues and is used to solve them, by, improving biodiversity and protecting it from other environmental hazards. There are three main motivations from the stakeholders, which are, motivation to uphold the university and cities reputation, motivation of personal interest, and the motivation to improve biodiversity loss and protect from environmental hazards.

4.1.5 Case relation to frameworks

The policies at Radboud University fit within both intrinsic and extrinsic values. However, each policy mainly fits intrinsic or extrinsic except for the Biodiversity Action Plan. The Biodiversity Action Plan has both intrinsic and extrinsic value. The intrinsic value of this policy stems from the environmental benefit section of the conceptual framework. In this section, the benefits include the conservation of native flora and fauna. This is the main goal of the university’s Biodiversity Action Plan, to increase the amount of biodiversity and develop new strategies to conserve biodiversity. This plan has an extrinsic value in the form of economic benefit by creating more projects for the hired landscaping company to execute. This policy is at the forefront of improving the biodiversity of the campus.

Next, are two initiatives taken on by the university which are completely intrinsic. The ISO 14001 certification and the Sustainable Development Goals are based on the intrinsic values of the university and the stakeholders who wanted to be a part of these initiatives. The ISO 14001 certification is essentially a guidebook that shows institutions how to integrate sustainable management practices. Even though the certification has newly involved strategies to protect biodiversity the certification is still based on intrinsic values that sustainability is inherently good. The SDGs are objective intrinsic values that were determined by the United Nations. The university objectively chose to take part in helping to achieve these goals. The rest of the policies which include the governmental, energy, and water policies are all grouped into extrinsic value. These are all grouped into the extrinsic value on account of they all were developed and are being used to gain a positive outcome from the natural environment, in this case being green space. These fall into the socio-political benefits of the conceptual framework.

Turning now to the stakeholders, the Radboud University stakeholders are mainly focused on the intrinsic values which green space provides for the university. These values were determined by discovering the motivations that were talked about above. Relating to the conceptual framework the intrinsic value of the stakeholders is focused on sustainability and environmental benefits. The value provided by these benefits for the university green space is supporting the environment and conserving native flora and fauna. These are what can be said through the results from the interviews. The other sub-information under those two benefits in the framework are extrinsic values gained from the conservation of biodiversity and improvement of habitat and wildlife.

4.1.6 Conclusion

The Radboud university stakeholders were all in agreement that the university needs to take care of nature and biodiversity on campus. As explained in the biodiversity section of this case there have been efforts to begin improving the campus's biodiversity. The university wants to protect the biodiversity of the campus as provides support for the increase in the national biodiversity of the Netherlands. Since the planting of the tiny forest this in March 2021, it is not clear if there are any other projects currently being developed. However, as of the Biodiversity Action Plan, the biodiversity of the Radboud University campus will continue to be improved monitored, and cared for.

4.2 University of Maryland case description

The University of Maryland has more than one campus which is spread throughout the state. For this study, the focus is on the main campus in College Park, Maryland. As mentioned above the Radboud University campus is considered small and even more so compared to the University of Maryland campus. The campus is a total of 500 hectares or 1,235 acres making the University of Maryland campus five times larger than the Radboud University campus. The University of Maryland's large campus provides ample room for green space. The image below provides a view of the campus (image 2). The student body of the University of Maryland is almost doubled that of Radboud University with a total of almost 41,000 students. This number includes both undergraduate and graduate students. The campus setting is also suburban surrounded by neighborhoods and local communities. The university has been using sustainable practices over the years and has expanded its scope for environmental issues. The topics focused on are energy, food, green buildings, transportation, waste, and water. Green spaces and especially trees are protected as the campus grounds are a nationally recognized Arboretum & Botanical Garden.

The University of Maryland like Radboud has sustainability goals. The university in 2007 signed the American College and University Presidents Climate Commitment. This is a commitment to improving the sustainability and environmental stewardship of the university and surrounding community (Second Nature, n.d.). UMD has adopted several other plans such as a climate action plan, a master plan for facilities, and a plan for sustainable water use among others

(sustainableumd, n.d.). An important aspect of the UMD campus is its 1,250 acres being nationally recognized “for the trees, shrubs, and flowers that now make up the UMD Arboretum and Botanical Garden” (History, 2020).

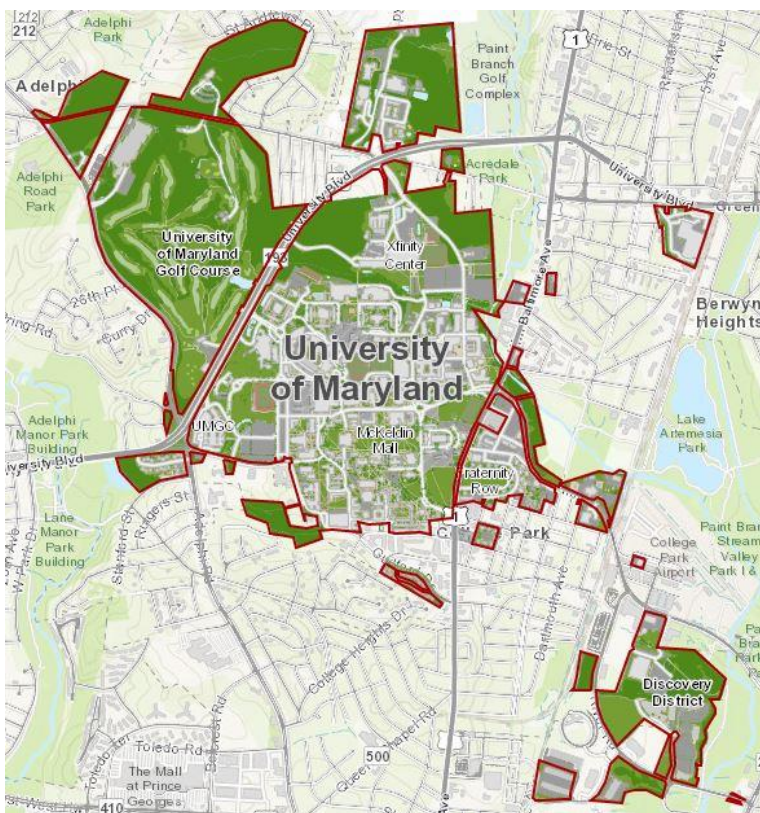


Image 2, source: University of Maryland Website, 2020

4.2.1 Green space and Biodiversity

The green spaces on the University of Maryland campus are divided into curated lawns, urban forests, gardens, and green roofs. It is important to note that the University of Maryland College Park campus is a nationally certified Arboretum and Botanical Gardens. With this, the campus has been curated with different native and non-invasive exotic species of trees, shrubs, and different types of flower gardens. The more central area of the campus is where these large, curated lawns are located. A few examples of these are McKeldin Mall, Chapel Lawn, and the engineering recreation field. These large lawns bring that clean-cut aesthetic, and provide large spaces as recreation areas for students, but do little in the way of harboring high amounts of biodiversity. There are other large and small patches of grass in and around the central portion of the campus that are scattered with trees, shrubs, and ornately placed flower gardens. As will be explained below some of these gardens have been designed specifically for insects, pollination, and to increase biodiversity. The urban forests along with the university tree bank are in the northern part of the campus and the northeast quadrant on the university's golf course. Next examples will be shared on what the university has or is currently doing to improve the biodiversity on campus.

The University of Maryland campus was designated an Arboretum and Botanical Garden in 2008 (History, 2021). With a title of that stature, it would seem obvious that the university would have a high amount of diversity in plants, trees, shrubs, and flowers, etc. With that being said, the university has planted 15,000 trees and 8,000 gardens around the College Park campus. There are numerous different varieties of native and non-invasive exotic species throughout the campus creating a rather diverse landscape. The gardens on campus are large, small, planted in raised boxes, but all add to the diversity. An example of a garden is the Knight Hall Pollinator Garden which "hosts both native and non-native pollinator-friendly plants" (Knight hall, 2021). This garden was designed specifically to attract pollinating insects such as bees, who may then spread carry the pollen and seeds to other plants on and off-campus. This example is one of many 'stepping-stones' for biodiversity. There are many different garden types on campus, some just ornamental, and others which serve a similar purpose as the Knight Hall Pollinator Garden, but each adds to the biodiversity of the campus.

The university has implemented different techniques for stormwater management throughout the campus. The planning strategies that have been used are the inclusion of rain gardens, vegetated swales, and collection ponds, among others. Each of these serves two functions, the main being management of stormwater, the other is the addition of water tolerable plants adding to biodiversity. In addition to these, several green roofs are providing new habitats, these include green roofs on the Stamp Student Union, St. John Center, and Physical Sciences complex to name a few. An important project that was completed only a few years ago is the campus creek restoration project.

"there is a small creek that runs through campus from West to East, um, through a strip of wooded area that is unknown by students, and unknown by staff, um, and it is creatively called campus creek. We're working on a project to create, what we're calling an eco-wellness

walkway, along campus creek. Uh, it would extend about a mile in length, and it would be both to showcase the flora and the fauna and the water resources along that stretch.” (participant 7)

The campus creek restoration project was completed in 2019 with the intended purpose of restoring an important natural environment on campus. The main goals of the project were to develop the creek to sustain larger amounts of stormwater water runoff and combat erosion on the banks of the creek. The technique used is called Regenerative Stream Conveyance (RSC) and consists of different pools to slow the flow of water through the creek helping to prevent scouring and erosion. Some of the pools allow for overflow into the natural surrounding flood plains providing the feeling of a wetland habitat where different native animal and plant species thrive. Lastly, within this corridor, 700 native tree species were planted to increase tree diversity and provide a more reliable, and safe habitat for fauna in the area (Carmichael, 2020).



Image 3



Image 5



Image 4

Source: Photos taken by Meg Smolinski, Outreach Coordinator, 2020

The last major project to mention is the AgroEcology Corridor. The College of Agriculture and Natural Resources is leading the creation of the AgroEcology Corridor. This project is a concept which “transforms the open, green spaces on the UMD College Park campus into learning and teaching opportunities for the serious student, the curious visitor, and the unintentional learner who happens to be passing by” (Beyrouy, 2020). The main goal of this project is to use the campus green spaces to their fullest potential by using them as an education tool, and not only for the aesthetic beauty. Steps will be taken where necessary to improve or develop green spaces that serve a specific educational purpose. These green spaces might be used for the study of ecology and biodiversity, or used for developing new urban farming techniques, among a multitude of other uses. The AgroEcology Corridor is meant for all students in any major to be a space of learning. This project is still in the early stages of development and is a hands-on project with students as designers.

4.2.2 Policies and Initiatives

This section looks at the different policies and initiatives related to green space and biodiversity on campus. These policies stem from internal values of protecting nature and improving sustainability, and externally from the national and local government which are to be followed by the university. The policies and initiatives that will be discussed are the Tree Management Plan, government policies, Facilities Master Plan, Climate Action Plan, and stormwater management. All of these are integral to keeping the university on track to achieving its sustainability goals.

The University of Maryland strives to improve the sustainability and environmental stewardship of its flagship campus. The university incorporates policies and initiatives related to all aspects of sustainability. This includes but is not limited to water, waste, energy, and conservation of the natural environment. The University of Maryland is a public institution and a state-backed and funded institution. With this, the Maryland state government works closely with the university. The state especially cares about the energy and water policies and holds high standards for renewable energy usage and the protection of its watershed. The University of Maryland has plans to mitigate climate change, reduce carbon emissions, improve water catchment and displacement, and improve the campus Arboretum and Botanical Gardens. Each of these plans has either direct or indirect relations to the green space and biodiversity of the campus.

Tree Management Plan

The purpose of the Tree Management Plan is to support the mission of the universities Arboretum and Botanical Garden. The objective of the plan is to “sustain a healthy, attractive and safe environment for the people and plants that are present on the campus at any given time” (Tree management plan, 2017). The mission statement for the Arboretum and Botanical Garden is as follows:

“The University of Maryland campus is an Arboretum and Botanical Garden that strives to be an instrument of horticultural distinction, landscape design and interpretation, and place-making reflecting the university’s education, research, and service missions. The Arboretum and

Botanical Garden incorporates the diverse heritage landscape of the campus from its beginnings as an agricultural college founded in 1856 to its current urban setting befitting a distinguished research university. Through exemplary practices of environmental stewardship, horticulture, and urban forestry, the Arboretum and Botanical Garden will enhance the campus's aesthetic and promote awareness of conservation and preservation of our natural environment for the enrichment of the university community, the citizens of Maryland, and our visitors.” (Tree management plan, 2017)

The university wants to ensure the safety of its 15,000 trees that are on the University of Maryland College Park campus. The university makes a point to have all tree maintenance be carried out by licensed tree experts from the state of Maryland. The specific goals of the plan are pruning, planting, maintenance, removal, and how to deal with catastrophic events. The plan has three overall goals to ultimately achieve with the tree management plan.

1. “40% urban canopy coverage”
2. “Comprehensive teaching collection including horticultural specimens, wooded corridors and preserved plant communities consistent with exemplary sustainable practice.”
3. “Incorporation of the co-benefits of the urban forest in the University of Maryland Climate Action Plan.” (Tree management plan, 2017)

The Tree Management Plan focuses directly on urban forestry and protecting the biodiversity of the university tree population of the university's campus. Whenever there is an issue with a tree due to construction or disease the stakeholders want to know where the that trees replacement is coming from, “You hear people saying, don't cut one more damn tree down, or wanting to know, that one got cut down, so where is its replacement?” (participant 5). This is to ensure that they keep the biodiversity and improve it, “every time we have a project like the purple line, which causes the number of prominent trees to be removed from campus, rather than just saying, you know, this took out a hundred pin oaks, we have to put a hundred pin oaks back” (participant 5). Ensuring the health and safety of the trees is the duty of the arboretum and is important in keeping the level of biodiversity not only consistent but improving it.

Government Policy

These government policies come from the United States national government, Maryland state government, and local county government. The University of Maryland stays strict to these policies and guidelines “because we are a state of Maryland institution, we are under state laws and state guidelines” (participant 6). There are not many governmental policies related to green space and biodiversity, policies that would seem to relate will usually reference these policies stated below. These policies are the Maryland Wildlife Diversity Conservation Plan, Endangered species Act of 1973, Clean Air Act, Clean Water Act, and Prince George's Countywide Green Infrastructure Plan. Table 3 gives descriptions of these policies.

Table 3, List of United States national and local policies on biodiversity

Policy	Description
Maryland Wildlife Diversity Conservation Plan	This plan was developed to identify which species in Maryland are most in need of conservation and to provide the necessary tools and resources to protect those species properly and adequately in their natural habitats (DNR, 2005).
Endangered Species Act of 1973	“Provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found” (EPA, 2020)
Clean Air Act	“Comprehensive federal law that regulates air emissions from stationary and mobile sources...to protect public health and public welfare and to regulate emissions of hazardous air pollutants” (EPA, 2020)
Clean Water Act	“Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters” (EPA, 2020)
Prince George’s Countywide Green Infrastructure Plan	The goal of this plan is to “preserve, enhance, and/or restore an interconnected network of countywide significant environmental features that retain ecological functions, maintain or improve water quality and habitat, and support the desired development pattern” (Green Infrastructure Plan, 2005)

Facilities Master Plan

The University of Maryland has a comprehensive facilities master plan with the intention of completing the written goals by 2030. The plan was mentioned in the interviews multiple times by different participants saying “I think a lot of our campus development on our state ground is guided by our master plan. And so, our master plan is a long-term vision of how we’re going to develop the campus and within that master plan are our recommendations for green space” (participant 6). This plan mentions a fair amount of information relating to the natural environment of the campus. To this it states:

“Environmental preservation and landscape enhancement form one of the underlying grids, or major infrastructure of the Plan. The Plan has addressed increased regulatory requirements related to surface and underground stormwater networks both on campus and at interfaces with the surrounding community. It shows greenway and open space networks linking pedestrian corridors within and between districts. In 2008 the campus was designed as an Arboretum & Botanical Garden (ABG), further revealing and advancing the value of campus natural resources as an instrument of pedagogy, research, and community engagement” (Facilities Master Plan, 2018)

There are specific goals in the master plan that focus on environmental stewardship and landscape design. The university goals for environmental stewardship mention ecosystem services. The goals are to “realize and reveal the ecosystem service potential of and increasingly urbanized landscape, and conserve” (Facilities Master Plan, 2018). This is to be done through research and development of green spaces to promote the full potential of the ecosystem services while conserving biodiversity. The Arboretum and Botanical Garden “promote ecological awareness” (ibid) on campus serve as the single most important educational tool for the AgroEcology Corridor. The landscapes and land use on campus are to be further integrated within the campus, to create a singular sustainable network between nature and buildings, with seamless integration and nature inclusive building. The facility's master plan has a high emphasis on both environmental stewardship and sustainability throughout the plan. The university is trying to further these aspects of the campus in all conditions.

Climate Action Plan

The University of Maryland developed its climate action in 2009, it is a 40-year plan designed to make the campus carbon neutral by 2050 (Allen et al, 2009). The university understands the importance of mitigating climate change and further becoming a role model for sustainability and environmental stewardship. The climate action plan was developed with the signing of the American College and University Presidents Climate Commitment in mind “to reduce and ultimately neutralize its greenhouse gas emissions” (Allen et al, 2009). Within the climate action plan, there are internal and external policies and strategies to aid in the mitigation of climate change and reduce the carbon footprint of the campus.

However, nowhere in the Climate Action Plan does it state that green space and vegetation can be looked at for the sequestration and offset of a portion of greenhouse gas emissions. The plan is focused on the implementation of new energy-saving strategies. These

include a new policy for environmentally friendly procurement of goods and resources, carbon-neutral buildings, grounds, and landscaping, LEED-certified buildings, energy conservation behavior, return of savings to university and state, and acquiring additional capital investment among others (ibid). These strategies are for the long term, but the university is still producing carbon emissions, which can be offset by the trees, vegetation, and green space on the campus. The same information on green space and carbon sequestration mentioned in the ‘energy policy’ section of the last chapter also applies to this climate action plan. This is a topic the university should consider looking into.

Water and Stormwater Management

The University of Maryland has many sustainability goals with one being to reduce the amount of water used on campus. This deals with green space in the form of stormwater management. The university is currently working to develop a stormwater management master plan to further improve this area. As part of this stormwater, master plan the university wants to “increase rainwater capture and re-use to protect local watersheds and reduce the use of potable water on campus” (sustainableumd, n.d.). Some of how they go about this task is implementing and developing Bioretention cells, vegetated swales, green roofs, rain gardens, and more (sustainableumd, n.d.). This is one way for the university to developing more green spaces on campus and incorporating different plant varieties increasing biodiversity.

An important permit that guides the university’s stormwater management practices is the Maryland state MS4 permit “it basically is, are kind of a mini stormwater master plan for how we’re going to take care of stormwater issues on campus” (participant 6). The state of Maryland requires the university to “own and operate a municipal separate storm sewer system (MS4), and therefore, must comply with the National Pollutant Discharge Elimination System (NPDES)” (NDPS, n.d.). The permit explicitly states what the institution needs to implement to regulate stormwater, including, “Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff Control, Post Construction Management, and Pollution Prevention and Good Housekeeping” (ibid). These rules and the MS4 permit help to prevent large amounts of pollutants from entering the tributaries in the watershed. The MS4 permit also ensures that fewer pollutants enter the campus green spaces, therefore, protecting the biodiversity of these harmful pollutants.

4.2.3 Motivations of stakeholders

Green space and biodiversity still take somewhat of a back seat in the policies and initiatives of the university. The stakeholders are motivated though to bring green space and biodiversity more to the forefront. The motivations of the University of Maryland stakeholders will be categorized in the same manner as above, internal, and external. The internal motivations presented by this group of stakeholders were personal interest and motivation through competition. In terms of external motivations, economic motivation, and the motivation of pressure from an outside organization stand out as the important factors.

The motivation of personal interest in this group of stakeholders is apparent from their knowledge base on the subject matter, “those of us who work in the natural resource world, um,

understand the benefit of preserving” (participant 7). It is that understanding which provides the basis for part of the self-interest, which motivates them to want to protect biodiversity on campus. Competitive motivation stems from the universities competing with each other to develop the most aesthetically pleasing and sustainable campus, “my quads better than your quad competition between institutions” (participant 5). Competition is also happening within the university. Different departments are competing to get the proper funding for their projects, and some are going to take precedence over others, “we have capital funding and it’s looked at a certain way. And so, to get those sustainable features, it’s competing with the Dean’s conference room.” (participant 6). The university is competing with itself while at the same time, trying to be better than competing institutions.

Economic motivation stems from the economic benefits green space can provide for the university. The economic motivation is for the persons, knowledge, and donors the university will gain. It was put nicely in the interview as, “if providing a campus with cutting edge and attractive forward-thinking buildings with sustainably designed landscapes that are well-maintained, and support biodiversity are what attract your top faculty, your top students, and ultimately donors, then that’s the economic driver” (participant 5). The university is using the campuses sustainable design and improved green spaces to fulfill the economic motivation. Participant 4 said “one big driver is the state saying, you got to do it, right. You need to increase your open space. And then beyond that is just the desire to create beautiful spaces on our campus”. This statement shows a relationship between internal and external motivation, in this case, it is the government saying that they need to increase open space (green space), and the stakeholder wanting to create this new open space. The University of Maryland being a state-run institution, the pressure from the Maryland government is from them wanting to better their institution, and in so motivates the stakeholders by adding this pressure.

4.2.4 Case relation to frameworks

The policies at the University of Maryland can also be divided into intrinsic and extrinsic values. Three of the policies stated are intrinsic values and the rest are grouped in for their extrinsic value. The Tree Management Plan, Climate Action Plan, and Facilities Master Plan all have an intrinsic value to the university. The Tree Management Plan is a great example of an objective intrinsic value of nature for the university because the stakeholders agree that trees are important to nature and the plan supports the mission of the University Arboretum and Botanical Gardens. The Climate Action Plan and Facilities Master Plan also exude the intrinsic value of nature as their purpose is to guide the university in the direction of becoming more sustainable. This falls under the sustainability and environmental benefit of the conceptual framework. The improvement of green space on campus is one of the ways the university is going to improve its sustainability.

The policies which are extrinsically valued are the stormwater management plans, and the government policies. With the stormwater management plan, the university is gaining the environmental benefit from a biodiverse landscape helping to improve the water quality and management of stormwater runoff. This falls under the environmental benefits which in this thesis is viewed as intrinsic as a whole, but within this benefit are extrinsic values making this

plan an extrinsic value for the university. The governmental policies are the same as stated for Radboud University. Governmental policies are created to help achieve an outcome, in this case, these policies are to engage the university in the conservation of biodiversity and protection of nature on the campus. They are policies that come from an external source and have an extrinsic outcome to them.

The motivations of the stakeholders from the University of Maryland were more favored on the side of extrinsic. First, they do have intrinsic values in some of their motivations, these are from the environmental benefits. The conceptual framework has them as intrinsic but the ecosystem services within those benefits are what make them extrinsic values. The extrinsic motivations are based on the socio-political and economic benefits of the conceptual framework. In the socio-political aspect, the university is mainly focused on using green space as an educational tool for the students. This is seen in the AgroEcology Corridor and the campus as a 'living lab' for research, experimentation, and learning. There was also mention that the stakeholders want to create these beautiful spaces for the mental health benefits urban green space can provide. Lastly, the economic benefit comes from gaining the best and brightest staff, students, and then donors who help with the creation of these new improved green spaces, as stated above by an interview participant. The University of Maryland stakeholders are looking to gain benefits from green space, looking towards the extrinsic value of the green space.

4.2.5 Conclusion

The University of Maryland is like Radboud University agrees that they need to improve the green spaces and in turn the biodiversity of the campus. With the campus being a recognized Arboretum and Botanical Gardens, the university is in a better place in terms of species diversity than Radboud University. However, they are still working to improve the richness of diversity on campus. The university wants to be a leader in sustainability for the state of Maryland and to attract new prospective students and staff with not just an aesthetically pleasing campus, but a living campus from which to learn from. The university understands the importance of biodiversity conservation in an urban setting and can be a location for threatened or endangered species, and or a steppingstone for species.

4.3 Student views

This section will provide the reader with an understanding of the student viewpoints on green space and biodiversity on campus and support the statements of the stakeholders. For this study, the responses to the survey were compared. The responses given by the students at both universities were remarkably similar in some instances and slightly different in others. What follows is the answer to sub-question 3.

How is green space and biodiversity on campus viewed intrinsically or extrinsically in the minds of the students?

The student answers to the survey questions were neither expected nor unexpected. There were no expectations that the students would answer the questions similarly, though it was welcome as it provides the answer to another question not posed in this research. That question is, do students from Europe and the United States have similar views on-campus green space and

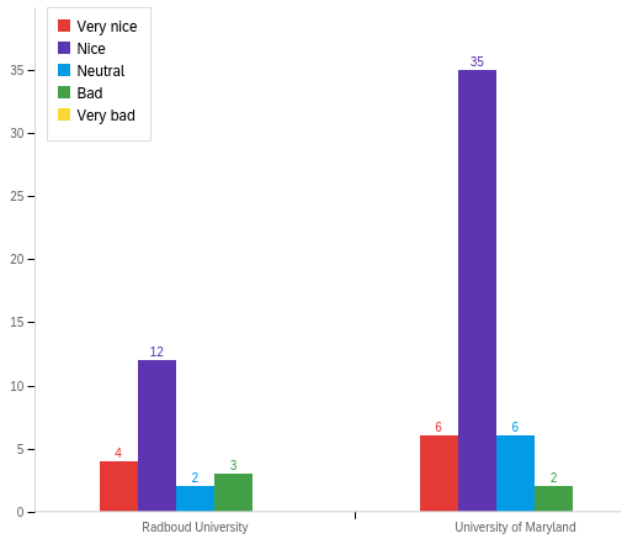
biodiversity? The answer to this is yes, these two groups of students who grew up in relatively different cultural and ethnic regions of the world have similar views on urban green space. These views can be intrinsic and extrinsic, what follows explains the student values of specific questions.

From the survey, it is apparent that the students at both universities think that green space on campus is inherently good. That the intrinsic value of nature or green space in this urban environment has value, whether it directly impacts them or not. This is interpreted from the results of the survey. The questions on the survey that stood out as intrinsic were:

- How would you rate the campus green space?
- How much do the different green spaces satisfy the function you are using it for?
- Do you wish there were more green spaces on campus?
- How much does the visual appearance of the university green space matter to you?
- Do you feel like nature on campus is connected to the nature of the surrounding area?
- Do you think the university has a duty to take care of nature and biodiversity on the campus?

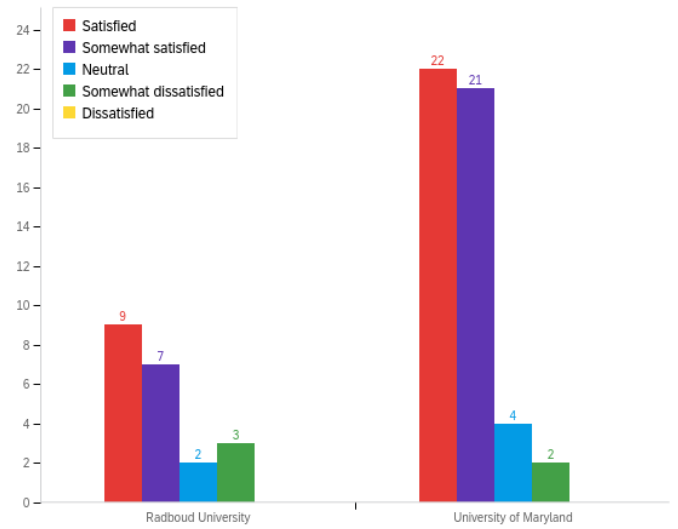
Each of these questions has a subjective intrinsic value attached to it. These questions portray the feelings the students have towards campus green space. These are all subjective intrinsic values because each student will have his or her own opinion on the topic. Some of the questions can be objective truths to the way the stakeholder's and universities are improving green space. Below are the graphs depicting the results of the questions above.

Student rating of campus green space



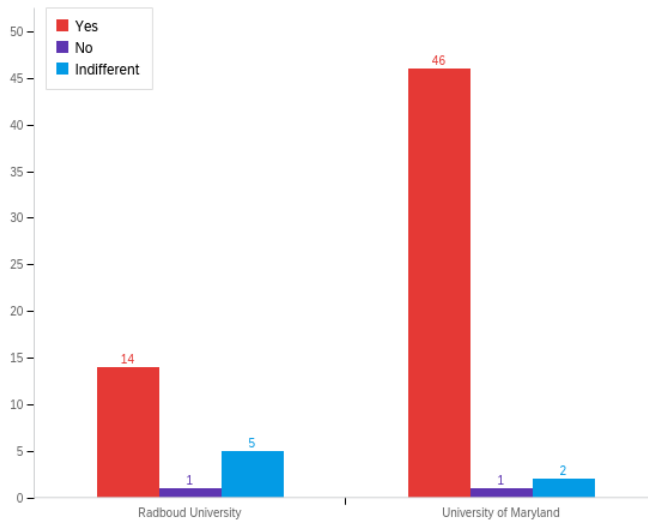
Graph 1

Satisfaction with campus green space



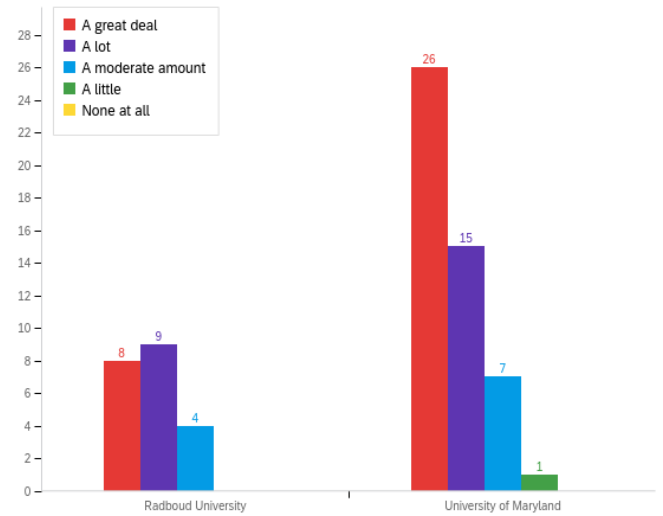
Graph 2

Want more campus green space



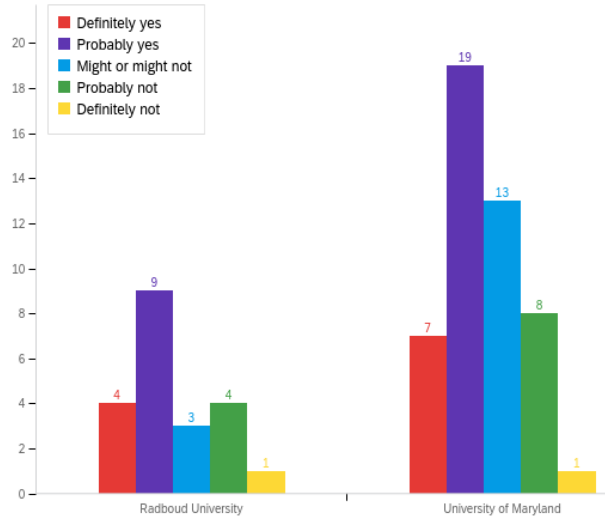
Graph 3

Visual appearance matters



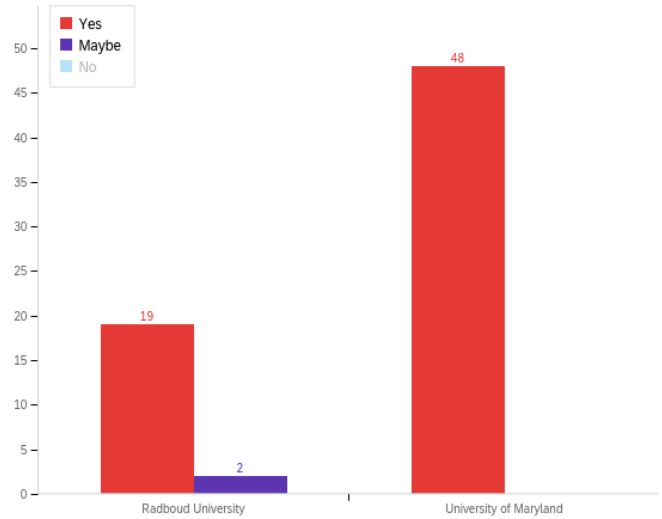
Graph 4

Nature on campus connection with off-campus



Graph 5

University duty to take care of nature and biodiversity on campus



Graph 6

As is apparent by the results in these graphs the students at both Radboud University and the University of Maryland agree on these six questions. In this case with the sample size, the students objectively agree that their universities have ‘nice’ green spaces, are satisfied with the green space, but would like more green space. That the visual appearance is an important factor, and that the university must take care of nature and biodiversity on the campus grounds. The answers were more so subjective for graph 5 in that students think it is connected but are also relatively unsure. The answers to the next question are going to be useful in helping the stakeholders develop the green spaces. This question asked, how would you like to see green spaces on campus improved? The responses to this question are shown in table 4 below.

Table 4, Student recommendations for improving campus green space

Radboud University	The University of Maryland
More variety, not just walkways but areas of interest. Sensory areas.	More flora diversity nearby/on-campus that is helpful to wildlife (native plants, grasses, flowers) to promote native landscaping and wildlife-human cohabitation design (providing food for pollinators, birds, more drainage ponds for wetland habitats).
Having nice shade areas can create some environment for students to work with their computers.	More vegetation and natural plant life. Allow some more tree cover.

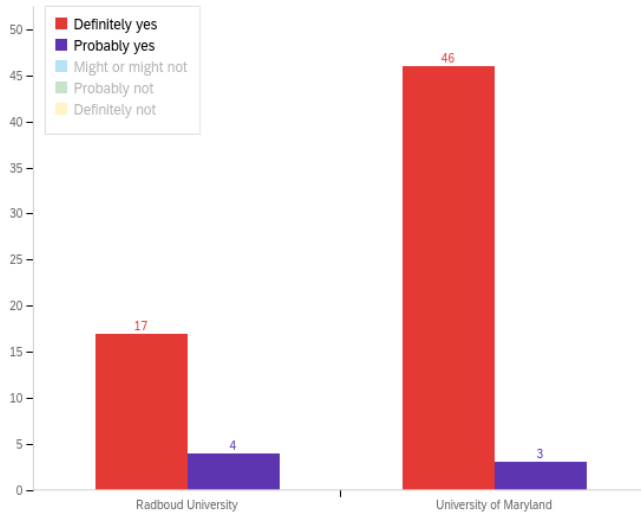
I would be excited to see green rooftop gardens! Also, maybe the university could give out information on different green walkways for example.	I think it would be nice if the green space, especially those with trees, were more connected to provide better habitat corridors.
More birdhouses/feeders and butterfly bush/squirrel facilities (in other words more biodiversity)	I would like to see the quantity of green spaces on campus improved. There is a lot of development of new buildings and it seems like many of the green spaces/lawns are being built over.
More trees, more plants, more grass	I would want green spaces accessible in all parts of campus.
I would like more trees, fewer empty lawns, and more native plants.	Gardens!! Green roof study spaces
Large (mainly unused) areas with only pavement should be greener (for example grass with some flower beds) with some small lanes that crisscross through it and enough places to sit and chill without having to sit on the grass.	Water features
I would like to see more flowers and bushes. Maybe bee-friendly plants like lavender. Maybe also some more trees	More green spaces
I would like to have more tables in green spaces around campus.	There is a lot of grass, but not many plants.

The survey also showed the extrinsic value of the students. The extrinsic value focuses more on the student's knowledge of certain policies and initiatives related to green space and biodiversity on campus, how they are affected by green space, and their awareness of biodiversity on campus. These questions are shown below.

- Do you think campus green space provides a better quality of life?
- How aware are you of the state of biodiversity on your university's campus?
- Have you seen the university implement strategies to protect biodiversity on campus?
- Are you aware of university policies or initiatives related to green space or biodiversity?
- Do you see the university educating students about sustainable/environmental initiatives and practices?

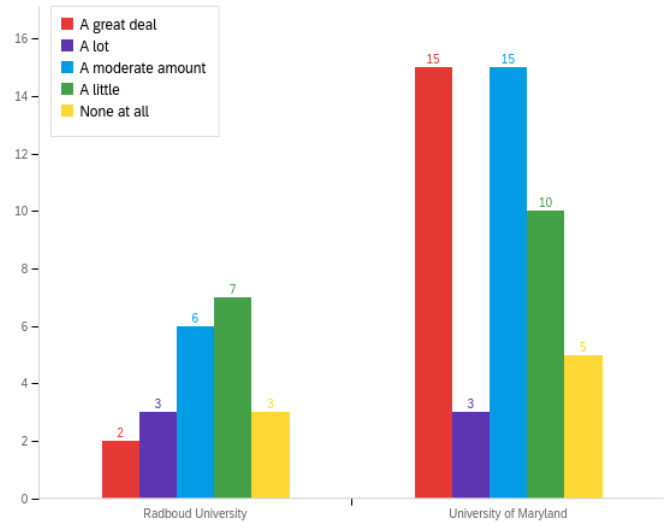
These values are extrinsic because of the way they affect or are seen by the students. Students agreeing that green space provides a better quality of life is an extrinsic value of nature and fits within the socio-political benefits of the conceptual framework. Biodiversity is an external entity of nature and understanding that and seeing that on campus is viewed in this way as extrinsic. The university stakeholders implanting strategies to protect campus biodiversity, developing policies and initiatives to aid in that effort, and providing education opportunities are intrinsic values of the stakeholders but seen as an extrinsic value to the students. The below graphs show the results of the data from these questions.

Green space provides a better quality of life



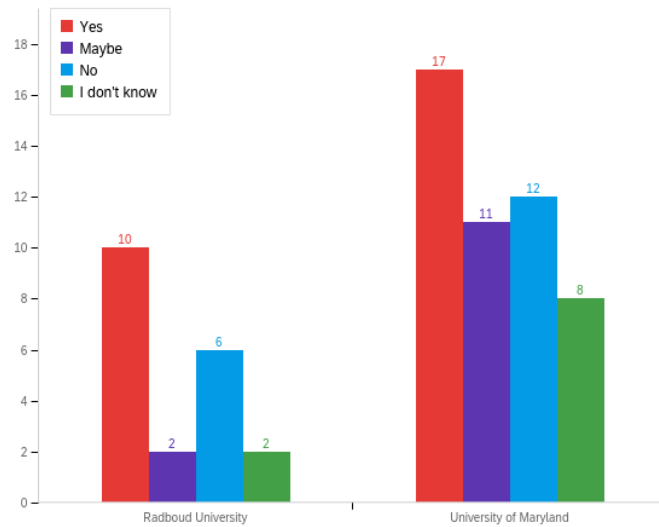
Graph 7

Aware of biodiversity on campus



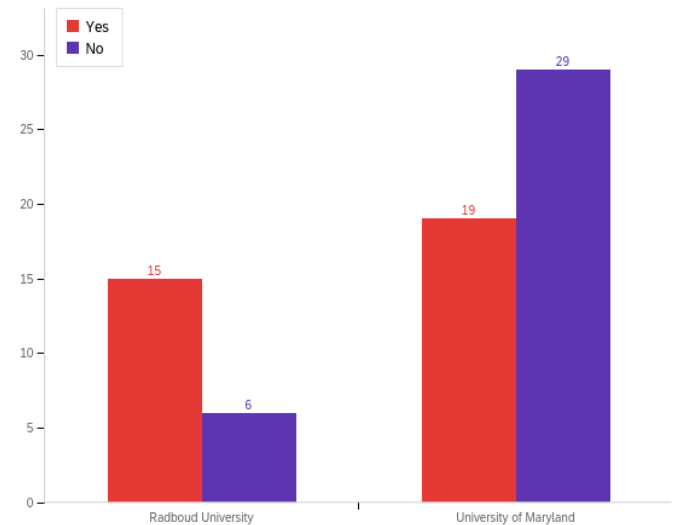
Graph 8

Students see the university protecting biodiversity



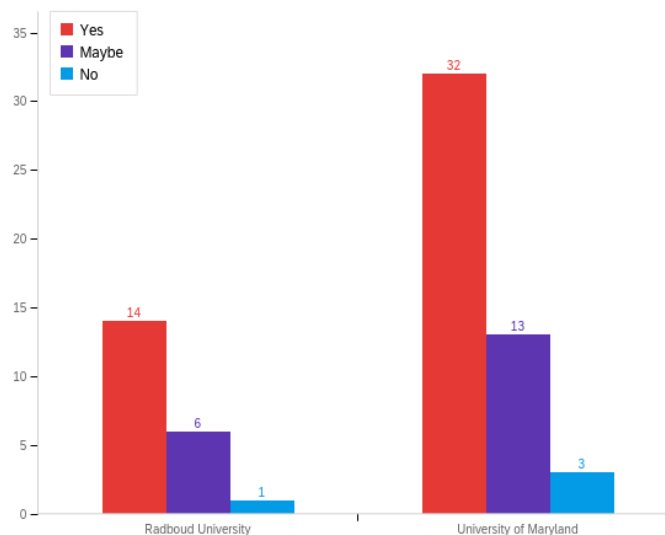
Graph 9

Aware of green space and biodiversity policies and initiatives



Graph 10

Educating students on sustainable/environmental initiatives and practices



Graph 11

The survey was also intended to help support the responses by the stakeholders obtained from the interviews. The responses from the survey do support certain claims. The stakeholders stated they had policies on green space and or biodiversity, that they are educating their students on sustainability, and that they were making efforts to develop more green spaces on campus. The survey results show that the students are at the very least somewhat aware of these policies, do see the universities educating the students on sustainability, and agree with the stakeholders that protecting nature and conserving biodiversity on campus is important. The next chapter concludes and discusses the relevancy of this thesis and research study.

5 Conclusion and Discussion

This chapter will conclude the study by answering the main research question. Section 5.1 is the conclusion and 5.2 is the discussion, and 5.3 wraps up the thesis with the limitations of the research, reflection, and recommendations to universities.

5.1 Conclusion

The motivation that someone has towards a specific agenda can vary from person to person. So, what is motivation? Motivation can be defined as “the process that initiates, guides, and maintains goal-oriented behaviors” (Cherry, 2020). These motivations can be both intrinsic and extrinsic, with intrinsic coming from within a person, and extrinsic coming from other people or sources (Cherry, 2020). The motivations of these universities are seen both as intrinsic and extrinsic. The motivations are guiding the stakeholders to achieving their set goals. These goals benefit all students, staff, faculty, community members, and the environment.

The motivations that were discovered through the interview process were personal interest, competitive, outside pressure, educational, economic, and environmental motivations. Personal interest motivation and competitive motivation are both categorized as intrinsic motivation, and outside pressure, education, economic, and environmental are each categorized as extrinsic motivation. The stakeholders at the universities are motivated to improve green space out of their self-interest for nature, and for the benefits it provides. Those benefits being social-political, environmental, economic, and sustainable as stated in the conceptual framework. Both universities have an equal interest in improving the sustainability of their campuses mainly through sustainable energy, water, and waste practices and technologies. As discussed in this thesis there are signs of support for improved biodiversity and green space management. This answers the main research question, *what motivates universities in the US and EU to invest time and effort in green spaces on campus and to what extent is biodiversity conservation part of these motives?*

The internal policies at both Radboud University and the University of Maryland that deal with sustainability should be looked at more closely by the universities to see the possible ways in which they can be used to help with improving green space and biodiversity. The energy and water policies/plans etc. can especially be looked at for these topics. The Biodiversity Action Plan developed by Radboud University is the most appropriate policy from either university for protecting or conserving biodiversity on campus. The University of Maryland should look into developing a dedicated policy for green space and biodiversity on campus. The policies the university has could be more related to green space and state nothing about biodiversity. The information in the policies is contradicting to what the Maryland stakeholders stated. Lastly, intrinsic and extrinsic values and motivations can have large effects on the decisions made by stakeholders.

5.2 Discussion

The discussion will go through the relation this study has to other studies and explains how the theories fit within the larger scope of this research study. It will also discuss the importance of biodiversity in urban environments. Finally, it will reflect on the research study and give recommendations for the universities that were researched for this study.

5.2.1 Relation to other papers

Urbanization is the first topic that would spark interest in urban green space. Urbanization is the “process by which large numbers of people become permanently concentrated in relatively small areas, forming cities” (Duignan, n.d.). This urbanization process takes away from the natural environment and building roads, structures, etc. At a certain point urban and city planners started to look at these urban environments to see where green space can be placed, what is the significance of green space in the urban environment, and how it will benefit the population in that environment. This is where the research for this thesis began.

This thesis was interested in the significance of urban green space and specifically urban green space on university campuses. There is a multitude of papers that speak to the significance of green space in cities, towns, and universities. However, these papers are mainly focused on a couple of topics. The first is how the green space is beneficial to the health and well-being of individuals in those urban environments. Second, the paper topics are about the natural sciences focusing on the biodiversity of insect or other animal populations in those environments. This thesis does not add to those forms of research but learned from them and used that information in helping to research the topics.

The main focus of this paper is the motivations of stakeholders to invest in green spaces on campus. There were very few papers found that related to this focus. Those papers mentioned stakeholder relationships and collaboration and would discover motivations of the stakeholder group as a whole but not individually. This thesis is original and adds to these studies by how it discovers motivations of stakeholders individually and groups them within intrinsic and extrinsic values. This thesis also adds to the research of green space development and conservation of biodiversity on university campuses.

5.2.2 Theoretical frameworks revisited

The theoretical frameworks were an integral part of this study. In this section, it will be discussed how they fit within the thesis. First, the intrinsic value of nature can be both subjective and objective. In this research, the value placed on green space on the university campus is decided by the individual and therefore a subjective intrinsic value. Also, urban green space, in general, has intrinsic value, separate from what any one person thinks of it. The extrinsic values of urban green space are the ecosystem services provided by the green space. Some of these ecosystem services are listed below.

- **Water flow and stormwater mitigation:** Green space and its vegetation in urban areas can mitigate the effects of stormwater runoff via tree canopies reducing the effect of flooding, and green space provides more permeable surfaces for water to be absorbed adding to the groundwater reserves (Bolund and Hunhammar, 1999). As an investment by the universities, they can develop green spaces to receive this ecosystem service. These developments could include rain gardens, bioswales, and water retention ponds to name a few.
- **Temperature regulation:** Trees and other vegetation can help to reduce the effects of ‘urban heat islands’ through producing shade, and absorbing heat with evapotranspiration (Hardin and Jenson, 2007). Another implication is the ability for tree canopies to shade sides of buildings helping to cool them, this could provide some energy savings in the warmer months.
- **Noise reduction:** Noise reduction is important in an urban setting, especially on a university campus where students are learning and need to concentrate. Soil, trees, and other vegetation can provide a reduction in noise pollution with the absorption of sound waves (Fang and Ling, 2003).
- **Air purification:** The vegetation within an urban environment also helps to improve air quality with the absorption of other harmful chemical compounds such as carbon monoxide (CO) and sulfur dioxide (SO₂) (Escobedo et al, 2008). This helps to purify the air within and around the campus.
- **Waste treatment:** Pollutants and other microbial waste can be broken down by the microorganisms in the soil inhibiting the number of pollutants absorbed (TEEB The Economics of Ecosystems and Biodiversity, 2011).
- **Climate regulation:** Trees can sequester carbon and other greenhouse gas emissions from urban environments. The emissions produced in this environment include nitrous oxide (NO₂), methane (CH₄), carbon (CO₂), and others, which are sequestered through photosynthesis (Nowak et al, 2013).
- **Pollination:** Flowers and other forms of vegetation attract certain animals or pollinators in the form of birds and bees which also improves the biodiversity in that urban environment (Melles et al, 2003). The services provided by these animals are pollination, pest control, and the dispersal of seeds, all of which are important for keeping a healthy ecosystem (Kremen et al, 2007).
- **Recreational opportunities:** Urban green space provides an area which people can choose to exercise, socialize, improve their mental health, and improve cognitive development (Gomez-Baggethun and Barton, 2013). People like to feel a sense of place in whichever environment they are in, and green space in urban environments plays a significant role in providing that feeling (Low and Altman, 1992).

The last theoretical framework to discuss is reciprocity. Reciprocity as defined in the theoretical framework section is the investment and return between two sources. It is different concerning the intrinsic and extrinsic values. In this case, the existence of extrinsic value in addition to the intrinsic value is what creates the dynamic of reciprocity. This means that the urban green space

has intrinsic value, has an extrinsic value (ecosystem services), which creates the reciprocity between the stakeholders, the university, and their green space.

5.2.3 Importance of urban biodiversity

This topic has been mentioned throughout the paper and needs to be fully addressed.

Biodiversity in an urban area is “*the variety of living organisms found in the ecosystems of urban areas, and it is usually measured as the number of species (and their abundance) found in a given city or area of the city*” (Oliveira, 2014, pg.462). In this paper, university campuses were categorized as urban areas for their size and active population. The conservation of biodiversity in urban areas is mentioned by Dyderski et al. (2017) who says that “the high rate of biotic homogenization in urban areas indicates a need for biodiversity conservation, even in habitats strongly transformed by humans. There is an especially high need for conservation of not only rare and endangered species but also those which are common in natural and near-natural habitats”.

Biotic homogenization is not a process that is good for diversity, instead, it pushes species to be more alike and pushes away more of the rare species leaving a few general species to take over a specific environment (Ibarra and Martin, 2015). This explains why in most urban areas we see only birds, squirrels, the occasional deer, and other small mammals, along with the same four or five tree and other plant varieties. A university campus provides an opportunity for biotic homogenization to occur less if the universities can provide a variety of natural habitats that appeal to many different species of flora and fauna. This also relates to the ‘living lab’ and the campus to be an educational tool since professors will want to have as much diversity as possible for learning purposes. This phenomenon of biotic homogenization makes biodiversity conservation a greater activity in urban areas since even the general more populous species need to be conserved.

University campuses can be havens for threatened and endangered species of flora and fauna in the region. Some of these species may need a certain habitat or ecological area to thrive and feel safe. The stakeholders at the universities need the knowledge and understanding of the different species so they can adequately develop or improve a green space to suit the needs of those specific species. A campus can become a green corridor so not only does the campus help to conserve biodiversity, but the landscape acts as a safe and reliable ‘stepping-stone’ for species moving towards their destination. These green corridors are “linear natural infrastructure, such as trees and plants, that link up other green and open spaces to form a green urban network” (Green corridor, 2019). A green corridor could lead species to an area off-campus that gives them a larger natural habitat or provide safe pathways for these species to move freely around the campus with little to no disturbances. It is important to conserve the biodiversity on a university campus to keep species and their ecosystems alive, to use them for study and research purposes, and to be environmental stewards for future generations.

5.3 Limitations and Reflection of research

The research did have its limitations in certain aspects of the research. A limitation regarding the case study was not always being able to find the actual policy document from Radboud University. The University of Maryland had all the necessary documents available for public access. This could have slight repercussions on the reliability of the information, but the information gathered for Radboud University was either from their website or documents that were available to the public. There was also no access to any type of facilities master plan from Radboud University. If that were available perhaps more information on how the university intends to improve the landscape or green space on campus would have been known. Another limitation was the number of participants for the interviews and survey. Due to the global pandemic, it made it more difficult to get in contact with all the intended participants. This limited the number of participants via people being too busy to offer up some of their time, or intended participants being sick and not able to participate. The data could have been stronger with more participants for the interview from both universities. The survey data comes down to the willingness of students to actively participate in the study. Each outlet to spread the survey around both schools was exhausted, leaving the data skewed between the two universities.

The research and the study that came with it turned out well in the end. The answers that I was looking for became clear and were found through the interview process and review of literature and documentation. The data collected could have been stronger were there more participants of both the interview and survey, however it was possible to determine answers to the questions with the data obtained from each method.

Introducing the idea of this thesis was rather new, in turn, the results were interesting. In terms of determining the motivations, there were no set expectations of what the results may have been. With these motivations finally determined it can be said that only a few of them were expected while the rest were rather unexpected. The motivations that were to be expected were, personal interest, environmental, and economic. These each made sense in the larger scheme because stakeholders are always taking their interests into account, the universities are already improving the sustainability of the campus, and economics must be thought of in all these major decisions. The competitive, outside pressure and educational motivations were not expected findings. The motivation to provide better learning and educational opportunities for the students should have been something that was expected given the research was conducted on universities. The motivation of competition and pressure from an outside source is understandable and fits within the socio-political sphere.

The focus of the research is green space and biodiversity in the urban environment. As this research looks at green space and biodiversity on university campuses it is important and relevant in this more niche area. A large majority of papers on the topic of urban green space focus on the city and town. Having green space and biodiversity on a university campus is highly beneficial to the students, staff, faculty, surrounding community members, and university grounds. Green space and biodiversity are providing sustainable, environmental, socio-political, and economic benefits. Each of these benefits can be grouped in the many ecosystem services provided by these green spaces.

The research on the internal and external policies relating to green space and biodiversity was rather fascinating and partly disappointing. At the governmental levels, the range of policy on these topics has grown over the years as would be expected. However, it was unexpected that the United States government had not incorporated or developed new policies on these topics. The EU continues to add to and adapt its policies on the environment and nature conservation. The disappointment came when discovering the internal policies of the institutions. It was expected that with a large number of other policies and initiatives towards sustainability that these institutions would have had at least a couple relating to green space and possibly biodiversity. They have policies that could be related but either mentioned green space and biodiversity slightly or not at all. It was also surprising that the University of Maryland was more involved with the green space than Radboud University. It was, however, important to see both universities developing more strategies for improving green space and biodiversity.

5.3.1 Recommendations for universities

Amending certain policies and initiatives.

Both universities should consider amending their policies on energy and water to include the potential of green space in helping to achieve the goals already stated within those policies. The climate action plan at the University of Maryland should be amended stating the potential for the trees on campus to sequester carbon.

Areas to protect.

The University of Maryland campus is much larger than Radboud University, in this respect, both universities need to carefully decide on the green spaces that need to be protected first before others. The spaces that they choose should be situated near green areas elsewhere on campus, and potentially to areas of campus. This will allow species to have a greater number of areas to traverse and will not have to come in close contact with people when wanting to leave the boundaries of the campus.

Reduce wildlife hazards.

Wildlife hazards are everywhere in an urban environment and should be addressed by the institutions. On-campus the biggest hazard is the buildings, others include vehicles, exposure to pesticides, harassment from people, and light pollution. The hazards can be mitigated through education by the university, signage, nature inclusive building, and blocking off certain natural areas.

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Appendix A

Interview guide

Introduction:

- **Permission to record.**
- **Purpose of interview**
- **Can you briefly tell me about your position at the university?**
- **Ask preference on privacy (name published vs. anonymous)**

Policies for green space

- Are there policies created by the university that are dedicated to green space on campus?
 - If yes, can you mention them? How do they relate to green space?
 - Is there a policy that focuses on the biodiversity of the campus? (Ask if not stated in first answer)
 - If no, why are there none and do you think there should be a dedicated policy?
 - Do you believe it is beneficial to look at other sustainable policies of the university when designing green space?
 - Any policies or initiatives from the national government or city of Nijmegen that need to be followed?

Development process

- How do the stakeholders/actors work together to develop and complete green space projects?
 - Who are all the parties involved in the project?
 - Internal/external actors or stakeholders?
 - What is the planning and design process like?
 - Who makes the final decisions on the project?
 - How are the policies you mentioned incorporated into the project?

Stakeholder motivations/ benefits

- What motivates these stakeholders (including you, and the university) to develop new improved green space?
 - Is conserving the biodiversity of the campus important? why, why not?
 - *Motives can include but are not limited to socio-political, environmental/sustainable, and economic (keep in mind for follow-up questions).*
 - Do you think the green spaces provide benefits to the university?
 - If yes, what kind?
 - ESS that benefits students, do you believe green space can positively benefit students? (follow up if not touched upon in questions before)
 - How might these benefits be linked to university policies and are they talked about in the development stage of the projects? (follow up)

Biodiversity

- How has the university improved the biodiversity of green space on campus? (refer to policies and projects that were talked about)
- What additional tools or resources might be useful in conserving biodiversity on campus?

Appendix B

Code's report – grouped by code groups

Total codes: 27

Green space and biodiversity policies (6)

Agree to dedicated biodiversity policy
 Agree to using other sustainable policies
 Green space and biodiversity policy
 Not aware of green space/biodiversity policies
 State/Country regulation
 Stormwater management

Green Space and Biodiversity (5)

Educational
 Important in urban setting
 Improved campus biodiversity
 More than just 'green'
 Realizing biodiversity loss

Development Process (11)

Acquire funding
 Acquire interested parties
 Difficulty with stakeholders
 External organizations
 Making a good argument
 Making final project decisions
 No student involvement
 Master plan
 Proper communication
 Speak with administration
 Student involvement

Motivations and Benefits (5)

Competitive motivation
 Economic motivation
 Environmental motivation
 Human well-being
 Personal interest

Appendix C

Survey

University green space

Welcome to the research study!

I am interested in understanding student perceptions of green space and biodiversity on university campuses. This survey is to help me understand how students at Radboud University (a Dutch university) and the University of Maryland (an American university) perceive green space on campus. You will be presented with information relevant to this and asked to answer some questions about it. Please be assured that all surveys will be anonymous and that your responses will be kept completely confidential. The study should take you around 8 minutes to complete. Your participation in this research is voluntary. You have the right to withdraw at any point during the study, for any reason, and without any prejudice. If you would like to contact the Principal Investigator in the study to discuss this research or address any concerns, please e-mail Noah.Kalicka@student.ru.nl. Please note that since the pandemic has changed the way students interact with the campus this year, please answer the questions thinking about how you would have interacted with the campus and its green space before the pandemic and during the pandemic if you stayed at school. By clicking the button below, you acknowledge that your participation in the study is voluntary, you are at least 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time for any reason.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

- I consent, begin the study
- I do not consent, I do not wish to participate

Q1 Which university do you attend?

- Radboud University
- University of Maryland

Q2 What is your gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Q3 What is your age?

- Under 20
- 21 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- Over 40

Q4 What is your ethnic group?

- Caucasian
- African American/ African
- Hispanic
- Asian
- Other

Q5 What year of university are you in?

- First-year
- Second-year
- Third-year
- Fourth-year
- Graduate student

Q6 Where do you live in relation to the school's campus?

- On-campus
- Off-campus: 15 min or less commute
- Off-campus: 15 min - 30 min commute
- Off-campus: 30 min to 1-hour commute
- Off-campus: commute over 1-hour

Q7 How do you get to the university campus?

- Walking
- Biking
- Driving
- Public transport

The next set of questions are about the green space on campus. The term green space in this context refers to grass lawns, rain gardens, flower gardens, green roofs, forested areas, etc. that are on campus.

Q8 How aware are you of green space on campus?

- Aware
- Somewhat aware
- Not aware
-

Q9 How would you rate the campus green space?

- Very nice
- Nice
- Neutral
- Bad
- Very bad

Q10 How often do you spend time outdoors on-campus green space?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q11 How often do you spend time on campus green space relaxing?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q12 How often do you spend time on campus green space exercising?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q13 How often do you spend time on campus green space playing sports?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q14 How often do you spend time on campus green space socializing?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q15 How often do you spend time on campus green space having meetings?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q16 How often do you spend time on campus green space studying?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q17 How often do you spend time on campus green space eating (ex. lunch)?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q18 How often do you spend time on campus green space, walking?

- 3 or more times per week
- 1 - 3 times per week
- 0 or rarely

Q19 How much do the different green spaces satisfy the function you are using it for?

- Satisfied
- Somewhat satisfied
- Neutral
- Somewhat dissatisfied
- Dissatisfied

Q20 Which campus green spaces do you frequent the most? Please name the area(s) on campus in the space provided. Ex. the space in front of this dormitory

Q21 Why would you choose not to spend time outside in nice weather? Please state your answer in the space provided.

Q22 How would you like to see green spaces on campus improved? Please write your response in the box provided.

Q23 Do you wish there were more green spaces on campus?

- Yes
- No
- Indifferent

Q24 How natural do you think the campus is? 1 being the lowest score and 5 being the highest score.

- 1
- 2
- 3
- 4
- 5

Q25 Do you think campus green space provides a better quality of life?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Q26 Does looking at or being in a green space help with any of the following? Choose all that apply.

- Stress relief
- Clearing your mind
- Concentration
- Calming effect
- Brightens your mood
- Other

Q27 How much does the visual appearance of the university green space matter to you?

- A great deal
- A lot
- A moderate amount
- A little
- None at all

Q28 Please rank the following regarding the impact they had in your decision to attend your current university. Please use a 1-5 scale, with 1 being most important, and 5 being least important. Click and drag the answers into the order you choose.

- _____ Reputation of school
- _____ Program you liked
- _____ Aesthetics of campus
- _____ Location of school
- _____ Tuition fees

This next section asks a few questions about biodiversity on university campuses. For those who do not know, a simple definition of biodiversity is the number of plants and animals that make up the ecosystem in a certain area.

Q29 How aware are you of the state of biodiversity on your university's campus?

- A great deal
- A lot
- A moderate amount
- A little
- None at all

Q30 Do you feel like the nature on campus is connected to the nature of the surrounding area?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Q31 Have you seen the university implement strategies to protect the biodiversity on campus?

- Yes
- Maybe
- No
- I don't know

Q32 Do you think the university has a duty to take care of nature and the biodiversity on the campus?

- Yes
- Maybe
- No

Q33 What might motivate you to get involved in a project related to green space and biodiversity? Select all that apply.

- I care about the environment
- Relates to my major/minor
- Want to help improve the aesthetic of the campus
- Class project
- Other
- I would not work on this type of project
- Indifferent

Q34 Are you aware of any university policies or initiatives related to green space or biodiversity?

- Yes
- No

Q35 To what extent do you believe as a student you have influence over policies and initiatives on campus?

- Always
- Most of the time
- About half the time
- Sometimes
- Never

Q36 Do you feel like your voice is heard and thoughts are taken into account during discussions on projects related to green space and/or biodiversity conservation?

- Yes
- Maybe
- No

Q37 Who do you think is making the final decision on projects related to green space and biodiversity on campus?

- President of the university
- Someone in administration
- University real estate office
- Professors
- Facilities maintenance team
- External stakeholders
- Other
- I don't know

Q38 Do you see the university educating students about sustainable/environmental initiatives or practices?

Yes

Maybe

No