Valuation of cultural ecosystem services of innovative nature-based solutions in an urban context: the case study of the EU project VARCITIES[1] in Gzira, Malta.

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To my beloved parents: Massoumeh and Akbar!

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INTRODUCTION

1.1 Introduction

Cities in today's world are growing and housing billions of people. It is predicted that 68% of people on Earth would live in urban areas by 2050. Our increasingly urban lifestyles are stressing ecosystems and accelerating climate change. Cities use 75% of the world's natural resources, produce 80% of the world's GDP, and are particularly vulnerable to climate change. Rapid urbanization and its environmental consequences have resulted in the depletion of natural resources and the degradation of ecosystem services, posing a number of challenges for human well-being. Urban green spaces have been identified as a potential solution to mitigate the negative effects of urbanization by providing ecosystem services that contribute to the health and well-being of urban residents. However, the economic value of cultural ecosystem services (CES) provided by urban green spaces is frequently overlooked, resulting in undervaluation and underinvestment.

Cities are dynamic environments where new ideas are tested, including how to more effectively incorporate nature-based solutions (NBS) for the benefit of both humans and the environment. NBS are one of many tools we have at our disposal to lessen the effects of climate change. Nature-based solutions are recognized as multi-purpose solutions with greater co-benefits than traditional technical measures. Ecosystems offer a variety of provisioning, supporting, regulating, and cultural services that are essential for environmental sustainability and climate change adaptation. Ecosystems and their capacity to deliver services, if preserved and managed sustainably, can play a critical role in aiding human adaptation to climate change.

It is difficult to assign a monetary value to ecosystems. This approach of valuing only carbon sequestration among a vast number of ecosystem services discouraged NBS projects in a variety of countries because it was nearly impossible to earn credits for non-quantifiable benefits. Non-market valuation is one effective way, to fill this gap.

Calculating citizens' willingness to pay for nature-based solutions (NBS) in urban green spaces is a way for their successful implementation and maintenance. Policymakers can make informed decisions about the allocation of resources for NBS projects by understanding citizens' preferences and willingness to pay for urban green spaces. Citizens' support for NBS projects can also increase their sense of ownership and stewardship, resulting in more sustainable and long-term solutions.

Furthermore, the monetary value of urban green spaces and cultural ecosystem services (CES) cannot be overstated. The cultural and recreational benefits provided by urban green spaces are critical for residents' well-being, stress reduction, and physical activity promotion. Furthermore, CES, such as aesthetic values, have a monetary value that is frequently overlooked in urban planning and decision-making. The economic valuation of these benefits can provide decision-makers with a more complete understanding of the value of urban green spaces and the potential benefits of investing in NBS projects, resulting in more informed decisions and more sustainable urban development.

The valuation of cultural ecosystem services of the VARCITIES project in Gzira, Malta, is the focus of this thesis. The study will investigate the economic value of the cultural ecosystem services provided by the innovative NBS in an urban context. The aim of the study is to provide insights into the economic benefits of the Visionary NBS interventions attributed to the EU project VARCITIES, which will assist decision-makers in making informed choices about the development and investment in urban green spaces.

1.2 Problem Definition

The valuation of cultural ecosystem services is crucial in understanding the full value of nature-based solutions. Cultural ecosystem services are non-material benefits people get from nature, such as cultural heritage, spiritual enrichment, and recreational opportunities. These services are often overlooked in economic assessments, despite their importance to human well-being.

Incorporating cultural ecosystem services in the valuation of nature-based solutions can help decision-makers better understand the full value of these solutions and the benefits they provide to the community. This recognition can inform policy-making and planning processes, leading to more sustainable and equitable outcomes. Additionally, valuation of cultural ecosystem services can help identify trade-offs and synergies between different ecosystem services, guiding the design and implementation of nature-based solutions that are more socially and environmentally just.

The purpose of this thesis is to investigate the potential of VARCITIES innovative nature-based solutions in addressing the environmental and social challenges focusing on Gzira, Malta. Specifically, the study will focus on the lack of green open spaces, limited walkability, and poor air and noise quality in the community, which have a significant impact on the health and well-being of its residents.

Valuation of cultural ecosystem services in the case of Gzira can help capture the cultural and recreational value of green spaces and community gardens, which may not be captured by traditional economic assessments. The study will employ a mixed-methods approach that combines quantitative and qualitative data collection and analysis methods. The primary data collection methods will include surveys and focus groups with members of the Gzira community. The study will also use choice modelling method and WTP (Willingness to Pay) results to estimate the economic value that the community places on the benefits provided by nature-based solutions.

The findings of this study will contribute to the growing body of knowledge on nature-based solutions and their potential to create sustainable and livable urban environments. The study's results will be relevant not only to Gzira, Malta, but also to other urban communities facing similar challenges. The recognition of cultural ecosystem services and the valuation of nature-based solutions can inform policy-making and planning processes, leading to more sustainable and equitable outcomes.

1.3 Scope

Gzira, Malta, continues to face a number of issues, including a lack of green open spaces, limited walkability due to narrow sidewalks, and poor air and noise quality. These issues have a significant impact on the community's health and well-being, and they require immediate attention. The goal of this thesis is to investigate the potential of VARCITIES innovative nature-based solutions to address these issues and meet the needs of the Gzira community.

The study will explore the effectiveness of VARCITIES-funded solutions, mainly Rue D'Argens: Micro-greening Interventions through a Participatory Design Process, Citizen Science on Air/Noise Quality to Increase H&WB Awareness, and Urban Biodiversity, Education, and Engagement through a Co-Created Community Garden Project, in addressing the identified issues. The first action aims to create small green spaces in the form of parks and gardens through a participatory design process, with the goal of improving air quality, reducing noise pollution, and increasing aesthetic value and walkability. The second action aims to increase awareness of the risks associated with poor air and noise quality by collecting data using citizen science techniques. The third action aims to promote urban biodiversity and community engagement through a co-created community garden project.

This thesis will look into the potential of VARCITIES' innovative nature-based solutions to Gzira, Malta's

urban problems and needs. It will provide insights into how nature-based solutions can be used to create more sustainable and livable urban environments by examining their effectiveness and citizens' preferences in this regard.

1.4 Research Questions and objectives

This study concerns five research questions:

1. What are the innovative nature-based solutions implemented by the VARCITIES project in Gzira, Malta, and how do they contribute to the provision of cultural ecosystem services in the urban context?

2. How can the cultural ecosystem services provided by the nature-based solutions implemented in the VARCITIES project in Gzira, Malta, be effectively quantified and valued using non-market valuation methods, stated preference survey design, and appropriate attributes and levels specific to the applied project?

3. How do the findings from the validation study, utilizing a non-representative sample of colleagues and students from the University of Bologna, contribute to assessing the applicability of the estimated willingness to pay (WTP) values based on this sample, as well as the effectiveness of using the designed questionnaire as a proxy for gathering real data from local people?

4. How does this assessment of estimated willingness to pay (WTP) values based on the non-representative sample of colleagues and students from the University of Bologna ultimately inform future research aimed at capturing the preferences and willingness to pay (WTP) of the broader local community for innovative nature-based solutions in the VARCITIES project in Gzira, Malta?

5. How does the utilization of stated preference methods and the estimation of willingness to pay (WTP) from citizens contribute to capturing and valuing the non-market values associated with green spaces in our biocities?

Based on the provided research questions, here are corresponding research objectives:

1. Identify and evaluate the innovative nature-based solutions implemented by the VARCITIES project in Gzira, Malta, and examine their contribution to the provision of cultural ecosystem services in the urban context.
2. Develop a framework to effectively quantify and value the cultural ecosystem services provided by the nature-based solutions implemented in the VARCITIES project. This involves applying non-market valuation methods, designing a stated preference survey, and selecting appropriate attributes and levels specific to the project.
3. Assess the applicability of estimated willingness to pay (WTP) values based on a non-representative sample of colleagues and students from the University of Bologna. Evaluate the effectiveness of the designed questionnaire as a proxy for gathering real data from local

people in terms of assessing WTP for ecosystem services provided by innovative nature-based solutions.

4. Utilize the findings from the validation study, which used a non-representative sample of colleagues and students, to inform future research efforts. Specifically, explore how the estimated WTP values and insights gained from this sample can guide the investigation of preferences and WTP of the broader local community for innovative nature-based solutions in the VARCITIES project.
5. Investigate the role of stated preference methods and WTP estimation from citizens in capturing and valuing the non-market values associated with green spaces in biocities. Explore the effectiveness of utilizing these approaches to account for the diverse benefits and contributions of green spaces beyond economic considerations, while considering the rule of citizen co-creation in shaping the future of biocities.

1.5 Audience

The primary audience for this thesis includes the academic community comprising professors, researchers, and students in environmental engineering, science, ecology, urban planning, sustainability, and related disciplines. Additionally, policy makers, urban planners, and environmental organizations seeking evidence-based insights on integrating ecosystem services into urban planning and decision-making processes are part of the target audience.

1.6 Disposition

Chapter 1 introduces the problem statement, research questions, and study objectives, while specifying the scope and intended audience of the thesis.

Chapter 2 provides a comprehensive literature review on current definitions of Ecosystem Services, with a focus on Cultural Ecosystem Services, and investigates the relationship between Ecosystem Services and nature-based solutions, particularly in the context of NBS management and monitoring, and introduces innovative NBS and participatory planning.

Chapter 3 discusses the VARCITIES project, its goals, and the implementation of visionary solutions in Gzira, Malta, as a pilot city, while highlighting urban challenges such as air and noise pollution and a lack of green space, and introduces Gzira's innovative NBS as part of the VARCITIES project.

Chapter 4 describes the theoretical framework and methodology for case study design, including the Total Economic Value framework and its relationship to Ecosystem Services, non-market valuation methods, selection of attributes and levels based on the case study and experimental design, and the steps involved in the stated preference survey design method and choice modeling.

Chapter 5 presents the results and discussion, including the random utility theory, calculation of willingness to pay, modeling and resulting correlations between background parameters and main attributes, and a discussion of research questions and objectives.

Chapter 6 concludes the report, summarizing the main findings, and providing responses to research questions, both technical and social. It also includes a reference section and appendix.

CHAPTER II

Literature Review
Part 1 : Conceptual Framework

2.1 Ecosystem Services Framework

Throughout history, humans have relied extensively on the natural environment for basic necessities such as shelter, water, and food. However, there is a significant issue in that many ecosystem goods and services that significantly contribute to human health and well-being are frequently undervalued or overlooked within our economic system.

The term "ecosystem services" (ES) refers to the benefits that humans obtain from ecosystems. These benefits range from more material benefits like food, fresh water, and materials to less material benefits like climate control, recreational activities, and aesthetic experiences, which are generally underappreciated. Unfortunately, ecosystems are routinely disregarded despite the fact that they provide essential functions that promote human well-being at free cost. These crucial functions can quickly decline due to a variety of circumstances, including human-caused activities like land-use modifications and natural events. When the full value of ecosystem services is not recognized, it may result in misuse and destruction of natural systems, leading to negative impacts on human health and well-being.

In order to guarantee the preservation and sustainable management of ecosystem services within an area, it is essential to identify which specific services are being provided. To do this, it is required to develop novel economic and policy instruments capable of accurately assessing the value of ecosystem services and integrating them into decision-making processes. By recognizing and valuing the whole variety of ecosystem services, we can make better informed decisions that promote sustainable development and protect human health and well-being.

The relationship between ecosystem services and human well-being is important, yet it is complex, dynamic, and dependent on individual circumstances. Many time and spatial scales must be considered to adequately evaluate this link, adding to the complexity. The ecosystem services (ES) framework, was created to better understand the links between ecosystems and human well-being. The ES framework provides a method for quantifying and evaluating the benefits that ecosystems provide to the people. Additionally, the ES framework facilitates identifying the trade-offs and synergies that exist between various ecosystem services and allows for the prioritization of management actions that optimize the benefits for society. The ES framework has been widely embraced by a range of stakeholders, including scientists, policymakers, practitioners, and NGOs, for various reasons, such as providing decision-making support and advocating for the preservation of biodiversity. (Barnaud and Antona, 2014). This involves combining ES considerations into environmental impact assessments, land use planning, and natural resource management.

Although the ES framework provides a means for assessing and measuring the benefits that ecosystems provide to the society, traditional economic accounting methods do not usually account for the monetary value of ecosystem services. As a result, their critical contributions are frequently overlooked in public, corporate, and individual decision-making, and their output may not reach optimal social circumstances. In some cases, the valuation of ecosystem services in monetary terms can be useful since it allows for a comparison of the economic costs and benefits of alternative management options.

2.1.1 Different types of Ecosystem Services

Ecosystem services can be classified into four broad categories: provisioning services, regulating services, cultural services, and supporting services.

- Provisioning services refer to the direct benefits that humans receive from ecosystems such as food, water, timber, fiber, and other raw materials.
- Regulating services are the benefits that ecosystems provide by controlling natural processes like air and water quality, climate, and nutrient cycles. Examples include carbon sequestration, erosion control, and water purification.
- Cultural services are non-material benefits that humans derive from ecosystems like aesthetic, spiritual, educational, and recreational values. Examples include ecotourism, spiritual and religious values, and cultural heritage.
- Supporting services are the fundamental services that underlie all other ecosystem services, such as soil formation, primary productivity, and nutrient cycling.

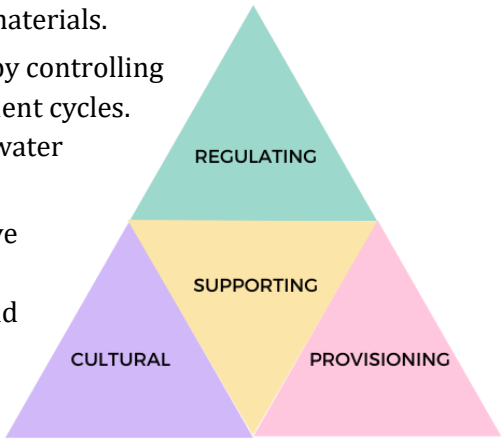


Figure 1Different types of Ecosystem Services

The interdependence and interconnectedness of ecosystem services can be seen through the relationship between the four categories. Supporting services, which include soil formation and nutrient cycling, are crucial for provisioning services like food production. Additionally, regulating services such as carbon sequestration and water purification help maintain the necessary conditions for all ecosystem services to function properly. We can understand better the valuable contributions that nature makes to humanity by learning more about the various types of ecosystem services and how they are interconnected. This understanding can help in the development of more effective and efficient strategies for managing and protecting these services to promote sustainable development. In this research, our focus is on Cultural ecosystem, services, and it's benefits for human health and well-being. We will proceed with that.

2.1.2 Cultural Ecosystem Services

The term "Cultural Ecosystem Services" (CES) refers to the not material benefits that people derive from ecosystems, which have a significant impact on human wellbeing and improve the quality of life for individuals and societies. The inclusion of cultural ecosystem services (CES) can provide an additional justification for urban nature conservation. Investigating people's attitudes and preferences toward cultural ecosystem services (CES) is a useful method for establishing which CES are most important to their well-being. We can improve our understanding of the cultural and social importance of ecosystems and design more viable approaches to preserving and managing these services for sustainable development by recognizing and evaluating the value

of CES. Cultural ecosystem services (CES) can take various forms, including social relations, sense of place, aesthetic values, spiritual and religious values, educational and scientific values, recreational and tourism values, and cultural heritage values.

Here we elaborate on them more:

Figure 2Different types of Cultural *Ecosystem Services*

- **Social relations**: CES are deeply embedded in the traditions, beliefs, and values of local communities and can contribute to social cohesion, community resilience, and cultural diversity. They provide opportunities for social interaction and connection, such as through recreational activities and cultural events.
- **Sense of place:** CES also contribute to a sense of place, which is the subjective and emotional attachment that people have to a particular location. This attachment is often based on the cultural and historical significance of the landscape, as well as the sensory and aesthetic qualities of the natural environment. For example, a local community may have a strong sense of place and identity associated with a particular forest or river that has been used for generations for traditional activities such as fishing, hunting, and gathering.
- **Aesthetic values**: The beauty and scenic qualities of natural landscapes, such as mountains, beaches, and forests.
- **Spiritual and religious values**: The cultural and spiritual significance of natural sites, such as sacred groves, holy mountains, and pilgrimage sites.
- **Educational and scientific values**: The knowledge and understanding that people gain from ecosystems, such as biodiversity and ecological processes.
- **Recreational and tourism values**: The opportunities for outdoor recreation and tourism that natural ecosystems provide, such as hiking, camping, and wildlife viewing.
- **Cultural heritage values**: The historical and cultural significance of ecosystems and their associated landscapes, such as traditional land uses, cultural practices, and local knowledge.

2.2 Nature-based solutions:

The IUCN provides a definition of nature-based solutions (NbS) as "actions that are taken to protect, sustainably manage, and restore natural or altered ecosystems that effectively and adaptively address societal challenges, while simultaneously providing benefits for both human well-being and biodiversity." Nature-based solutions are gaining favor as a more sustainable approach to environmental management that tries to use natural systems to achieve long-term results. Natural processes are used to address environmental problems such as water management, soil erosion, and biodiversity loss, and are frequently more resilient and cost-effective than traditional engineering solutions that rely on hard infrastructure such as dams and levees.

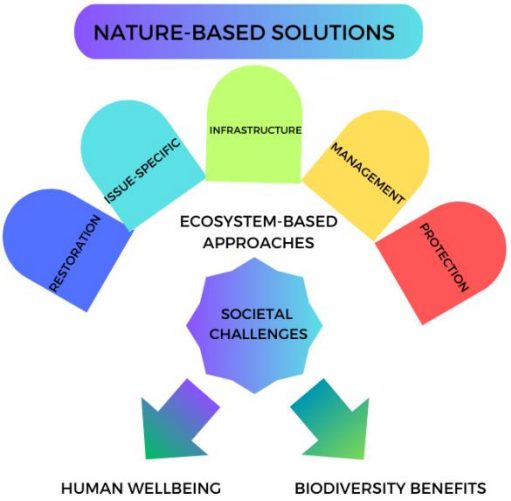


Figure 3Nature-based Solutions

2.2.1 Nature-based solutions as an umbrella term:

Nature-based solutions (NbS) refer to a wide range of methods and strategies that use nature and its processes to address social and environmental concerns and meet human needs. Natural ecosystem conservation and restoration, as well as the long-term management of changed ecosystems, are all part of NbS. Nature-based solutions (NbS) have the potential to be utilized across multiple sectors, such as agriculture, forestry, urban planning, water management, and disaster risk reduction, to address a variety of societal challenges. These solutions can offer numerous benefits, including but not limited to, conserving biodiversity, adapting and mitigating the effects of climate change, and providing essential ecosystem services.

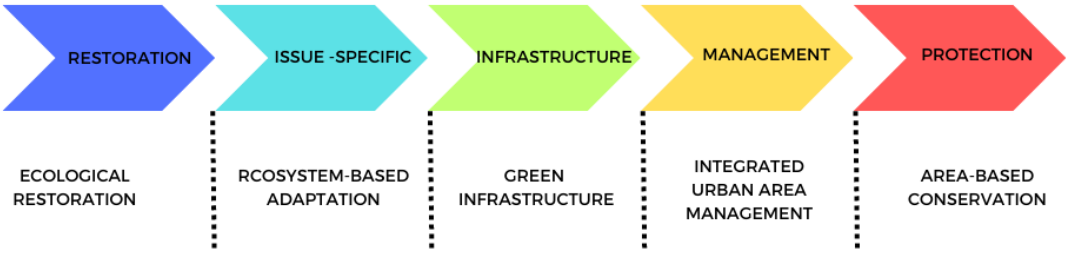


Figure 4Nature-based solutions as an umbrella term

2.2.2 Environmental Monitoring and Management of NBS:

Environmental monitoring and management play an essential role in maintaining the sustainability of natural resources and safeguarding human health and well-being. In the context of nature-based solutions, environmental monitoring and management become even more critical. Through the use of sensors, data analytics, and modeling tools, we can gain a deeper understanding of natural systems and evaluate the effectiveness of various management strategies.

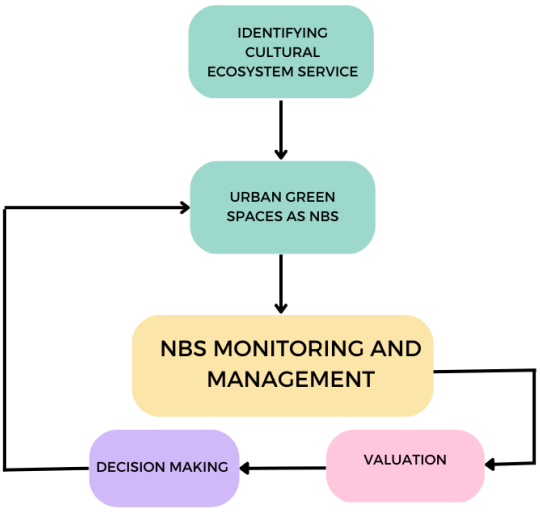


Figure 5Environmental Monitoring and Management of NBS

This data can then be utilized to refine and enhance nature-based solutions, leading to better outcomes for both the environment and society. We can create more sustainable and resilient communities that encourage a mutually beneficial interaction between human society and the natural environment by incorporating these insights into the development and management of nature-based solutions.

2.2.3 Innovative Nature-based solutions:

Modern technology tools can be crucial for improving the management, administration, and effectiveness of nature-based solutions. These tools can help us better understand the environments in which NBS operate, evaluate their effectiveness, and anticipate their impacts.

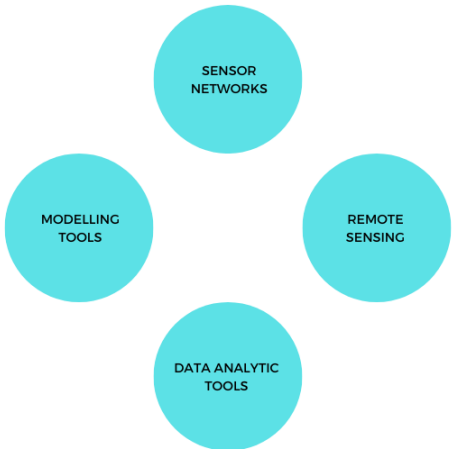


Figure 6Innovative Nature-based solutions

Examples include sensor networks that can provide real-time data on environmental factors like temperature, humidity, soil moisture, air and water quality. Remote sensing techniques like satellite imagery and aerial photography can be used to collect data over large areas and assess the efficacy of NBS projects. Data analytics methods like statistical and machine learning techniques can analyze large datasets, identify trends, and develop predictive models. Modeling tools can simulate NBS project performance under various environmental conditions, aiding in design and management optimization. By using these innovative nature-based solutions, we can ensure that NBS projects offer maximum environmental and community benefits.

2.2.4 Nature-based solutions for sustainability and livability in urban areas:

Ecosystem services can be classified into four broad categories: provisioning services, regulating services, cultural services, and supporting services. Nature-based solutions (NBS) can provide a variety of benefits in urban settings, including better air quality, a reduction in the urban heat island effect, the promotion of biodiversity, recreational opportunities, and benefits for mental health.

There are various nature-based solutions that can be implemented in urban areas, including trees that can help mitigate urban heat islands, provide shade, and improve air quality by absorbing air pollutants and sequestering carbon. Embodied greenery, such as green walls and roofs, can also improve air quality and reduce the heat absorbed by buildings. Grasslands and bushveld can improve soil quality, provide habitats for urban wildlife, and reduce the urban heat island effect while improving stormwater management. Urban waterways like rivers, canals, and ponds can serve as nature-based solutions to improve water quality and provide habitats for aquatic wildlife.

Figure 7 Nature-based solutions for sustainability in urban areas

Green open spaces, such as parks and gardens, can provide opportunities for recreation, mental health and well-being, while also reducing the urban heat island effect and improving stormwater management. Finally, urban agriculture can reduce the environmental impact of food transportation, provide fresh produce, and offer opportunities for community building and education.

2.2.5 Urban Green Spaces as NBS:

Nature-based solutions (NbS) are effective at addressing urban issues, promoting sustainability, and boosting resilience in cities. High population densities, a lack of green space, and a number of environmental and socioeconomic problems, such as urban heat islands, air pollution, and social inequality, are typical characteristics of urban regions. Urban green spaces, including parks, gardens, and green roofs, are recognized as nature-based solutions that can provide social, ecological, and economic benefits to urban environments and communities, contributing to the well-being of urban residents.

These benefits are diverse and include:

Figure 8 Benefits of Urban Green Spaces

- Improved mental health: Urban green spaces have been found to reduce symptoms of depression, anxiety, and stress, providing a sense of relaxation, tranquility, and restoration that can improve overall mental health.
- Increased physical activity: Urban green spaces can provide opportunities for physical activity, such as walking, jogging, cycling, and sports, leading to reduced risk of chronic diseases such as obesity, diabetes, and cardiovascular disease.
- Social interaction and community development: Urban green spaces can provide opportunities for social interaction and community building, promoting social cohesion and sense of community. They can be used for community events, festivals, and gatherings, fostering a sense of belonging and social connectedness.
- Improved air quality: Urban green spaces can help to improve air quality by filtering out pollutants and producing oxygen, leading to improved respiratory health and overall well-being.
- Reduced noise pollution: Urban green spaces can also help to reduce noise pollution, providing a peaceful and quiet environment that can improve mental health and well-being.
- Climate change adaptation and mitigation: Urban green spaces can help to reduce urban heat islands, mitigate flooding, and sequester carbon dioxide, contributing to climate change adaptation and mitigation efforts.
- Biodiversity conservation: Urban green spaces can support biodiversity by providing habitat for plants and animals, contributing to ecological health and resilience. Biodiversity can also have positive effects on human well-being, such as increased aesthetic value and opportunities for nature-based recreation.
- Increased property values: Properties located near green spaces are often more desirable and have higher values, providing economic benefits to property owners and local governments.

Part 2 : Co-creation with NBS

Nature-based solutions (NBS) are co-created by partnering with nature rather than resisting it, and by involving local communities and other interested parties in the creation and implementation of NBS projects that are tailored to local needs and concerns.

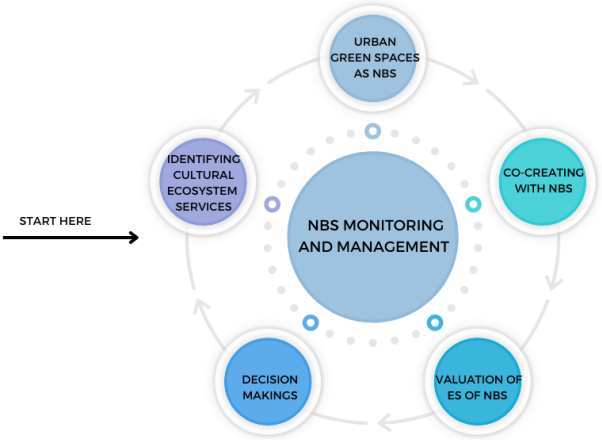


Figure 9 NBS Monitoring and Management

2.3 Citizen participation in monitoring and managing NBS:

Involving individuals in the monitoring and management of nature-based solutions (NBS) is essential to their success and long-term sustainability. There are several advantages to including the public in the administration and observation of nature-based solutions (NBS), one of which is raising public knowledge and comprehension of the importance, benefits and limitations of NBS. Additionally, citizen participation can improve outcomes, increase accountability for the success or failure of NBS programs, and give decision-makers relevant information by obtaining public input and ideas.

There are several ways to involve the public in the management and monitoring of nature-based solutions (NBS), such as **citizen science**, **participatory planning**, **community-based monitoring**, and **education and outreach**.

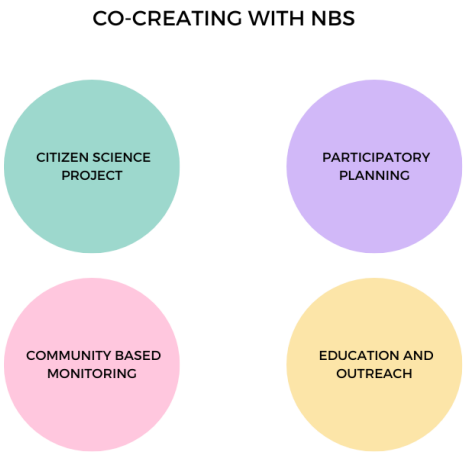


Figure 10 Co-Creating with NBS

- Citizen science involves the participation of volunteers in scientific research, data collection, and analysis, which can supply valuable data for monitoring and evaluating NBS projects.
- Participatory planning involves involving citizens in the planning and design of NBS projects to ensure they meet the needs and preferences of the local communities.
- Community-based monitoring requires involving local communities in monitoring and evaluating NBS projects, ensuring their long-term effectiveness and sustainability.
- Education and outreach to citizens about NBS and its benefits can increase awareness and support for these types of solutions.

The viability and sustainability of nature-based solutions (NBS) depend heavily on citizen involvement in management and monitoring. By incorporating residents in the process, decision-makers can make sure that NBS projects are efficient, meet the requirements of the community, and have a positive long-term environmental impact.

2.3.1 Citizen science project in managing NBS:

Projects involving citizen science can be very helpful in managing nature-based solutions (NBS). Citizen science can increase the reach and efficacy of NBS management by involving the public in scientific research, data gathering, and analysis. Data gathering on NBS conditions, mapping activities to identify potential dangers and possibilities, and assessments of NBS efficacy in lowering pollution levels or enhancing ecosystem services are a few examples of citizen science projects in NBS management.
For NBS management, citizen science initiatives have various advantages: 1. more public participation; 2. better data collecting and analysis; and 3. improved cooperation and communication amongst various stakeholders. Additionally, by giving participants resources and training, citizen scientists can aid in increasing capacity for NBS management.

2.3.2 Participatory Planning in managing NBS:

In order to ensure that stakeholders' needs and concerns are taken into account during the decision-making process, participative planning is a crucial part of managing nature-based solutions (NBS). This approach recognizes that local populations have valuable knowledge and insights about the ecosystem that can enrich and inform decision-making.
To ensure the success of participatory planning projects, a range of techniques can be used, such as 1. focus groups, 2. social events, 3. stakeholder workshops, and 4. participatory mapping exercises. It is possible to identify important stakeholders, understand viewpoints and concerns, and develop a shared vision for NBS management by employing these strategies. In addition to enhancing NBS management and making it more sustainable, participatory planning can also promote confidence and collaboration among stakeholders.

2.3.3 Community-based monitoring in management of NBS:

Community-based monitoring (CBM) is an effective method of managing natural resources because it allows local groups to monitor their surroundings. Since it encourages people to actively participate in the monitoring and management of natural resources, it is especially helpful for managing nature-based solutions (NBS).
Depending on the unique demands and circumstances of the community, different CBM strategies are employed in NBS management. These methods assist in gathering essential information about NBS's state, which guides managerial choices. In addition, CBM increases stakeholder cooperation and communication, develops local capacity for NBS management, and makes sure that local knowledge and viewpoints are taken into account, all of which contribute to more sustainable and successful management outcomes.

2.3.4 Education and outreach in management of NBS:

In order to effectively manage nature-based solutions (NBS), education and outreach initiatives are needed to help stakeholders understand the value and benefits of NBS. Public lectures, neighborhood workshops, and social media campaigns can help achieve this. Involving stakeholders in planning and execution through outreach and education also contributes to the growth of NBS support and produces more sustainable and successful management results.

CHAPTER III

Case Study
VARCITIES' Pilot City: Gzira, Malta.

3.1 Horizon 2020

Horizon 2020, the EU's large research and innovation program running from 2014 to 2020, is focused on sponsoring innovative projects that address global concerns. It aims to strengthen Europe's global standing by encouraging research collaboration among institutions, researchers, and industries. It focused on scientific excellence as well as societal challenges such as climate change, healthcare, and technological growth.

Horizon 2020 fostered sustainable urban development in line with bigger EU goals. It promoted smart cities, inclusive governance, and robust urban ecosystems, all supported by nature-based principles, in harmony with the European Urban Agenda and the UN's New Urban Agenda.

The use of nature-based solutions was essential to the urban change. In order to manage urban problems responsibly and build cities that are healthier and more environmentally friendly, these ideas tapped into natural processes.

3.1.1 Horizon 2020 : Nature-based solutions

NBS (nature-based solutions) have gained traction in the EU research agenda and have been particularly well-integrated into Horizon 2020, the main initiative for EU research and innovation. By using natural processes to solve problems, NBS promote sustainability and improve the environment and human health.

Specific funding streams under Horizon 2020 were allocated to NBS research and innovation, concentrating on the following main areas:

Nature-Based Solutions (NBS) have played an important role in fortifying communities against the effects of climate change. NBS has evolved as a potent weapon for fortifying society against climate difficulties, thanks to approaches such as wetland restoration and novel nature-based flood control strategies. The field of biodiversity has seen an upsurge in activities aimed at preserving ecological diversity. NBS developed as a catalyst for preserving and nourishing varied types of life by arranging habitat restoration efforts and the creation of green corridors to improve ecosystem connectivity.

NBS applications in urban contexts produced transformative results in the domain of sustainability. Green roofs, urban agricultural programs, and a variety of nature-based solutions are being seamlessly integrated into urban landscapes, resulting in increased resilience to adversity and significant improvements in air quality. In terms of water management, NBS pioneered a new method to resource conservation. NBS was a pioneering force in reinventing water management policies by supporting the restoration of aquatic habitats and adopting innovative natural purification procedures. The concepts of NBS have spread to the realms of land and agriculture. NBS emerged as an enabler of biodiversity enrichment and ecosystem service augmentation through methods such as agroforestry and sustainable land management, marking a paradigm shift in the way we approach agricultural activities.

3.1.2 Varcities – Greener cities are healthier cities.

The VARCITIES project has recently come into prominence as a potential approach intended to address a variety of difficulties spanning Health & Well Being (H&WB), climate-related hazards, and environmental stressors across varied climatic conditions. With the use of a number of successive actions, each designed to achieve a particular goal, this novel approach employs a bottom-up strategy:

- Visionary City Projects: Eight regional city initiatives that address various H&WB issues are identified and chosen by VARCITIES.
- Professional Cooperation: It is made possible for creative solutions to be developed for each chosen pilot project by the establishment of expert groups made up of STKs and SMEs (Small and Medium-sized Enterprises).
- Identification of ideas: The initiative explores forward-thinking ideas relevant to each pilot, integrating them with the larger goal of promoting urban well-being.
- Technology integration: Wearable gadgets are transformed into integrated telehealth tools by VARCITIES, which uses innovative Information and Communication Technology (ICT) goods and services. These tools can be used both indoors and outdoors.
- Data Gathering and Knowledge Base Development: Citizen Observatories and local databases are used as sources for data gathering, which helps to build a thorough knowledge base. The project also describes connectivity with international databases like GEOSS.
- Projecting pilot data into dashboards and displays helps people recognize and comprehend the benefits that nature-based solutions (NBS) and the Sustainable Development Goals (SDGs) share.
- Behavioral and psychological aspects: VARCITIES addresses these aspects through custom outreach programs and apps created for specific target audiences within each experiment.
- Key Performance Indicators (KPIs): To evaluate the effectiveness and impact of actions, the initial KPIs are determined.

The VARCITIES program takes a novel approach to urban development by incorporating nature-based solutions (NBS) from the digital, social, and cultural dimensions. VARCITIES departs from the typical 'nature-centered' paradigm, focusing on a more holistic 'human community-centered' perspective, envisioning public spaces as catalysts for creativity, diversity, and citizen well-being through collaborative co-design.

The initiative's goals include implementing visionary urban solutions, holistic evaluation through key performance indicators linked to health and the SDGs, fostering a sustainable transition to smart cities through tailored governance models, engaging stakeholders, collaborating with EU initiatives, and ensuring best practices replication. VARCITIES aspires to reimagine urban environments by merging NBS with a focus on human well-being and collaborative development in order to make resilient, healthy cities.

3.2 Varcities : pilot cities

VARCITIES has selected eight municipalities in Europe as the Pilot Cities for its project. These cities will implement integrated and sustainable initiatives aimed at enhancing the health and well-being of their citizens. The project will provide support to municipal actions and local Small and Medium-sized Enterprises (SMEs) to seize credible opportunities for growth and revenue generation. Each Pilot City has identified a specific pilot site where local actions will be implemented. While these cities vary in terms of geography, climate conditions, and challenges they encounter, they all share a common vision of fostering a healthier and more sustainable urban future.

- Skelleftea (SE) Transforming old land fill area into a residential and educational area using green/blue solutions
- Bergen (NO) sustainable re-establishment of an urban water park
- Dundalk (IE) Dundalk Library and Museum Quarte
- Castelfranco (IT) A "Healing Garden" for elderly and people suffering from Alzheimer
- Novo mesto (SI) Sports and recreational park Cescavas
- Gzira (MT) Regeneration of a high traffic road in the Gzira locality in Malta
- Chania (GR) Creation of a Mobile Urban Living Room in open public spaces
- Leuven (BE) Hertogensite – Regeneration of former hospital site

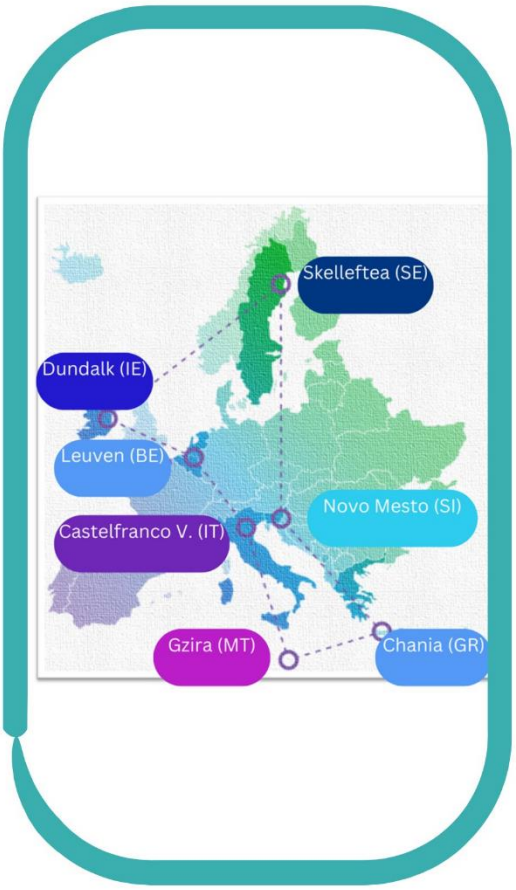


Figure 11Pilot Cities of Varcities Project

3.2.1 Varcities : Nature-based Visionary Solutions

The visionary nature-based solutions for each pilot city has been shown in the tables below:

Pilot	Visionary Solutions
Skelleftea - SK	**VS1**:Build natural infrastructure to create urban resilience **VS2**:Creation of a wetland bed to increase biodiversity
Bergen - NO	**VS3**: Optimized urban park biodiversity
Dundalk - IE	**VS2**: Outdoor urban green learning and sensory garden for health and wellbeing
Novo Mesto - SI	**VS1** : Brownfield remediation and greening with plant species indegenious to the nearby Natura 2000 areas **VS2** : Creating sustainable forest trails
Gzira - MT	**VS1** : Micro-greening interventions through a participatory design process

Key Challenges	Skelleftea	Bergen	Dundalk	Castelfranco	Novo Mesto	Gzira	Chania	Leuven
Climate Resilience	VS1							
Water Mnagement	VS2							
Natural and Climate Hazards	VS1							
Green Space Management		VS3	VS2		VS1, VS2	VS1		
Biodiversity Enhancement	VS2	VS3			VS1			
Air Quality								
Place Regeneration		VS3	VS2		VS1, VS2	VS1		

Figure 12 Nature-based Solutions of Varcities Project

3.2.2 Varcities : Digital Visionary Solutions

The visionary digital solutions for each pilot city has been shown in the tables below:

Pilot	Visionary Solutions
Skelleftea - SK	**VS3:** Installation of smart lighting to contribute to an inviting environment and encourage activities in the park
Bergen - NO	**VS1**: A digitalized urban water park including city beach **VS2**: AR applications for inspiring more physical activities and area exploration
Dundalk - IE	**VS3 :** Sensors on bikes and bike-stations
Novo Mesto - SI	**VS4:** Integrated management of the facilities **VS5:** IoT solutions for measuring the health and wellbeing of the visitors
Castelfranco - IT	**VS2 :** Analysis and monitoring of psychological wellbeing ad the quality of life for healthy individuals, and physiological changes in people suffering from dementia **VS3**: Full monitoring of micro-climatic conditions in the different areas of the garden **VS6:** Adaptive and intelligent information system for visitors
Chania - GR	**VS2 :** Sensors on bikes and bike-stations
Leuven - BE	**VS2 :** Sensors for health and water measurments **VS4**: IoT infrastructures (screens) for smart lighting and noise **VS5**: Mobility sensors to measure the peestrian and bike flows
Gzira - MT	**VS2 :** Citizen science in air/noise quality to increase health and well-being awareness

Key Challenges	Skellefte a	Bergen	Dundalk	Castelfranco	Novo Mesto	Gzira	Chania	Leuven
Sustainable Urban Mobility		**VS2**	**VS3**				**VS2**	**VS5**
Sustainable Built Environment		**VS1**		**VS2,VS3, VS5**		**VS2**		**VS2**
Integrated Infrastructures And Processes	**VS3**			**VS6**	**VS4, VS5**			**VS4**

Figure 13 Digital Visionary Solutions of Varcities Project

3.2.3 Varcities : Socio-cultural Visionary Solutions

The visionary Socio-cultural solutions for each pilot city has been shown in the tables below:

Pilot	Visionary Solutions
Skelleftea - SK	**VS4 :** Educating and engaging citizens in the area to level up their awareness of climate change and the importance of the biodiversity **VS5**: Creation of space in the park with bee hotels/insect habitats, permanent school material
Bergen - NO	**VS4:** Bergen City Beach Health Effects Assesment
Dundalk - IE	**VS1:** Creation of outdoor learning pod between Dundalk library and museum quarter to showcase the newest technologies and host shared functions
Novo Mesto - SI	**VS3 :** Interconnectedness of sports, recreational, and the therapeutic facilities
Castelfranco - IT	**VS1 :** Creation of garden access routes to ensure an improved access according to the needs of the garden users **VS4**: Development of a green public spaces (re)design toolbox and establishment of the "local observatory of the therapeuric effects of the green and blue area"
Chania - GR	**VS1 :** Mobile urban living rooms
Leuven - BE	**VS1 :** Riverside mobile urban living room for cultural activities **VS3** : Health trail with the "moving bench", Therapeutic sensory garden for the elederly people
Gzira - MT	**VS3 :** Urban biodiversity, education, and engagement, through a co-created community garden project

Key Challenges	Skelleftea	Bergen	Dundalk	Castelfranco	Novo Mesto	Gzira	Chania	Leuven
Knowledge And Social Capacity Building	VS4, VS5		VS1			VS3	VS1	VS1
Participatory Planning And Governance	VS4	VS4		VS4		VS3	VS1	VS1
Social Justice And Social Cohesion								
Health And Wellbeing	VS5	VS4		VS1	VS3			VS3
New Economic Opoortunities And Green Jobs								
Integrated Planning, Policies, And Regulations					VS3			
Bussiness Models And Finance								
Citizen Focus				VS1				VS3

Figure 14 Socio-cultural Visionary Solutions of Varcities Project

3.3. Challenges of City of Gzira, Malta

Gzira is a heavily populated town in central Malta, and is facing urbanization issues. It's a popular destination with a lively coastal vibe, but rapid development has resulted in limited natural spaces, pedestrian areas, and connections. Urbanization has increased air and noise pollution, affecting community well-being..

Figure 15 Location of Gzira,Malta on the Map

Gzira exemplifies the interaction between urban planning and health, where poor governance has resulted in undesirable urbanization. Policy proposals emphasize the need for creative methods that prioritize understanding and addressing urban health concerns. The Planning Authority should place an emphasis on health and equity in its planning, recognizing health as a holistic concept. The physical environment, which includes natural, manmade, and institutional aspects, has a substantial impact on community health.

Dense transportation within limited spaces, often via one-way streets, causes localized pollution in congested urban areas like Gzira. Air pollution is a significant result of harmful substances suspended in the air. Climate change and pollution amplify environmental-induced illnesses, causing healthcare professionals to be concerned. This type of pollution has been linked to increased environmental health risks, which contribute to premature deaths and diseases. According to the World Health Organization, air pollution is responsible for a significant portion of Malta's mortality and loss of life years. Traffic flow, congestion, and an increase in registered vehicles all contribute to poor air quality, with nitrogen dioxide and particulate matter being major pollutants. In Gzira, monitoring reveals occasional exceedances of airborne pollutant levels, particularly PM and NO2.

Figure 16Current Situation of Streets of Gzira with Less to No Amount of Greenary

This is a serious health concern, particularly for children who are vulnerable to traffic-related respiratory disorders.

Green spaces are critical in combating sedentary urban lifestyles and the health risks that come with them in communities like Gzira. These areas promote physical activities like walking, jogging, and biking, which promotes both physical and mental well-being. Congestion in cities frequently causes social stress, sleep problems, fatigue, and weakened immune systems. Gzira's proposed mega-project on Manoel Island, on the other hand, offers limited and inaccessible public open space, as well as a lack of proximity and accessibility for older and disabled residents. Inadequate physical activity facilities, walkways, and bike paths exacerbate the problem. A healthier living environment necessitates that the development plan prioritizes inclusive and easily accessible green and recreational spaces as essential rights for the residents of Gzira.

3.3. Varcities Visionary solutions for Gzira, Malta

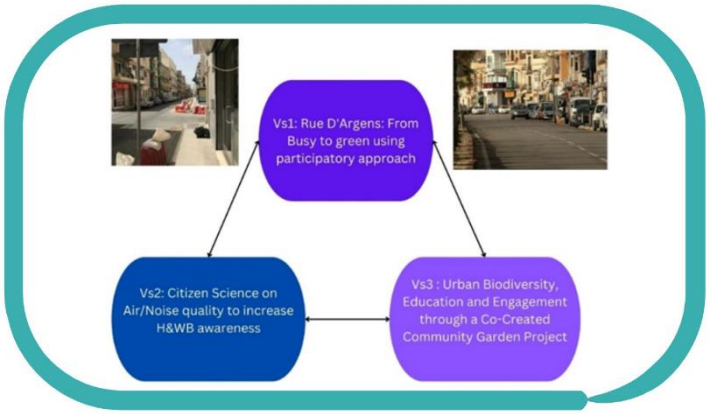
The pilot project will transform Rue D'Argens, a heavily trafficked road in Gzira with limited green space amid residential and office structures, into a pedestrian-friendly environment. Parking dominance contrasts with the possibility of high-rise development. Nature-based solutions aim to reshape this scenario by converting roadside areas into pedestrian zones, establishing community gardens, and reintroducing native plants. VARCITIES supports participatory design micro-greening, citizen science awareness campaigns on the health effects of air and noise pollution, and a co-created community garden centered on urban biodiversity, education, and sustainability.

The city council has committed to improving air quality through nature-based solutions while revitalizing the urban landscape. For solution implementation, they advocate co-design, transition management, and active citizenship. The chosen location aspires to improve air quality, reduce noise, and promote health by encouraging physical activity, relaxation, safety, and psychological well-being.

VARCITIES funds three comprehensive solutions that include participatory processes and novel air pollution measurement methods. The goals include increasing urban vegetation, reducing air and noise pollution for walkability and well-being, encouraging civic engagement and environmental awareness, deploying novel sensor technologies, improving community cohesion, and reducing car usage in line with green transportation trends.

3.3.1 Visionary solutions in Gzira

Figure 17 Visionary Solutions in Gzira, Malta.



3.3.2 VS1: Rue D'Argens : Micro-greening interventions through a participatory design process

3.3.2.1 General project background, context and rationale:

The pilot site is a high traffic road called Rue D'Argens, flanked by residential and office buildings on both sides. The road sees constant traffic and there is little to no greenery. Like many roads in Malta, priority is given to parking, preserving space for trees and other native vegetation, and wide pavements for walking. Implementation for nature-based solutions will include exploring areas alongside the road that can be transformed into community gardens, as well as providing spaced for reintroducing indigenous plants.

Figure 18 Visionary Solution 1 : Microgreening in High Traffic Road Called Rue D'Argens

3.3.2.2 Description of the Visionary Solution:

VS1 provides a greener urban environment by supporting and involving residents and local businesses in the process of greening their properties and embellishing the street of Rue D'Argens in order to revitalise the area through a participatory process where residents are active agents in the decision-making process of the preferred micro-greening interventions.

- Micro Greening of an Area in Rue D'Argens to improve visual aesthetics of streetscape.
- Property owners and businesses will be invited to contribute to the Varcities project through greening : balconies, facades, other exteriors.
- Pop-up greening setups to create temporary community spaces.

Figure 19 Left: Current state , Right: Micro-greening Through Participatory Design

3.3.2.3 Pop-up description and case-study:

i. A modular and mobile green set-up, engaging citizens and local businesses
ii. Pop-up parks are created by taking over car designated zones for use by pedestrians.
iii. Apart from offering seating and possibly bike parking and other amenities, such spaces usually incorporate vegetation so as to encourage human-nature interaction.

Figure 20 Pop-up Parks in Gzira, Malta

3.3.2.4 Targeted Areas:

- Nature-based solutions

i. Building Scale Interventions

ii. Public Spaces Interventions

iii. Interventions in Ecological and Habitat Biodiversity

- Smart city/ Digital solutions

i. Digital Tools for Citizen Engagements

3.3.2.5 SDGs:

Figure 21 SDG's correlated with Visionary Solution 1 in Gzira, Malta

3.3.3 VS2: Measurement of air quality and noise pollution with citizen science to increase H&WB awareness

3.3.3.1 General project background, context and rationale:

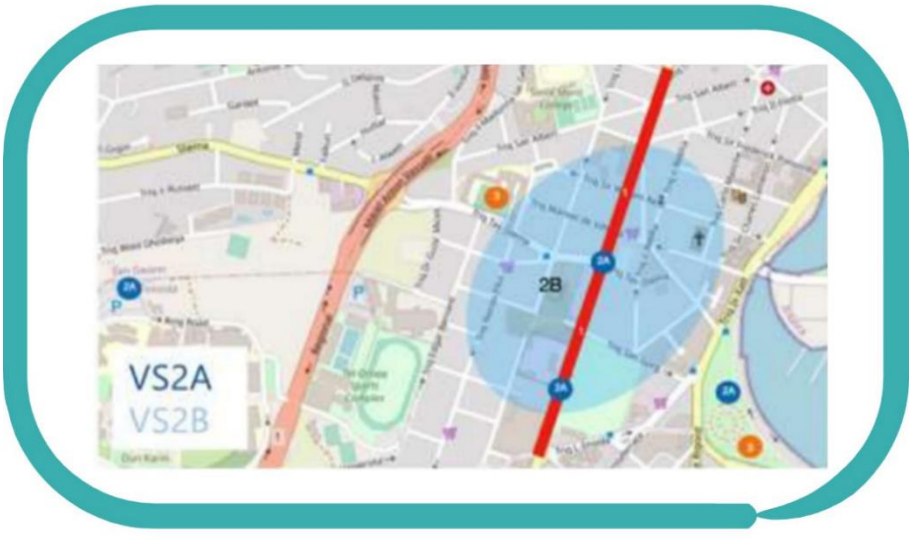


Figure 22 Measurement of Air Quality and Noise Pollution with Citizen Science Project

The basin type terrain and densely built urban zone with high-rise buildings deflect wind flows and traps air pollution at surface level within the street canyons. The ambient air quality legislation, which includes the assessment, monitoring, reporting on air quality and air pollution impacts, together with the reporting of the emissions inventory and projections is found in Malta's National Air Pollution

Control Program-2019. With high levels of air pollution and a few green open spaces, introducing more greenery into the context pilot site will contribute towards more awareness about the benefits of green spaces.

3.3.3.2 Description of the Visionary Solution:

VS2 provides environmental awareness and democratization of knowledge to citizens over the project's duration in order to improve their health and wellbeing through awareness of the air quality of their locality.

- Sensors are to be installed at various locations, mostly within Gzira, to collect and compare data at various geographical points to identify the various pollutants.
- Handheld sensors (Indicated as light blue on the map) will be provided to citizens who will be intrestes in participating in the data collection of pollutant measurements..

3.3.3.3 Targeted Areas:

- Nature-based solutions

i. Building Scale Interventions

ii. Public Spaces Interventions

- Smart city/ Digital solutions

i. Sustainable Urban Mobility

Figure 23 Example: NO2 Measurements Already Carried Out on Site

3.3.3.4 SDGs:

Figure 24 SDGs correlated with Visionary Solution 2 in Gzira, Malta

3.3.4 VS3: Urban Biodiversity, Education, and Engagement, through a Co-Created Community Garden Project

3.3.4.1 General project background, context and rationale:

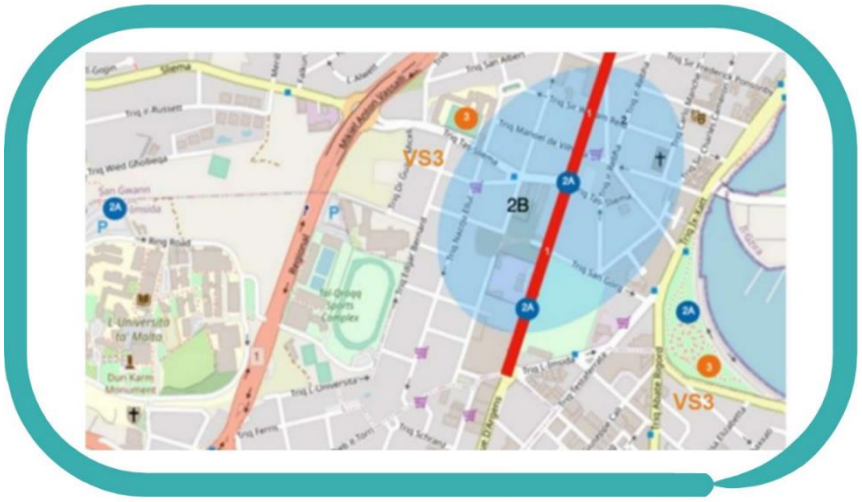


Figure 25 Community Garden in The Gzira Primary School

The Gzira Primary School has one of the few open public spaces in the locality which is only accessible to school children and parents. Focusing on a public institution rather than a private space proved to be more achievable in the course of the VARCITIES Project. Attempts have been made to owners of private open land however complications were arising. By implementing NBS in this pilot site we will not only be providing citizens of the area with a greener space but also educating school children on their benefits. The garden implemented at the school will be open to the public after school hours to provide citizens with a recreational space, which is lacking in the central areas of the locality.

3.3.4.2 Description of the Visionary Solution:

The Visionary Solution provides a social engagement activity in a green public space in Gzira which has been earmarked for renovation. In addition, it targets increased biodiversity and environmental education to school children and the local community as well as improve the health and well-being of both children and adults through the development of an ecological playscape and community garden. Pop-up engagements will be used around Gzira.

- A community garden with co-design educational workshops involving school children to improve the urban ecosystem, educate children, and improve wellbeing.
- Cultural and pop-up events at Gzira gardens to raise awareness on benefits of NBS.
- Creating a green public space in a densely built urban environment.

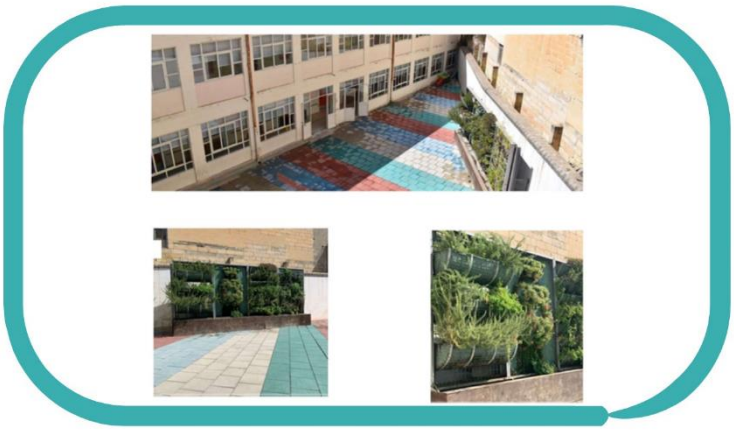


Figure 26 Gzira Primary School

3.3.4.3 Targeted Areas:

- Nature-based solutions

i. Public Spaces Interventions

ii. Interventions in Ecological and Habitat Biodiversity

- Others

i. A gamified experience using digital tools

3.3.4.4 SDGs:

Figure 27 SDGs Correlated with The Visionary Solution 3 in Gzira, Malta

CHAPTER IV

Theoretical Framework

4.1 What is Economic Valuation?

Economic valuation refers to the worth an individual places on an economic good or service based on the benefits they derive from it. This worth is an indicator of what can be obtained from a resource by utilizing it in a particular way. As we make decisions, we are constantly weighing the pros and cons of different alternatives. When we directly benefit from a good or service, it is easier to place a monetary value on it, but there are many benefits that are not easily quantifiable in terms of money. Disputes can arise when there are competing uses for a resource, and in such cases, we often prioritize the uses that have a direct contribution to economic growth. This can be problematic because it undervalues goods and services that do not have a direct market value.

Urban green spaces often provide cultural ecosystem services that fall under these non-marketed goods and services. Assigning a value to such goods or services does not necessarily mean that we will charge citizens for them. However, assigning a monetary value to specific ecosystem services in urban areas can help in situations where there is a dispute over resource use. By comparing market and non-market goods and services, we can make more informed policy decisions aligned with sustainable development goals. Therefore, monetary value can be a useful tool for highlighting trade-offs in resource use decisions and increasing resource use efficiency.

There are various methods available to calculate the monetary value of a trade-off that people are willing to make to improve the quantity or quality of a particular good or service. One valuable contribution of consumer behaviour research to marketing researchers is the understanding of how consumers think and express their preferences. According to O'Donnell (2007), these methods gauge people's preference for a good or service by determining their willingness to pay (WTP) for it.

Utility Theory assumes that people are rational decision makers and evaluates the outcomes of choices for both market and non-market goods or services based on the utility (or value) that individuals assign to them. Within this framework, choices can be interpreted in terms of logically arranged utility levels associated with various outcomes, and respondents tend to choose the option that provides the highest utility. For instance, if respondents have to choose between options A and B, assuming they are rational, they would select option B if it has a higher utility level than option A.

4.2Total Economic Value Approach

4.2.1 Definitions and concepts

Ecosystem goods and services are typically categorized based on their utilization, according to economists. The economic value of any such good or service is determined by the trade-off that a person makes between two options based on the utility they receive from these goods and

services or the level of protection they require. The Total Economic Value (TEV) method is the primary framework utilized in assessing the utilitarian value of ecosystems, as described by Pearce and Warford (1993).

While the terminology and classification may differ between analysts, the TEV approach typically includes four types of values: (i) direct use value, (ii) indirect use value, (iii) option value, and (iv) non-use value. The first three are collectively referred to as "use value."

Non-use values, which are also known as passive use values, come into play when an individual is willing to pay for a good or service even if they do not directly use it, do not expect to profit from it, and do not plan to use it in the future for themselves or others. Existence value is another term for this non-use value.

4.2.2. The Components of Total Economic Value

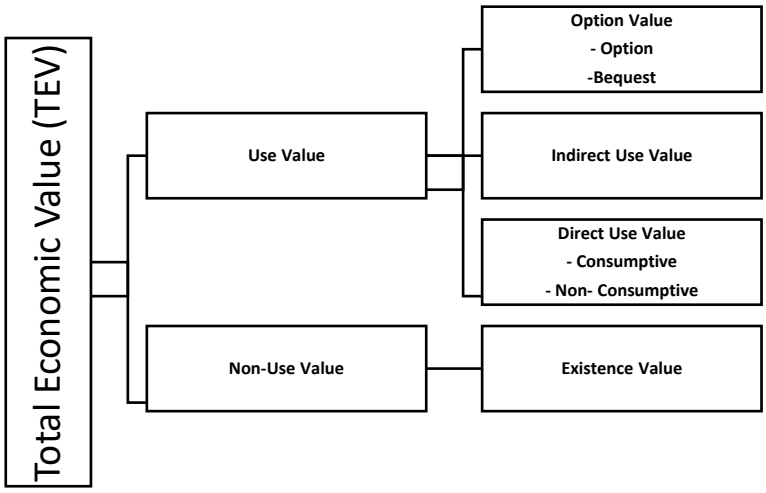


Figure 28 Total Economic Value

Table 1 Use and Non-Use Values

Value Type	Definition	Examples
Direct Use Value	Value derived from using ecosystem services directly.	Fish caught from a river, timber harvested from a forest.
Option Value	Value placed on the option or potential to use an ecosystem service in the future.	Option to use a plant for medicine in the future.
Indirect Use Value	Value derived from ecosystem services indirectly.	Value of pollination provided by bees supporting crop production.
Existence Value	Value placed on ecosystem services not used directly or indirectly, but because they exist.	Value of rare or endangered species, aesthetic value of natural landscapes.

- The term "**direct use values**" refers to advantages of directly using ecosystem goods, whether for consumption, which reduces resource quantity, or for non-consumption, which maintains resource quantity. Examples include cutting down trees for fuel (consumptive) and watching wildlife or taking in the scenery in green spaces (non-consumptive), both of which are advantageous to the ecosystem's inhabitants.
- "**Indirect use values**" result from ecosystem services that go beyond the ecosystem's scope and make indirect but measurable contributions, like water purification. Notably, ecosystem services with easily quantifiable value include soil nutrients, pollination, and biological control, which act as intermediate inputs in the production of final goods and services for human consumption.
- "**Option value**" refers to the potential future use of ecosystem goods and services that are currently not being used. This includes provisioning, regulating, and cultural services that are not being used now but may be in the future.
- The satisfaction gained from a resource's bare existence, regardless of future plans for use, is referred to as "**non-use values**" in the context of ecosystem goods and services. This satisfaction is also referred to as "existence value" or "passive use value." Understanding these value categories is essential for developing policies that acknowledge the intrinsic and utilitarian values of ecosystem services and for managing sustainable ecosystems.

The process of valuing ecosystem services varies: direct use values, such as recreational visits, are easily observed and priced, whereas evaluating the experience is more difficult. Pricing is complicated by the fact that indirect use values, such as carbon storage, are hard to quantify and have no market value. The hardest to assess is non-use value, or the pleasure of having a resource without actually using it. Surveys are necessary because it can't be seen in actions, like willingness to pay for faraway ecosystems. Exceptions, such as selfless donations to "good causes," are uncommon. In conclusion, direct use values are simple, whereas indirect use and non-use values require complex methods because they are hard to observe.

4.2.3 Total Economic Value and Ecosystem Services

The absence of market trading makes it difficult to value non-market ecosystem services, which are frequently disregarded but are crucial for humans. To determine the monetary value of these non-market services, economic valuation methods employ empirical techniques. Cultural ecosystem services, for example, are non-market services, and it takes research to determine their economic value while market ecosystem services have clear economic value that is reflected in market pricing.

Public goods like urban green spaces are frequently included in the subset of non-market services known as cultural ecosystem services. Public goods are those that are challenging to exclude others from using, and these services are non-excludable and non-rivalrous. Due to these distinctive qualities, market producers find it difficult to sell such goods to specific consumers, which complicates their valuation.

Research, as shown by the references (Garrod & Willis, 1999) and (Ezebilo, 2016), is required to address this challenge and recognize the importance of public goods within ecosystems in order to understand the economic value of non-market ecosystem services.

Table 2 Total Economic Value and Ecosystem Services

Ecosystem Service	Direct Value	Indirect Value	Option Value	Existence Value
Provisioning	X	X		
Regulating	X	X	X	
Cultural	X	X	X	X
Supporting		X		

4.3 Non-market valuation methods

Environmental economics valuation techniques frequently express outcomes in monetary terms to make them easier to compare and directly communicate. By avoiding the conversion of values into various units, comparisons with other welfare-contributing activities like spending on health and education are made simpler. Decision-makers and the general public benefit from monetary units' effective communication of the effects of changes to ecosystem services. It's important to evaluate non-market benefits without readily observable monetary value in environmental and natural resource valuation; however, using monetary units does not imply a focus only on financial gains.

Revealed preferences and stated preferences are two methods used to value non-market goods and services. By measuring the impact of non-market goods on ancillary markets—such as housing prices—revealed preferences examine how non-market goods affect those markets. The stated preference approach, in particular contingent value and choice modeling, is highlighted in this study. While choice modeling infers respondents' willingness to pay based on how they ranked various options, contingent valuation asks respondents directly about their willingness to pay for a service.

In order to determine an item's overall economic value, economic valuation approaches aim to evaluate the full impact on human well-being resulting from changes in the provision of that item. The costs and benefits incurred by both users and non-users are included in this total value. Users interact with the item either directly or indirectly, whereas non-users are willing to pay for changes to the item's provision but don't directly use it. Someone who is willing to help preserve an endangered species even though they have never seen it or do not foresee seeing it is an example of a non-user. A thorough assessment of the economic value of ecosystem services is necessary to inform effective policy and management decisions. This requires an understanding of the combined effects on users and non-users.

Table 3 Revealed Prefernece Method and Stated Preference Methods

Method	Revealed Preference Methods	Stated Preference Methods
Approach	Based on real-world behavior and choices	Based on hypothetical scenarios or responses in surveys
Data Requirement	Uses historical or existing data, like purchase behavior or consumption records	Requires data from surveys or experimental scenarios
Limitations	Limited to observed choices and may not fully capture preferences or trade-offs	Prone to hypothetical bias and may not mirror real-world behavior

4.3.1 Main Economic Valuation Techniques:

Technique	Method Type	Description
Hedonic Pricing	Revealed Preference	A method for valuing the economic worth of a good or service by examining the prices of related goods or services in the market. The method assumes that the price of a product reflects the value consumers place on its features.
Travel Cost Method	Revealed Preference	A method for valuing the economic value of a recreational site by studying the costs individuals incur in traveling to and using the site. The method assumes that the travel and usage costs represent the value individuals place on the site's attributes.
Contingent Valuation	Stated Preference	A method for valuing the economic value of a good or service by directly asking individuals about their willingness to pay for it or accept compensation for its loss. The method assumes that individuals can accurately express their preferences and willingness to pay or accept compensation.
Choice Experiments	Stated Preference	A method for valuing the economic value of a good or service by presenting individuals with hypothetical choice scenarios and asking them to choose their preferred option. The method assumes that individuals can accurately express their preferences, and the choices they make reflect the value they place on the options' characteristics.

Table 4 Main Economic Valuation Techniques

4.4.1 Implementing a stated preference study

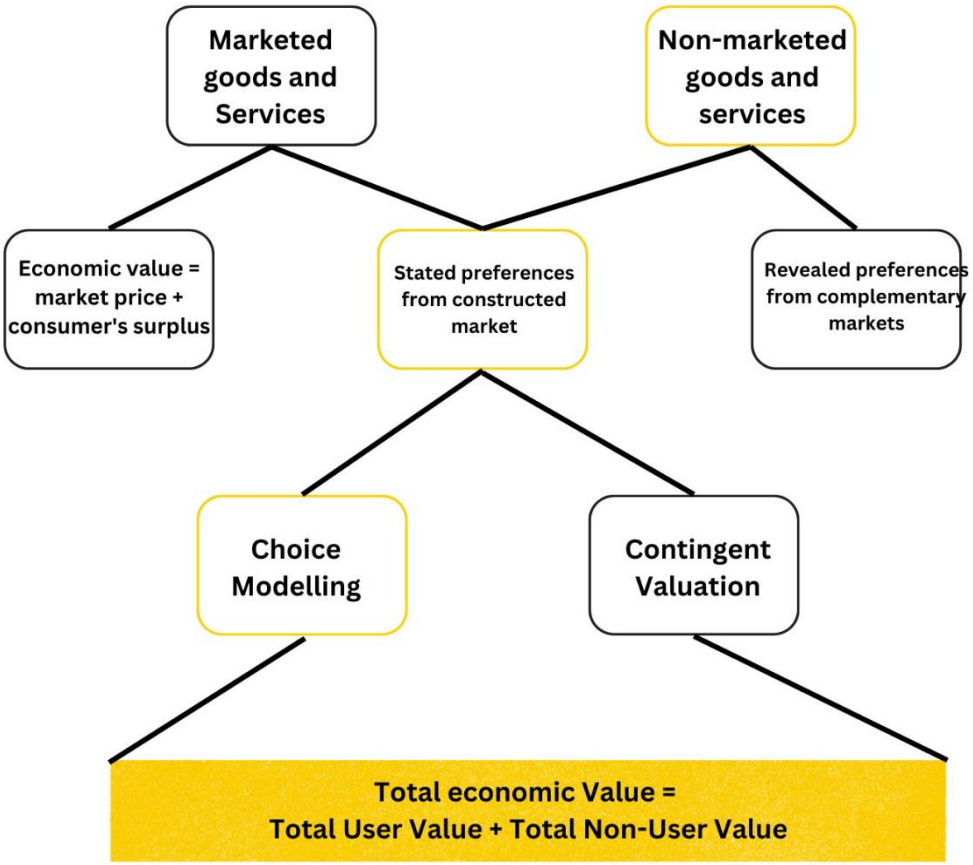


Figure 29 Marketed and Non-Marketed Good And Services

Survey analysis using stated preference (SP) methods is essential for determining economic value. Discrete choice contingent valuation (CV) and discrete choice experiment (DCE) are two well-known SP methods. When revealed preference (RP) data is lacking, it becomes necessary to use SP methods, especially when valuing changes to public goods like environmental services and health effects. They are crucial for welfare analysis because they are the only way to evaluate non-use and use values when changes take place outside of existing markets or observed conditions.

Despite having different questionnaire designs and data analysis stages, both contingent valuation and choice modeling studies can be conducted using the standard work plan for an SP study. With the help of this methodical approach, a thorough assessment of the economic values of non-market goods and services is ensured, providing crucial insights for effective policy and

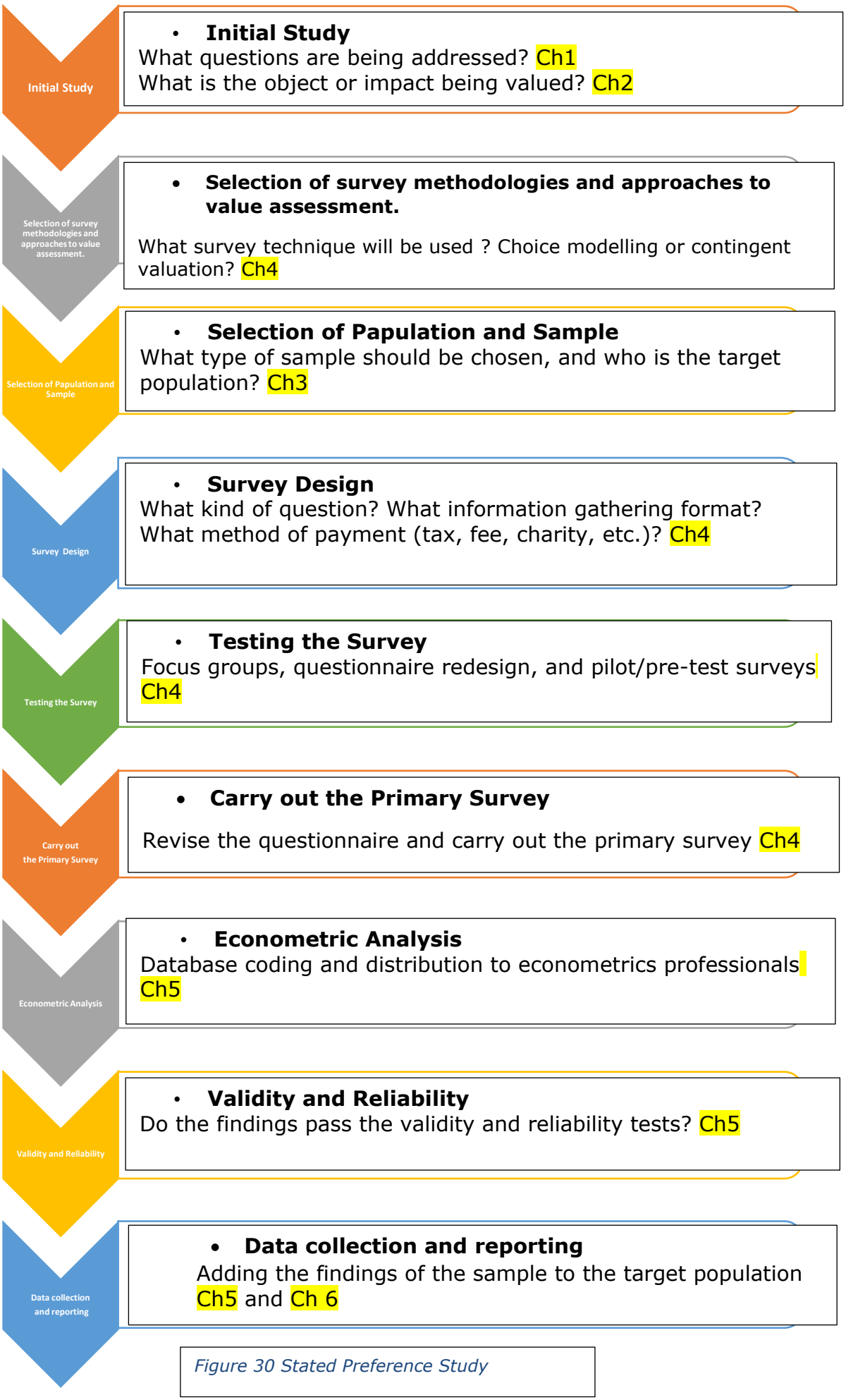


Figure 30 Stated Preference Study

4.4.2 Choosing between Economic Valuation Techniques

Contingent valuation (CV) and choice modeling (CM), two essential stated preference (SP) techniques, are covered in this section. It highlights how different they are in how a good's various characteristics are valued economically. Choice modeling excels at determining individual characteristics, while contingent valuation excels at determining the total economic worth of the in-question good. However, combining the two approaches can greatly improve the analysis's robustness.

Choice modeling offers a sophisticated method for assessing particular qualities of a good, such as distinctive features or characteristics, by capturing people's preferences and trade-offs. Contrarily, contingent valuation, with its emphasis on overall value, may be better suited for determining the overall value of the entire good, taking a more thorough approach.

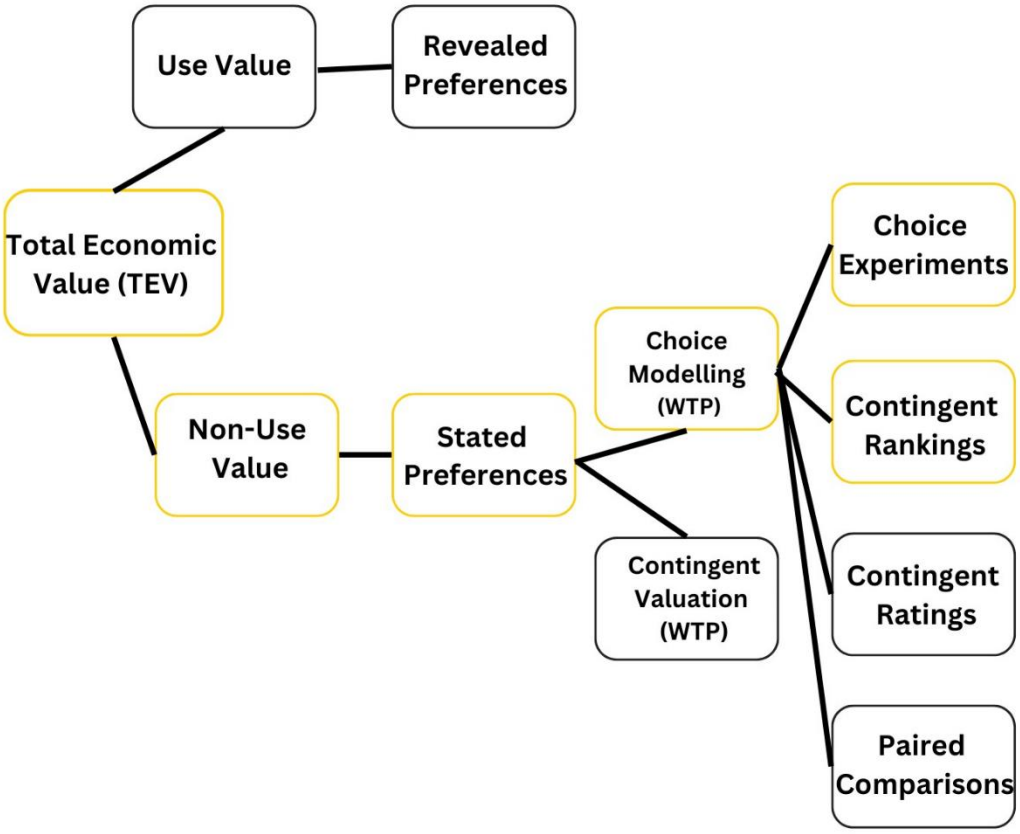


Figure 30 Choice Experiment And Contingent Rankings

Choice modeling outperforms other approaches like contingent valuation and revealed preference in valuing specific product or service characteristics due to its advantages. When dealing with interrelated characteristics, revealed preference may run into problems because contingent valuation can be complicated. Choice modeling outperforms dichotomous choice designs in contingent valuation by presenting uncorrelated options that allow respondents to express preferences at various price points.

Choice modeling makes it possible to evaluate individual attributes because it makes the task for respondents easier by providing options A, B, or neither. It is advised to validate this with other techniques, such as contingent valuation, to ensure accuracy, despite the assumption that a good's value is equal to the sum of its attributes.

Both the stated preference (SP) and revealed preference (RP) techniques are important in determining willingness to pay. While RP makes use of market data already available, SP relies on hypothetical questions. Choice modeling, a common SP technique, includes a number of methods. When proxy markets are not available, SP is the preferred option. The choice of valuation technique is dependent on the context of the problem. For measuring use values in markets with various effects, SP and RP are both useful and ensure a thorough understanding of economic value.

The conventional method for Discrete Choice Experiments (DCEs) involves participants selecting the best option from various attribute sets. By asking participants to select from all available options, a more thorough approach that is gaining popularity elicits complete preference orders. Smaller sample sizes, a lighter burden on respondents, and more sophisticated analysis capabilities are some advantages of this approach. This methodology has increased complete preference order elicitation in DCEs in the field of environmental research.

Different techniques can be used by researchers to obtain full preference orders. One such approach, simultaneous ranking, has been around for a while but has its drawbacks. Another technique, known as Best-Worst DCE (BWDCE), lessens cognitive load by asking participants to select the best and worst options from a set, resulting in a complete preference order. BWDCE provides a strong substitute for ranking by balancing the demands for comprehensive data and participant convenience. Depending on their particular needs and preferences, researchers can choose between the two methods.

4.5 Designing and testing stated preference questionnaire.

4.5.1 Choice of Survey Method

After selecting a valuation technique, the next decision is determining the appropriate survey method, which will mostly rely on the available resources, such as time and money. Generally, high quality and dependable survey results require a significant investment of both time and financial resources. With the prevalence of the internet, online survey tools have become a common method of data collection in academia and marketing. Utilizing web technology has made it easier to design, create, and collect responses from users. Consequently, for the purposes of this research, we have opted to use Google Forms as our survey tool.

4.5.2 Identifying the target population and choosing the sample

This study focuses on the residents of Gzira, Malta, and the research sample consists of University of Malta students, parents and children attending the main primary school, and participants in co-creation workshops.

4.5.3 Questionnaire Design – Choice Modelling

Choice modeling, also referred to as conjoint analysis, is based on the idea that a product's characteristics define it, with varying degrees of these characteristics resulting in different products. A forest's age distribution, species diversity, and recreational opportunities are a few examples. Estimating the value of these attribute variations is the main goal of choice modeling. Choice modeling asks respondents to rank or rate options as opposed to contingent valuation, which seeks direct monetary values, potentially addressing the problem of protest votes.

Choice modeling does not ask for money directly, but it does include a monetary indicator, like a charge or tax, as a feature in each choice. By including it, the analysis's framework now makes it possible to determine economic values. By focusing on attribute variations and preferences, this methodology offers a beneficial alternative and enables more nuanced insights into the perceived value of various product features.

Method	Description	Tasks
Choice Experiments	Participants make hypothetical choices between two or more alternatives, systematically varying attributes to estimate attribute importance in decision-making.	- Designing the choice sets - Collecting and analyzing the responses
Contingent Ranking	Participants rank a set of alternatives based on a specific criterion, systematically varying the criterion to estimate its importance in the ranking process.	- Designing the ranking tasks - Collecting and analyzing the responses
Contingent Rating	Participants rate a set of alternatives on a specific criterion, systematically varying the criterion to estimate its importance in the rating process.	- Designing the rating task - Collecting and analyzing the responses
Paired Comparisons	Participants choose the preferred option from pairs of alternatives, assuming constant attributes across all pairs.	- Designing the paired comparison task - Collecting and analyzing the responses

Table 5 Different Choice Modelling Methods

Contrary to contingent valuation, choice modeling offers a unique method for calculating the economic value of a good or service. Assuming that a product's description depends on its attributes, participants rank or rate various alternatives based on those attributes, resulting in different levels of attributes producing distinct product options. Choice modeling avoids making explicit financial inquiries, in contrast to contingent valuation, which directly probes a party's willingness to pay (WTP) or accept a loss (WTA). Instead, it places emphasis on respondents' preference rankings while using deceptive methods to infer the product's economic worth. By emphasizing preferences rather than directly addressing monetary values, this methodology offers a beneficial alternative and may offer more accurate and sophisticated insights into how people value various product attributes.

4.6 The structure of a Choice Experiment Questionnaire

The structure of a typical Choice Experiment questionnaire is like:

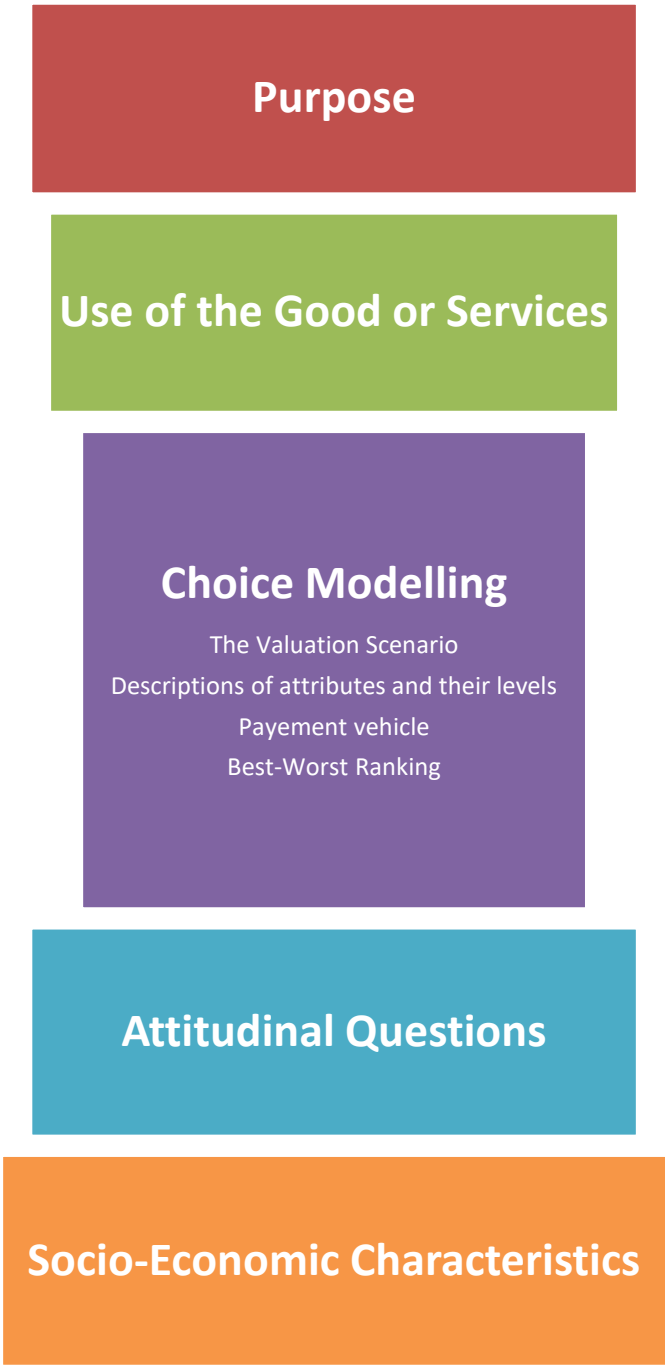
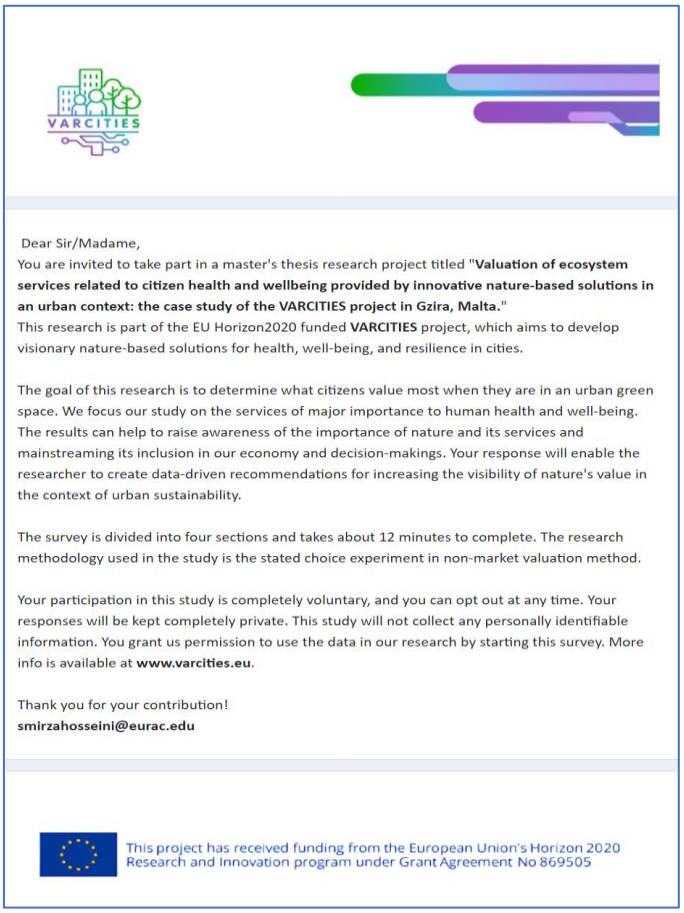


Figure 31 The Structure of a Typical Choice Experiment Questtionnare

4.6.1 Purpose

In choice modelling, clearly articulating the purpose of the questionnaire is crucial to promote respondent comprehension, engagement, and informed participation. To elicit realistic and unbiased responses, the context of the survey should reflect real-life scenarios. Additionally, interviewers must identify themselves and the organization they represent, and guarantee confidentiality to encourage honest answers.



Dear Sir/Madame,
You are invited to take part in a master's thesis research project titled "**Valuation of ecosystem services related to citizen health and wellbeing provided by innovative nature-based solutions in an urban context: the case study of the VARCITIES project in Gzira, Malta.**"
This research is part of the EU Horizon2020 funded **VARCITIES** project, which aims to develop visionary nature-based solutions for health, well-being, and resilience in cities.

The goal of this research is to determine what citizens value most when they are in an urban green space. We focus our study on the services of major importance to human health and well-being. The results can help to raise awareness of the importance of nature and its services and mainstreaming its inclusion in our economy and decision-makings. Your response will enable the researcher to create data-driven recommendations for increasing the visibility of nature's value in the context of urban sustainability.

The survey is divided into four sections and takes about 12 minutes to complete. The research methodology used in the study is the stated choice experiment in non-market valuation method.

Your participation in this study is completely voluntary, and you can opt out at any time. Your responses will be kept completely private. This study will not collect any personally identifiable information. You grant us permission to use the data in our research by starting this survey. More info is available at **www.varcities.eu**.

Thank you for your contribution!
smirzahosseini@eurac.edu

This project has received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement No 869505

Figure 32 Purpose of The Questionnaire

4.6.2 Use of The Good or Services

The primary goal of the following stage is to determine the intended purpose of the specific product or service. This is done to assess the respondent's familiarity with it and to distinguish between users and non-users. The first query seeks to determine the frequency of use of urban green spaces for social reasons, while the second seeks to determine the frequency of use for recreational purposes. The following are the survey questions: "

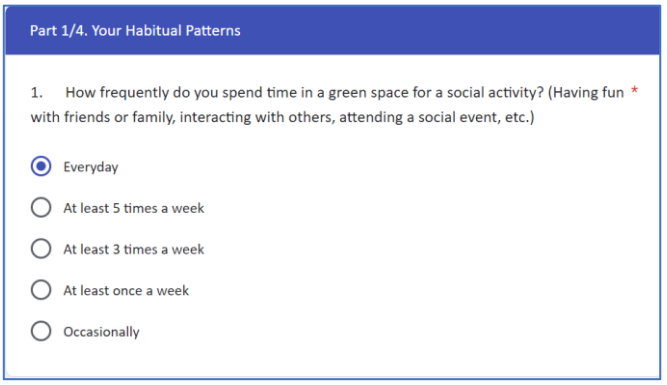


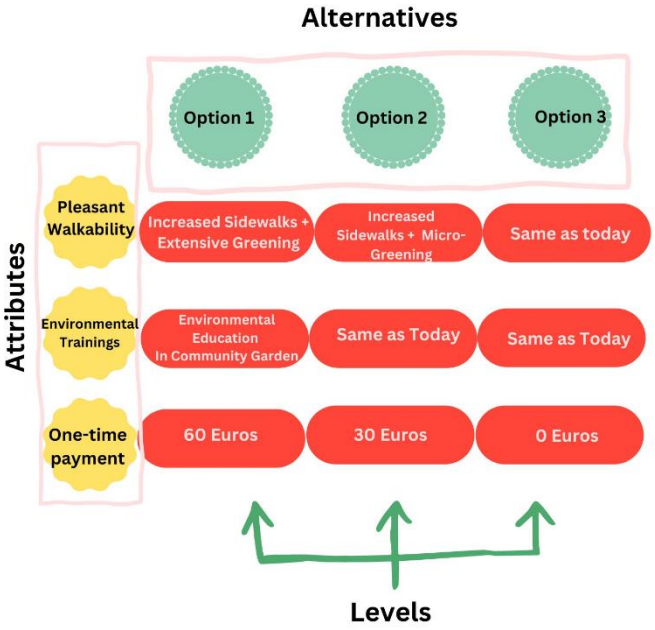
Figure 33 Frequency Use of The Good or Services

4.6.3 Choice Modelling

The purpose of this research is to evaluate the cultural ecosystem services provided by innovative nature-based solutions (NBS) in urban green spaces in the pilot city of Gzira. To achieve this, we will present two different options to respondents, each featuring varying degrees of innovative NBS application in a specific context. A third option, the Opt-out, will be provided for those who do not want any change and therefore, no monetary value will be assigned to it. The respondents will be presented with 10 choice cards featuring three alternatives:

- Alternative 1, where they pay a hypothetical monetary value for Option 1;
- Alternative 2, where they pay a hypothetical monetary value for Option 2;
- Alternative 3, where they choose not to pay anything and select the Opt-out option.

To ensure that respondents do not repeatedly choose the Opt-out option, we will use the best-worst discrete choice experiment (BWSDCE) approach. This approach not only asks respondents to choose the best option but also to select the worst option, which ensures that we obtain more comprehensive input information to analyze.An example of a choice set is like below:



The set of choices available in this scenario includes three options: Option 1, Option 2, and Option C (Opt-out). Each option has three attributes to compare: Pleasant Walkability, Environmental Trainings, and One-time payment. Each attribute has two levels, and Option C does not bring any changes, so no monetary value has been assigned to it. By analyzing the respondent's selection, we can infer the trade-offs they make. For instance, if the respondent chooses Option 1 as the best and Option C as the worst, we can deduce that they place a high value on the improvement of urban green space services and are willing to pay 30 euros more than Option B for the "Environmental Education in community garden" improvement. However, more observations are necessary to understand the respondents' preferences better.

	Option A	Option B	Option C	Change in attribute level from A to B (+ better, - worse, 0 No change):
Attribute	A1	B1	0	0
	A2	B2	0	-
	A3	B3	0	+
	A4	B4	0	+
	A5	B5	0	0
	A6 (Price)	B6 (Price)	0	+

Figure 34 Anatomy of a Choice Experiment

4.6.4 The Valuation Scenario

The way in which a good or service is described and the changes that may occur to it are what make up a valuation scenario. It is important to carefully consider the scenarios presented to respondents, as too many scenarios can lead to confusion and meaningless responses. When designing a questionnaire, the scenario must be well-defined in order to elicit meaningful answers. For instance, in the context of the thesis, the focus is on urban green spaces and their cultural services in the VARCITIES project, and the valuation scenario must relate to the improvements in these spaces and their services that are associated with the innovative NBS implemented in Gzira.

Assume that you, as a Gzira resident, would consider spending a certain amount of money as a **one-time payment** to help Gzira in improving its urban green spaces and services.
There will be **10 different choice sets**, each one with **3 options**: **A**, **B**, **C**.
Option A and **B** propose some improvements to public space, considering the one-time payment that you are theoretically required to make. **Option C** proposes no change (leaves the situation as it is) therefore no cost.
Please select one of the following options from each choice set:

- The option that most closely resembles the desired change for its cost
- The worst option for its cost

Figure 35 The Valuation Scenario

4.7 Common Design Stages for Choice Modelling

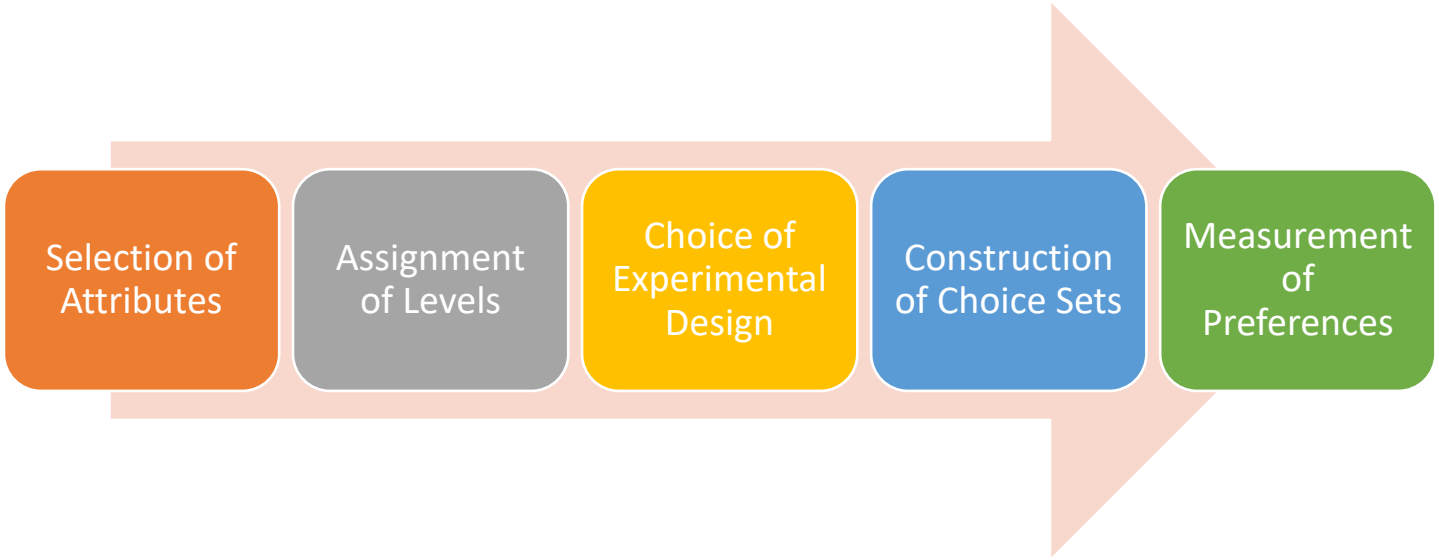


Figure 36 Common Design Stages for Choice Modelling

4.7.1 Selection of Attributes

The questionnaire we have created focuses on 4 key attributes, each with 3 levels, as well as 2 additional attributes with 2 levels. These attributes have been carefully chosen through a review of relevant literature, ensuring that they are linked to Varcitie's innovative solutions and objectives for Gzira, as well as to the cultural ecosystem services. At least one attribute is related to each of the three pillars of sustainability - environment, economics, and social. The following section provides further details on the selected attributes.

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4.7.2 Attributes in relation to Urban Sustainable development goals

Figure 37 The Three Pillars of Sustainable Development Goals

Sustainable urban development has 3 main pillars, Economics, Environment, and Social and Cultural Aspects.

the connection of attributed to the pillars Environment and Social are quite intertwined; For example, starting from the first Attribute, "**Pleasant Walkability**", as we plan to enlarge the pedestrian sidewalks to improve walkability (**Social Aspect**), we at the same time, improve the healthy lifestyle of walking more and reducing cars, which can help to reduce noise and improve air quality. Therefore, they can have **multi-benefits** to environment and social aspects at the same time. Also this attribute, as well, focuses on the co-creating with citizens to green their balcony, which we mention it as micro-greening. This act again has multi-benefits to human health and well-being, as well as the environment, since it's proven that the improving in greenery can reduce noise and improve air quality, which as a result improve the health and well being and is good for the environment. Also it improves aesthetics of the city, which is an intrinsic service of the nature, which provides a number of mental health benefits.

The second attribute, the **cycling facilities**, is very similar to the first attribute, in the sense that the benefits coming from this service is quite intertwined as well, since it can encourage the healthy and sustainable lifestyle, by facilitating biking in the city as the sustainable mode of mobility. Which in result is good for human health and well-being and also the environment. Also the Visionary solution of green Bike Stations are relevant to the aesthetics and reduction in air and noise pollution, and again, improving health and well-being.

The similar aspect is happening in the third attribute, which is the **recreational value**. Community gardens **provide multiple social and environmental benefits**, and the ones in the school with playscapes are great place for children to feel connected to nature, to have social connection, and to learn, and it's good for their mental health.

The fourth Attribute, which is titled as "**the cultural and artistic activities**", has a focus on social aspect of the sustainability, and the benefits that people get from being present in the urban green space and doing social activities, such as music events, and the act of co-creating with and in nature. In the literature, it's been mentioned that placemaking can improve mainstreaming the nature-based solutions, and this attribute is more relevant to that.

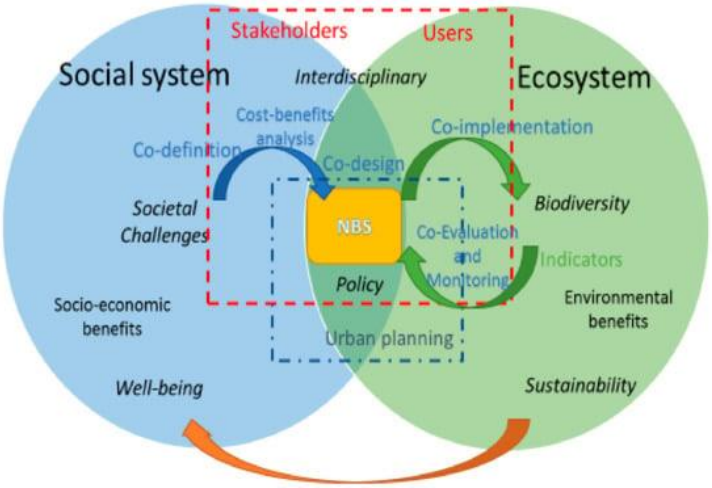

Figure 38 Interconnection of Socia System and Ecosystem

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The Fifth attribute, titled "**Educational Trainings**" is interdisciplinary between environmental and social aspects, since it involves the co-creation with citizen participation in the air and noise measurement citizen science project, as well as educational trainings, for mainstreaming the sustainability knowledge among children and citizens in the community garden.

The final attribute, which is **one-time payment**, is directly related to the Economic aspects of the sustainability, since it aims to measure the Willingness to pay, to added characteristics to the urban green spaces via innovative NBS. This, with the help of right design of the survey, and right analysis, can help in inclusion of value of nature in the economy and decision makings more often.

4.7.3 Attributes in relation to the VARCITIES' Visionary Solutions and objectives, and cultural Ecosystem Services

Starting from the **pleasant walkability**, which is the first attribute, it's directly related to these objectives of the Varcities project in pilot city Gzira: Improving General Health and Wellbeing of the residents, Improving walkability, Facilitate cultural shift towards green transport, and indirectly related to the objectives: Reducing air pollution, Reducing Noise Pollution.

The **cycling facilities**, which is the second attribute in the choice sets, is directly related to the goals: Improve general health and well-being of the residents, Facilitate cultural shifts towards green transport, boost sports and healthy lifestyle of citizens, and indirectly related to the goals : Reducing air pollution, Reducing noise pollution, environmental sustainability awareness, and reducing car use.

The third attribute, which is the **recreational value**, is related to the goals: Reducing air pollution, reducing noise pollution, Improving general health and wellbeing of residents, and boost sports and healthy lifestyles of the citizens.

The fourth attribute, which is the "**cultural and artistic activities**", is related to the boosting civic participation, boost community building, and boost sense of belonging, and it's also related to the pop-up workshops held in Gzira by Varcities team.

The fifth attribute which is the "**Educational Trainings**", and it's related to the boosting civic participation, social responsibility, environmental and sustainability awareness, Citizen science project for measuring air and noise pollutions, and boost community building.

The last attribute, one-time payment, is to calculate WTP.

The selected attributes, are also relevant to the concept of cultural ecosystem services, since Cultural ecosystem services and benefits can include health, learning, social connections, sensory experiences, cultural and symbolic importance and identity.

The attributes, Pleasant Walkability, Cycling Facilities, and the Recreational Value provide direct health benefits by reducing air and noise pollution as well as living in more pleasant and less stressful environment. The attributes Cultural and Artistic Activities and Environmental Educations, are related to the place making and sense of belonging in citizens, as well as learning.

The final attribute one-time payement is to calculate WTP.

Attributes	Attribute Levels Options
Pleasant Walkability	1. Same As Today 2. Increase Sidewalks + Micro-Greening 3. Increase Sidewalks + Extensive Greening
Cycling Facilities	1. Same As Today 2. Cycling lanes with Green Bike Stations
Recreational Values	1. Same As Today 2. Community Garden with Playful Greenery
Cultural and Artistic Activities	1. Same As Today 2. Music Events 3. Music Events + Trying New Instruments
Educational Trainings	1. Same As Today 2. Environmental Education in Community Garden 3. Environmental Education in Community Garden + Citizen Science Project
Price	1. 0 Euros 2. 30 Euros 3. 60 Euros 4. 90 Euros

Table 6 Selection of Attributes and Levels

4.7.4 Assignment of Levels

As the complexity of the attribute increases, the levels of the attribute should also increase. It's important to ensure that the attribute levels are realistic and cover a range of preferences that respondents are likely to have. This range may include policy targets and should include a "do nothing" level as well as a range around the existing level to determine willingness to pay for improvement. After discussing the selection of attributes, the appropriate levels have been determined.

- **Pleasant Walkability:**

Visionary solution: Increasing the size of the sidewalks and add more greenery to the Rue D'Argens road through a citizen participation program.

The levels in the choice sets are:

1. Same As Today
2. Increase Sidewalks + Micro-Greening
3. Increase Sidewalks + Extensive Greening

Same As Today

Increase Sidewalks + Micro-Greening

Increase Sidewalks + Extensive Greening

Figure 39Attribute Pleasant Walkability and Its Levels

- **Cycling Facilities:**

Visionary solution: Encourage individuals to embrace sustainable modes of transportation and improve their daily interactions with environment by introducing additional cycling lanes and green bike stations.

The levels in the choice sets are:

1. Same As Today
2. Cycling lanes with Green Bike Stations

Same As Today

Cycling lanes with Green Bike Stations

Figure 40 Attribute Cycling Facilities and Its Levels

- **Recreational Value:**

Visionary solution: a community garden will be built at St. Clare Gzira Primary School using certain plants and trees that can endure the area's climate and attract biodiversity, as well as co-designing artistic playscapes.

The levels in the choice sets are:

1. Same As Today
2. Community Garden with Playful Greenery

Same As Today

Community Garden with Playful Greenery

Figure 41 Attribute Recreational Value and Its Levels

- **Cultural and Artistic Activities:**

Visionary solution: Pop-up park with an entertainment schedule that includes local musicians from Gzira, with the chance for anyone to try out instruments and play together!

The levels in the choice sets are:

1. Same As Today
2. Music Events
3. Music Events + Trying New Instruments

Same As Today

Music Events

Music Events + Trying New Instruments

Figure 42 Attribute Cultural and Artistic Activities and Its Levels

Educational Trainings:

Visionary solution: To develop ecological awareness in the younger generations, workshops with schoolchildren, NGOs, and artists will be organized.

The second visionary solution involves including the community in the research process in order to increase awareness of the quality of the air and noise. Data is gathered and analyzed using sensors that are installed in various locations, mainly within Gzira, in order to detect the various pollutants.

The levels in the choice sets are:

1. Same As Today
2. Environmental Education in Community Garden
3. Environmental Education in Community Garden + Citizen Science Project

Figure 43 Attribute Educational Trainings and Its Levels

4.7.5 The Payment Vehicle

The payment vehicle describes the way in which the respondent is (hypothetically) expected to pay for the good. For this research the payment vehicle is selected as **One-time payment** (per household*)

- **One-Time Payment (Per Household):**

You can select from these **monetary values** if you'd like to make a financial contribution to the improvement of the urban green spaces in Gzira through visionary nature-based solutions.

Figure 44 The Payment Vehicle

4.7.6 Best-Worst Ranking

- **Best Option:**

Which alternative do you believe is the **best** given the characteristics listed in Options A, B, and C for each choice set?

- **Worst Option:**

Which alternative do you believe is the **worst** given the characteristics listed in Options A, B, and C for each choice set?

Figure 45 The Best-Worst Ranking

4.7.7 Attitudinal Questions

The next stage seeks the respondent's attitudes to general issues concerning the good or service and then to the good or service in question. Here we chose 3 relevant variables: **Attitude Towards The Environment, Attitude Towards The Citizen Health and Well-Being , Attitude Towards The Citizen Co-Creation .** 14 Questions, in general has been selected , and the respondants should chose from scale 1 to 5, how much they agree or disagree to the statement above.

Each variable (construct) should be measured by several rating statements. Because only a reasonable number of statements should be given to each survey respondent, about 3-6 statements per construct is appropriate.

In the section **Attitude towards the Environment**, there are 5 questions. The aim of the questions is to asses the sustainability knowledge of the citizen, and the willingness to participate in workshops, and activities that aim in increasing their environmental awareness.

In the section **Attitude towards the citizen health and wellbeing**, there are 4 questions with the aim is to measure how much the respondent values the health and well being benefits they receive from the urban green space, and this section can be relevant to the question about Habitual Patterns of the citizen and their frequency of use of green spaces for recreational aims.

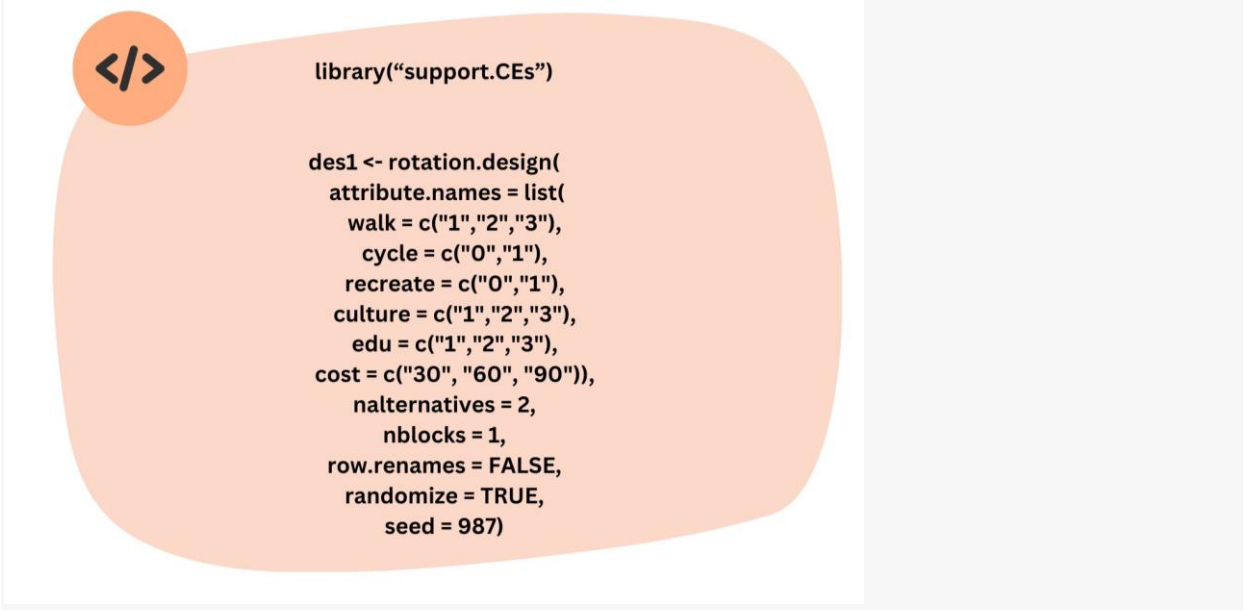
In the last section, which **is Attitude towards the citizen co-creation**, there are 5 questions, related to how much the citizen values participating in the social and cultural activities in the urban green spaces. The questions are related to the workshops and interoperated from the visionary solutions applied in Gzira, such as co-greening the balcony, and co-creation. Also a number of attributes, such as music events and trying the new instruments, as well as the citizen science project, are related to this section. As well as the second question in the habitual pattern, which asks the respondent about the frequency of the use of the urban green space for the aim of social motivations.

4.7.8 Socio-Economic Characteristics

The final section of the questionnaire asks for the socio-economic characteristics of the respondents. This information is used to test whether the WTP answers conform to theoretical expectations (e.g. whether WTP varies with income). A minimum list of such characteristics is **age**, **gender**, **income** (or surrogate measure) and **education**. Other factors such as nationality and health state may also be relevant according to the issue.

4.8.1 Pilot study and experimental design

An experimental design is essentially a set of values used to organize a choice experiment survey. Different types of designs, such as full factorial designs that include all possible combinations, are used to combine attribute levels into choice alternatives. In our case, using full factorial design would require $3^4 \times 2^2 = 324$ alternatives. The second type of design is **orthogonal fractional factorial**, which is a fraction of full factorial design where attribute correlations are zero. To construct the alternatives, we chose to use an orthogonal fractional factorial design. Setting priors to zero and using Rstudio, and the "support.CEs" package are the first two steps in designing a pilot DCE.



4.8.2 Construction of Choice Sets

Experimental design is used to identify profiles which are then organized into choice sets for respondents. The presentation of profiles can be done individually, in pairs, or in groups depending on the chosen method. It is recommended to limit the number of options, which are different combinations of attributes, to 12 or fewer. To achieve this, Support.CEs coding is utilized in RStudio.

```
questionnaire(des1)
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The outcome of the process produced 36 choice cards featuring unique combinations of attributes and levels. After eliminating redundant and weakly dominant alternatives, only 10 choice cards remained, which were then randomized and included in the survey design. The questionnaire function transforms a CE design created by either rotation.design or Lma.design functions into CE questions suitable for a survey. The choice.experiment.design argument is assigned the CE design, and the resulting CE questions are returned in ascending order of the number of blocks and questions.

4.8.3 Testing The Questionnaire Design

The Eurac statistical center has made three revisions to the questionnaire, which have resulted in improvements to its effectiveness, clarity, and other factors. Additionally, the questionnaire has undergone review and revision by the Varcities focus group in their weekly meetings, as well as by the supervisor.

The questionnaire was tested with a focus group of eight participants who provided feedback, which was used to make further improvements. Several errors were identified, including issues related to the use of Google Forms as the publishing platform and suggestions for improving the quality and presentation of the visual aids such as images and graphs.

4.8.4 Measurement of Preferences

Our next step involves designing the blocks in Google Forms, which we acknowledge has its limitations. However, we can rely on its continued availability as a free tool. We will follow the same structure as the stated preference method discussed earlier in this chapter.

To create the choice sets comprising the best and worst options, we will use multiple choice grid

questions and include an image of the choice set with each question. To prevent respondents from choosing the same option as both the best and worst, we will select the "Limit to one response per column" option.

4.8.5 Survey Distribution

The questionnaire's online link was sent via email to the participants of the pop-up workshops in Gzira, and it was also shared in the relevant Facebook group for VARCITIES activities in Gzira. Despite efforts to gather responses from actual Gzira residents using various means like LinkedIn messages and groups, only a few responses were received. Consequently, for the purpose of this thesis, the data collection proceeded as a preliminary test of the questionnaire and methodology by emailing colleagues at EURAC Research and students at the University of Bologna.

This study was designed as a validation study utilizing a non-representative sample, chosen purposefully to serve as a first step and pre-test in determining citizens' willingness to pay for innovative nature-based solutions. Given the initial nature of the research and the need to assess the effectiveness of the questionnaire and methodology, reaching out to colleagues and students of the University of Bologna via email was considered appropriate for this goal. While the sample is not fully represent the broader local community, it allows for valuable insights and feedback during this preliminary stage of investigation. The focus of this study is to evaluate the questionnaire design and methodology, and the selected sample provides an initial understanding of preferences and willingness to pay, laying the groundwork for future research involving a more representative sample from the local community.

CHAPTER V

Analyzing The Stated-Preference Data

5.1 Sample Characteristics

In this section, the descriptive statistics of the collected sample has been shown in the following tables, dedicated to the **Sociodemographic**, **Habitual Patterns** and **Attitudinal** questions.

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5.1.1 Sociodemographic

The distribution according to sociodemographic variables of the collected sample is shown in the below table.

Table 7 Sociodemographic Distribution Data

N = 64	**Absolute**	***Relative***
Gender *0 = Male* *1 = Female* *2= Other* *3 = I prefer not to answer*	Male= 38 Female = 25 I prefer not to answer = 1	*Male= 59.6%* *Female = 38.5%* *I prefer not to answer = 1.9%*
Age *20 = 18-24* *30 = 25-34* *40 = 35-44* *50 = 45-54* *60 = 55-64* *70 =65 +*	18-24 = 4 25-34 = 54 35-44 =6	*18-24 = 5.8%* *25-34 = 84.6 %* *35-44 = 9.6%*
Education *0 = Middle school diploma* *1 = High school diploma* *2 = Technical School diploma* *3 = Bachelor's degree* *4 = Master's degree* *5 = PhD and above*	BSc = 10 Msc=37 PhD and above = 17	*Bachelor's degree = 15.4%* *Master's degree = 57.7 %* *PhD and above = 26.9%*
Income *5,000 = €0 – €10,000* *15,000 = €10,001 – €20,000* *25,000 = €20,001 – €30,000* *35,000 = €30,001 – €40,000* *45,000 = €40,001 – €50,000* *55,000* = €50,001 +* *0= Prefer not to answer*	€0 – €10,000 = 21 €10,001 – €20,000 =9 €20,001 – €30,000 =12 €30,001 – €40,000 = 12 €40,001 – €50,000 =2 €50,001 + = 1 Prefer not to answer = 7	*€0 – €10,000 = 32.7%* *€10,001 – €20,000 =13.5%* *€20,001 – €30,000 =19.2%* *€30,001 – €40,000 = 19.2%* *€40,001 – €50,000 =3.8%* *€50,001 + = 1.9%* *Prefer not to answer = 9.6%*

The data reveals a higher participation rate from males in the survey. The largest portion of respondents falls within the 25-34 age range, followed by the 35-44 age group in second place, and the 18-24 age group in third place. A considerable number of respondents are relatively young and possess a high level of education, as observed from their age and educational attainment. All respondents either currently attend or have completed postsecondary education, with 15.4% holding bachelor's degrees, 57.7% holding master's degrees, and 26.9% holding doctorates or higher degrees. The distribution of income is positively skewed, with nearly 32.7% of individuals falling into the lowest income bracket, earning an annual income of less than 10,000 euros.

5.1.2 Habitual Patterns

The distribution for the questions related to the Habitual Patterns of the collected sample is shown in the below table.

Table 8 Habitual Patterns Distribution Data

N=64	**Absolute**	***Relative***
SocFreq	Everyday = 5 At least 5 times a week = 7 At least 3 times a week = 17 At least once a week = 27 Occasionally = 8	*Everyday = 7.7%* *At least 5 times a week = 11.5%* *At least 3 times a week = 26.9%* *At least once a week = 42.3%* *Occasionally = 11.5%*
RecFreq	Everyday = 7 At least 5 times a week = 6 At least 3 times a week = 18 At least once a week = 26 Occasionally = 7	*Everyday = 11.5%* *At least 5 times a week = 9.6%* *At least 3 times a week = 28.8%* *At least once a week = 40.4%* *Occasionally = 9.6%*

According to the data, the majority of the respondents are visiting the urban green spaces, at least once a week for both social, and recreational activities. The frequency of visiting the green space for both aims are relatively comparable and similar.

5.1.3 Attitudinal Questions

The distribution for the questions related to the Attitudinal questions of the collected sample is shown in the below table. We take the average of the answers for statement 1 to 5, which are related to the attitude towards the environment, statement 6 to 9 which are related to the attitude towards the citizen health and well-being, and the statements 10 to 14, which are related to the attitude towards the citizen co-creation.

Table 9 Attitudinal Distribution Data

N= 64	**Absolute**	***Relative***
AttitudeEnv *Concern about Environment*	Real number ranging from 1 (Strongly Agree) to5 (Strongly Disagree) 1= 23 2= 24 3= 11 4= 5 5= 1	*1= 37.32%* *2= 37.68%* *3=17.32%* *4=7.3%* *5=0.35%*
AttitudeHWB *Concern about Health and Wellbeing*	1= 32 2= 20 3= 6 4= 5 5= 1	*1= 49.975%* *2= 31.75%* *3= 10.075%* *4= 7.2%* *5= 0.95%*
AttitudeCo Concern about co-creation	1= 15 2= 27 3= 16 4= 5 5= 1	*1= 23.08%* *2= 42.32%* *3= 25.75%* *4= 6.94%* *5= 1.91%*

The results indicate that the majority of the respondent had great concern towards their health and well-being as a citizen. They also show a relatively high concern towards the environment and high enthusiasm towards citizen co-creation activities. The results can be biased since the majority of respondents are generally highly educated and young. This might not be the case if the sampling consisted all the groups of the society as residents.

5.2.1 Coding of Choices

Each choice set requires the respondents to answer two sub-questions:

(a) The best option relative to it's cost.

(b) The worst option relative to it's cost

Therefore, each set can be seen as a 6-alternative set which includes:

- Alternative #1: Choosing option A as the best and Option B as the worst.
- Alternative #2: Choosing option A as the best and Option C as the worst.
- Alternative #3: Choosing option B as the best and Option A as the worst.
- Alternative #4: Choosing option B as the best and Option C as the worst.
- Alternative #5: Choosing option C as the best and Option A as the worst.
- Alternative #6: Choosing option C as the best and Option B as the worst.

Answer to *(Best)*	Answer to (Worst)	***Coding***
A	B	*1*
A	C	*2*
B	A	*3*
B	C	*4*
C	A	*5*
C	B	*6*

Based on respondents' answers to the two sub-questions, their choices will be coded as follows for themodel estimation.

5.2.2 Coding of Background Variables

The coding of all of background variables are presented in the below table. For continuous

backgroundvariables that are divided into sub-categories, the midpoint of each category is used as the code, which allows interpretation of the estimated parameters in the variables' original units.

Table 10 Coding of Background Variables

Background variables name	**Description**	***Coding***
SocFreq	How often goes to park for social reasons	*Real number ranging from 1 (Everyday) to5 (Occasionally)*
RecFreq	How often goes to park for recreational reason	*Real number ranging from 1 (Everyday) to5 (Occasionally)*
AttitudeEnv	Concern about Environment	*Real number ranging from 1 (Strongly Agree) to5 (Strongly Disagree)*
AttitudeHWB	Concern about Health and Wellbeing	*Real number ranging from 1 (Strongly Agree) to5 (Strongly Disagree)*
AttitudeCo	Concern about co-creation	*Real number ranging from 1 (Strongly Agree) to5 (Strongly Disagree)*
Gender	Female / Male / Other	*0 = Male* *1 = Female* *2= Other* *3 = I prefer not to answer*
Age	Age on March 2023	*20 = 18-24* *30 = 25-34* *40 = 35-44* *50 = 45-54* *60 = 55-64* *70 =65 +*
Education	Highest level of education	*0 = Middle school diploma* *1 = High school diploma* *2 = Technical School diploma* *3 = Bachelor's degree* *4 = Master's degree* *5 = PhD and above*
Income	**Net annual income**	***5,000 = €0 – €10,000*** ***15,000 = €10,001 – €20,000*** ***25,000 = €20,001 – €30,000*** ***35,000 = €30,001 – €40,000*** ***45,000 = €40,001 – €50,000*** ***55,000* = €50,001 +***

5.2.3 CODING OF ATTRIBUTES AND LEVELS:

Table 11 Coding of Attributes and Levels

Attribute	No. of Levels	Levels	Coding
Pleasant Walkability	3	Same As Today Increase Sidewalks + Micro-Greening Increase Sidewalks + Extensive Greening	1 2 3
Cycling	2	Same As Today Cycling lanes with Green Bike Stations	0 1
Recreational Value	2	Same As Today Community Garden with Playful Greenery	0 1
Cultural and Artistic Activities	3	Same As Today Music Events Music Events + Trying New Instruments	1 2 3
Educational Trainings	3	Same As Today Environmental Education in Community Garden Environmental Education in Community Garden + Citizen Science Project	1 2 3
Annual Additional Cost	3	30 € 60 € 90 €	30 60 90

5.3.1 Summarising the data

The organization of data is an extremely important task, especially in CM contexts where data do not take on continuous form. Each record must contain details of the levels of attributes of each of the options presented to a respondent as well as a dependent variable that indicates which of the options was selected. The particular form of the data will depend on the econometric package being used to estimate the model.

For the work done on this thesis, since we used the **rotation.design** function from **support.CEs** package in R, we generated 36 choice cards as a result. Then after analyzing for the ones who are appropriate for choice cards in the rem that they are not so similar and actually offer an alternative, and choosing 10 choice cards (No: 2, 4, 11, 15, 19, 24, 25, 31, 34, 36), we later randomized them, and in the end the choice cards where appeared as: (No 15 as 1st, No 34 as 2nd, No 36 as 3rd, No 24 as 4th, No 25 as 5th, No 2 as 6th , No 11 as 7th, No 4 as 8th, No 31 as 9th, No 19 as 10th.)

So, for the changes we did to the design matrix, we need to carefully reorder the design matrix, with the relevant rows of the choice set, as the one in the survey.

After doing that, we uploaded the renewed design matrix to our R workspace, using readx1

package in R. The edited design matrix was named: designmatrix1.

```
install.packages("readx1")
library(readxl)
filepath <- "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/design matrix.xlsx"
> designmatrix1 <- read_excel(filepath)
```

Table 12 Design Matrix

	BLOCK	QES	ALT	ASC	X2	X3	X1	X1.1	X2.1	X3.1	X2.2	X3.2	cost
1	1	1	1	1	1	0	0	0	0	0	0	1	90
2	1	1	2	1	0	1	0	1	0	0	1	0	90
3	1	1	3	0	0	0	0	0	0	0	0	0	0
4	1	2	1	1	0	1	0	1	1	0	0	0	90
5	1	2	2	1	1	0	1	1	1	0	1	0	60
6	1	2	3	0	0	0	0	0	0	0	0	0	0

In the context of the support.ces package and the choice card with the specified attributes, the columns in the design matrix have the following meanings:

Table 13 Symbols and Descriptions of Design matrix

Symbol	Description
BLOCK	Represents the block of choice sets presented to respondents.
QES	Represents the respondent identifier or participant number.
ALT	Represents the alternative number within each choice set.
ASC	Represents the alternative-specific constant term in the choice model.
cost	Represents the cost or price attribute in the choice model.

Attribute	Code	Description
X2 = Increase Sidewalks + Microgreening	0	Attribute "Pleasant Walkability": No increase in sidewalks.
	1	Attribute "Pleasant Walkability": Increase sidewalks + micro greening
X3 = Increase Sidewalks + Extensive Greening	0	Attribute "Pleasant Walkability": No increase in sidewalks.
	1	Attribute "Pleasant Walkability": Increase sidewalks + extensive greening.
X1 = Cycling Lanes with Green Bike Stations	0	Attribute "Cycling Facilities": No cycling lanes with green bike stations.
	1	Attribute "Cycling Facilities": Cycling lanes with green bike stations.
X1.1 = Community Garden with Playful Greenary	0	Attribute "Recreational Value": No community garden with playful greenery.
	1	Attribute "Recreational Value": Community garden with playful greenery.
X2.1 = Music Events	0	Attribute "Cultural and Artistic Activities": No music events.
	1	Attribute "Cultural and Artistic Activities": Music events.
X3.1 = Music Events + Trying New Instruments	0	Attribute "Cultural and Artistic Activities": No music events + trying new instruments.
	1	Attribute "Cultural and Artistic Activities": Music events + trying new instruments.
X2.2 = Environmental Education in Community Garden	0	Attribute "Educational Trainings": No environmental education in the community garden.
	1	Attribute "Educational Trainings": Environmental education in the community garden.
X3.2 = Environmental Education in Community Garden + Citizen Science Project	0	Attribute "Educational Trainings": No environmental education in the community garden.
	1	Attribute "Educational Trainings": Environmental education in the community garden + citizen science project.

5.3.2 Reshaping the data

We need to resize the data from the Google Forms survey. When we download the survey data from Google Forms, the data is shaped in 'wide' format (Table 4), and we need to resize it to 'long' format (Table 5) for the logit model to understand it.

Wide-shaped dataset

	1	2	3	4	5
1	A	B	A	C	B
2	B	C	A	B	B
3	C	C	A	A	C
4	A	A	C	B	A
...	...	...	...	...	...
N	A	B	B	C	C

Long-shaped data set

Person ID	Choice Set	Choice Dummy	Alternative	...	price
1	1	1	1	...	150
1	1	0	2	...	100
1	1	0	3	...	200
1	2	0	1	...	200
1	2	1	2	...	100
...	...	...	...	...	...
50	800	0	3	...	100

Figure 46 Wide Shaped and Long Shaped Data Sets

After downloading the dataset of responses from Google Forms, we need to reshape it.

In order to simplify the analysis, we divided the responses of the "best" option, and the "worst" options, in separate excel files. The excel file relevant to the responses for the "best" options had been stored in excel file called "Responsesb", and the ones relevant to the responses of the "worst" option had been stored in the excel file called "Responsesw".

Continuing with the process of making the write dataset for the "best" answers, we start with the excel file Responsesb , which looks like the table below, in which the ID is the Respondent, Block in our case was 1, and q1b to q10b, which are answers of the respindants to the choice sets 1 to 10, as only considering their answers for the "best".

Table 14 Response Matrix for Answers Related to The "Best" Option

	ID	BLOCK	q1b	q2b	q3b	q4b	q5b	q6b	q7b	q8b	q9b	q10b
1	1	1	A	B	B	A	A	B	A	A	A	B
2	2	1	B	B	A	A	A	B	B	B	B	B
3	3	1	B	B	A	A	B	B	A	B	A	A
4	4	1	B	B	B	A	B	B	A	A	A	A
5	5	1	B	B	A	A	B	A	B	A	A	A
6	6	1	A	B	A	A	B	A		B	B	B
7	7	1	B	A	A	A	B	B	B	B	A	B
8	8	1	A	A	A	A	A	A	A	A	A	A
9	9	1	B	B	A	B	A	A	B	A	A	C
10	10	1	A	A	B	C	B	A	A	B	C	A

After creating the responses matrix for the answers for the "best" option, we need to upload it to our R workspace. To do that we used readx1 package in R.

```
library(readxl)
filepath2 <- "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/Responsesb.xlsx"
Responsesb <- read_excel(filepath2)
```

The same process goes for the "worst" answers, which are being edited accordingly, and stored in R by using the following code, as Responsesw:

```
library(readxl)
filepath3 <- "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/Responsesw.xlsx"

Responsesw <- read_excel(filepath3)
```

5.3.3 Making a dataset

We follow by making the write dataset with the format supported by the conditional logit model analysis of support.Ces package in R.

In order to create this dataset, we write these codes:

```
library(support.CEs)
dataset2 <- make.dataset(
 respondent.dataset = Responsesb,
 choice.indicators = c("q1b", "q2b", "q3b", "q4b", "q5b", "q6b", "q7b", "q8b", "q9b", "q10b"),
 design.matrix = designmatrix1
```

So, the dataset2, is the name of the dataset created for the “best” answers.

The dataset follows a form like below:

...1.x	ID	BLOCK	QES	ALT	RES	...1.y	ASC	X2	X3	X1	X1.1	X2.1	X3.1	X2.2	X3.2	cost	STR
1	1	1	1	1	TRUE	1	1	1	0	0	0	0	0	0	1	90	101
1	1	1	1	2	FALSE	2	1	0	1	0	1	0	0	1	0	90	101
1	1	1	1	3	FALSE	3	0	0	0	0	0	0	0	0	0	0	101
1	1	1	2	1	FALSE	4	1	0	1	0	1	1	0	0	0	90	102
1	1	1	2	2	TRUE	5	1	1	0	1	1	1	0	1	0	60	102
1	1	1	2	3	FALSE	6	0	0	0	0	0	0	0	0	0	0	102
1	1	1	3	1	FALSE	7	1	1	0	1	1	1	0	1	0	30	103
1	1	1	3	2	TRUE	8	1	0	1	1	0	1	0	0	0	30	103
1	1	1	3	3	FALSE	9	0	0	0	0	0	0	0	0	0	0	103
1	1	1	4	1	TRUE	10	1	1	1	1	1	1	0	0	0	[illegible]	104
1	1	1	4	2	FALSE	11	1	1	[illegible]							30	104
1	1	1	4	3	FALSE	12	0	0	0	0	0	0	0	0	0	0	104
...																	
64	64	1	10	1	FALSE	28	1	0	0	1	1	0	0	0	0	30	6410
64	64	1	10	2	TRUE	29	1	0	1	0	0	0	1	0	1	60	6410
64	64	1	10	3	FALSE	30	0	0	0	0	0	0	0	0	0	0	6410

Figure 47 Dataset for Answers Related to The "Best" Option

The same process goes for creating the dataset of answers for the “worst” option, which is compatible with clogit function of support.Ces package, therefore, in order to create that we follow with these codes, and we call it dataset3:

```
dataset3 <- make.dataset(
 respondent.dataset = Responsesw,
 choice.indicators = c("q1w", "q2w", "q3w", "q4w", "q5w", "q6w", "q7w", "q8w", "q9w", "q10w"),
 design.matrix = designmatrix1
)
```

Since I changed the initial design matrix of the one automatically made by the support.Ces package according to what had been said before in this chapter, I also manually entered the data for the RES, such that the responses for the best, and worst answers where in the dataset. In order to do that, I first downloaded the created dataset2, and dataset3, from my R space to my computer, manually added the Responses of answers for “best” in file dataset2, and answers for “worst”, in dataset3, and uploaded the new file back to the R space. The files had been edited such that if the respondent in choice set1, chose forexample the alternative B as the best option, the RES column

in the alternative 2 is TRUE, and the alternative 1 and 3 are FALSE. The same goes for the answers edited in the dataset3 file.

In order to download the datasets from the R workplace, I used openxlsx package in R.

```
library(openxlsx)
write.xlsx(dataset2, file = "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/datasetbest.xlsx", rowNames = FALSE)
 write.xlsx(dataset3, file = "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/datasetworst.xlsx", rowNames = FALSE)
```

And then upload the edited dataset with assigned RES column, back to the R space using the following code, and we call the new dataset as datasetbest. The same process is happening for the datasetworst.

```
library(readxl)
filepathbest <- "C:/Users/mirza/OneDrive/Documents/ERE/Thesis/THESISS/Chapter 5 - Results and Discussions/datasetbest.xlsx"
datasetbest <- read_excel(filepathbest)
```

5.4 Choosing Econometric Model

5.4.1 Random Utility Theory

In order to analyze the data from our Choice Experiment (CE) and obtain reliable estimates of mean and median Willingness to Pay (WTP) along with confidence intervals, we need an appropriate econometric model that captures the discrete choice behavior of individuals. Random Utility Theory (RUT) provides a framework that aligns with the economic assumption that rational individuals select the option that offers the highest expected utility from a set of alternatives.

According to RUT, the utility an individual derives from choosing alternative j, denoted as Unj, consists of two components: a deterministic component, Vnj, and an unobserved random component, εnj. The decision-making process involves comparing the total utilities of different alternatives, and since the random component is not observable, we can only make probabilistic statements about the choices made.

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

where Unj: total utility of alternative j

Vnj: systematic utility of alternative j

εnj: error term of alternative j

We assume that an individual will choose alternative j if:

$U_{nj} > U_{ni}$ for all $i \neq j$

Since part of U is unobservable, we can only make probabilistic statements:

$$P_{nj} = \text{Prob}(V_{nj} + \varepsilon_{nj} > V_{ni} + \varepsilon_{ni} \text{ for all } i \neq j)$$

$$= \text{Prob}(V_{nj} - V_{ni} > \varepsilon_{ni} - \varepsilon_{nj} \text{ for all } i \neq j)$$

The deterministic component of utility, Vnj, can be specified using the observed attributes of the alternatives, Xmj, and their associated weights, βm.

We can specify this relationship as $U_{nj} = \beta_{mj}.X_{mj} + \varepsilon_{nj}$, (4)

β_m: parameter (weight) of attribute m

x_{jm}: attribute level of attribute m in alternative j

In our case, we assume that the tastes of respondents are homogeneous, meaning that the utility varies across individuals but remains consistent across alternatives. To estimate the weights (βm), we will employ the conditional logit model (CLM), which is a widely used approach in econometric analysis.

$$V_j = \text{ASC} + \beta Cost \bullet Cost_j + \beta Walk \bullet Walk_j + \beta Cycle \bullet Cycle_j + \beta Recreate \bullet Recreate_j + \beta Culture \bullet Culture_j + \beta Edu \bullet Edu_j$$

Where:

Coefficient	Meaning
βCost	Effect of "Cost" on the dependent variable.
βWalk	Effect of "Walk" on the dependent variable.
βCycle	Effect of "Cycle" on the dependent variable.
βRecreate	Effect of "Recreate" on the dependent variable.
βCulture	Effect of "Culture" on the dependent variable.
βEdu	Effect of "Edu" on the dependent variable.
Coefficient	Meaning
βCost	Effect of "Cost" on the dependent variable.

Table 15 Coefficents of the conditional logit model and their meanings

5.4.2 Calculating Maximum Likelihood, using support.Ces package in R.

5.4.2.1 Maximum Likelihood Procedure related to the “best” option

Probabilistic models like multinomial logit models can be estimated using maximum likelihood procedures. These estimation methods are widely available in econometric software packages.

Regardless of the chosen Random Utility Model, econometric analysis is used to estimate mean and median Willingness to Pay (WTP information, along with confidence intervals. Data from a Choice Modelling survey allows for the estimation of the indirect utility function, which is a simplified approximation of the actual utility function. Welfare measurement involves two steps: first, assessing how respondents' utility would change if the attributes of a non-marketed good were altered from their current level (status quo) to different levels being reviewed. Second, expressing this utility change in monetary terms.

It's important to note that by varying the attribute levels, welfare benefits for various alternatives can be estimated. This is a strength of the Choice Modeling (CM) approach compared to the CV method.

The goal of maximum likelihood estimation is to find the values of the individual-specific parameters that maximize the likelihood of observing the observed choices. This involves iteratively searching for the optimal parameter values that maximize the likelihood function using numerical optimization algorithms. By maximizing the likelihood function, the conditional logit model provides estimates of the individual-specific parameters, allowing researchers to understand the relative importance of the different variables in determining the choice probabilities.

In order to use the conditional logit model according to the model above using support.Ces package in R, we write this code:

```
library(support.ce)
model <- clogit(RES ~ ASC + X2 + X3 + X1 + X1.1 + X2.1 + X3.1 + X2.2 + X3.2 + cost + strata(STR), data = datasetbest)
```

The variables are the levels of the attributes, which have been introduced earlier in the chapter.

If we proceed by the analysis, we get:

Table 16 Results From The clogit Model Fr The "Best" Option Using The Support.CEs Package in R

```
model
Call:
clogit(RES ~ ASC + X2 + X3 + X1 + X1.1 + X2.1 + X3.1 + X2.2 +
   X3.2 + cost + strata(STR), data = datasetbest)

       coef exp(coef)  se(coef)     z      p
ASC   1.025789  2.789294  0.420271  2.441 0.01466
X2    0.457162  1.579584  0.210425  2.173 0.02981
X3    0.602086  1.825924  0.241116  2.497 0.01252
X1    0.360463  1.433993  0.321640  1.121 0.26241
X1.1  0.678267  1.970459  0.326422  2.078 0.03772
X2.1  0.264544  1.302837  0.386111  0.685 0.49325
X3.1  0.318838  1.375528  0.180003  1.771 0.07651
X2.2  0.580539  1.787001  0.213775  2.716 0.00661
X3.2  0.243297  1.275448  0.380479  0.639 0.52253
cost -0.001278  0.998723  0.007022 -0.182 0.85558
Likelihood ratio test=448.2  on 10 df, p=< 2.2e-16
n= 1920, number of events= 639
```

Based on the provided data, we can assess the significance of the variables as follows:

Variables	Coefficient	p-value	Significamce
Increase Sidewalks + Microgreening	0.457162	0.02981	Significant
Increase Sidewalks + Extensive Greening	0.602086	0.01252	Significant
Cycling Lanes with Green Bike Stations	0.360463	0.26241	Not Significant
Community Garden with Playful Greenary	0.678267	0.03772	Significant
Music Events	0.264544	0.49325	Not Significant
Music Events + Trying New Instruments	0.318838	0.07651	Not Significant
Environmental Education in Community Garden	0.580539	0.00661	Significant
Environmental Education in Community Garden + Citizen Science Project	0.243297	0.52253	Not Significant

Table 17 Significance of the variables

5.4.2.2. McFadden's R2

The gofm function provides both ρ^2 and its adjusted version, ρ¯^2. Additionally, it displays the number of estimated coefficients and log-likelihood values, which are automatically computed in the clogit function. Therefore we have:

Table 18 Results of The McFadden's R2 for The "Best" Options Using The Support.CEs Package in R

gofm(model)

Rho-squared = 0.31925
Adjusted rho-squared = 0.3050052
Akaike information criterion (AIC) = 975.7911
Bayesian information criterion (BIC) = 1020.39
Number of coefficients = 10
Log likelihood at start = -702.0133
Log likelihood at convergence = -477.8955

According to the results of the goodness of the fit, we can make the following comments about the goodness of fit of the model:

Table 19 R2 Value and Interpretation

Measure	Value	Interpretation
Rho-squared	0.31925	Model explains about 32% of the variation in the dependent variable. Moderate fit.
Akaike Information Criterion (AIC)	975.7911	Lower value is better. The model fits reasonably well.
Number of coefficients	10	The number of variables in the model.

We can say that, the model demonstrates a **moderate** level of goodness of fit, as indicated by the Rho-squared value.

5.4.2.3 Calculating MWTPs for the answers related to the "best" option

Willingness to Pay (WTP) is defined as the ratio of the partial derivative of systematic utility with respect to the studied attribute and to price. Because the parameter of price is negative, a minus sign in front of the formula is required, giving positive values of willingness to pay.
Consumers prefer higher rating (positive rating parameter) and lower price (negative price parameter). To keep the utility constant, an increase in price (negative utility contribution) is required to compensate for an increase in ratings (positive utility contribution).
MWTP = (ΔU / ΔP)
Where:
MWTP: Marginal Willingness to Pay
ΔU: Change in utility or satisfaction derived from the good or service
ΔP: Change in price or cost of the good or service

In order to calculate MWTP from the CL model estimates, the function mwtp is used.

```
mwtp_best <- mwtp(output = model, monetary.variables = c("cost"), nonmonetary.variables = c("X2", "X3", "X1", "X1.1", "X2.1", "X3.1", "X2.2", "X3.2"), confidence.level = 0.95, seed = 987)
mwtp_best
```

Table 20 MWTP Results for The "Best" Options Using The Support.CEs Package in R

	MWTP	2.5%	97.5%
X2	357.7	-973.7	1016.5
X3	471.1	-1188.2	1323.0
X1	282.0	-874.2	908.6
X1.1	530.7	-1320.6	1426.7
X2.1	207.0	-635.0	761.3
X3.1	249.5	-588.9	694.1
X2.2	454.2	-1303.8	1353.1
X3.2	190.4	-729.2	752.2

method = Krinsky and Robb

Table 21 MWTP of attributes

Option	MWTP	Explanation
Increase Sidewalks + Microgreening	357.7	People are willing to pay 357.7 euros for "Increase sidewalks + microgreening" in pleasant walkability.
Increase Sidewalks + Extensive Greening	471.1	People are willing to pay 471.1 euros for "Increase sidewalks + extensive greening" in pleasant walkability.
Cycling Lanes with Green Bike Stations	282.0	People are willing to pay 282.0 euros for "Cycling lanes with green bike stations" in cycling facilities.
Community Garden with Playful Greenary	530.7	People are willing to pay 530.7 euros for "Community garden with playful greenery" in recreational value.
Music Events	207.0	People are willing to pay 207.0 euros for "Music events" in cultural and artistic activities.
Music Events + Trying New Instruments	249.5	People are willing to pay 249.5 euros for "Music events + trying new instruments" in cultural and artistic activities.
Environmental Education in Community Garden	454.2	People are willing to pay 454.2 euros for "Environmental education in the community garden" in educational trainings.
Environmental Education in Community Garden + Citizen Science Project	190.4	People are willing to pay 190.4 Euros for "Environmental education in the community garden + citizen science project" in educational trainings.

To estimate the Mean Willingness to Pay (MWTP), we can interpret the exponentiated coefficient as the multiplicative factor by which the odds of the outcome variable increase. For example, for the variable X2, a one-unit increase is associated with 1235.8718 times higher odds.
In the context of the study, the MWTP for X2 can be interpreted as follows: On average, a one-unit increase in X2 is associated with a MWTP of 1235.8718. This implies that individuals, on average, are willing to pay an amount equivalent to the estimated MWTP for a one-unit increase in X2.

5.4.2.4 Results of Conditional Logit Model For The Best Options Using The DCEtool Pacakage

In order to be sure of the results above, we decided to try one more time the analysis with an interactive tool and package in R, called DCEtool. DCEtool is a R package to design, respond and analyze DCEs. DCEtool has been coded in R using the visual interface provided by the shiny package. DCEtool is available in the CRAN repository and can be easily installed typing the following code in R or RStudio. Before running it, shiny must be installed and activated:

```
install.packages('shiny')
library('shiny')
install.packages('DCEtool')
library(DCEtool)
DCEtool()
```

After this code, the interface is appearing, and since we only want to do the analysis part, we directly go to the "Results" part, and upload our edited Dataset for the Best answers. After choosing the dependent, independent, and group variables, we have the results for the conditional logit as:

```
all:
coxph(formula = Surv(rep(1, 1920L), RES) ~ ASC + X2 + X3 + X1 +
  X1.1 + X2.1 + X3.1 + X2.2 + X3.2 + cost + strata(STR), data = as.data.frame(cdesmat),
  method = "exact")

 n= 1920, number of events= 639
```

Table 22 Results of Conditional Logit Model For The Best Options Using The DCEtool Pacakage

```
       coef exp(coef)  se(coef)     z Pr(>|z|)
ASC   1.025789  2.789294  0.420271  2.441  0.01466 *
X2    0.457162  1.579584  0.210425  2.173  0.02981 *
X3    0.602086  1.825924  0.241116  2.497  0.01252 *
X1    0.360463  1.433993  0.321640  1.121  0.26241
X1.1  0.678267  1.970459  0.326422  2.078  0.03772 *
X2.1  0.264544  1.302837  0.386111  0.685  0.49325
X3.1  0.318838  1.375528  0.180003  1.771  0.07651 .
X2.2  0.580539  1.787001  0.213775  2.716  0.00661 **
X3.2  0.243297  1.275448  0.380479  0.639  0.52253
cost -0.001278  0.998723  0.007022 -0.182  0.85558
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


    exp(coef) exp(-coef) lower .95 upper .95
ASC    2.7893    0.3585   1.2239    6.357
X2     1.5796    0.6331   1.0458    2.386
X3     1.8259    0.5477   1.1383    2.929
X1     1.4340    0.6974   0.7634    2.694
X1.1   1.9705    0.5075   1.0392    3.736
X2.1   1.3028    0.7676   0.6113    2.777
X3.1   1.3755    0.7270   0.9666    1.957
X2.2   1.7870    0.5596   1.1753    2.717
X3.2   1.2754    0.7840   0.6051    2.689
```

cost 0.9987 1.0013 0.9851 1.013

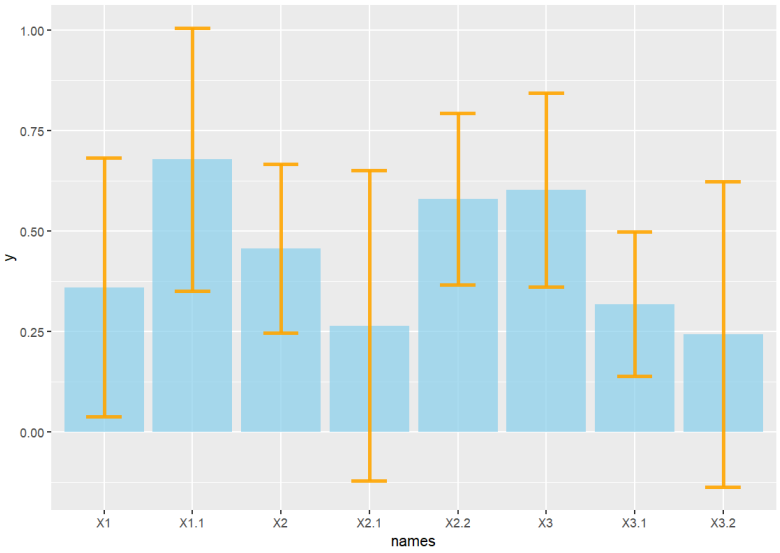
Concordance= 0.808 (se = 0.016)
Likelihood ratio test= 448.2 on 10 df, p=<2e-16
Wald test = 258.5 on 10 df, p=<2e-16
Score (logrank) test = 392 on 10 df, p=<2e-16

So the answers where the same as the ones for the ones coded using support.Ces package. Therefore our model and coding were correct.

5.4.2.5 Barplot for the answers related to the "best" option

DCEtool is also able to plot the figure of MWTP in regards to different variables, for the answers related to the "best" option, we have:

Figure 48 Barplot for the answers related to the "best" option



X2= Increase Sidewalks + Microgreening
X3= Increase Sidewalks + Extensive Greening
X1= Cycling Lanes with Green Bike Stations
X1.1= Community Garden with Playful Greenary
X2.1= Music Events
X3.1= Music Events + Trying New Instruments
X2.2= Environmental Education in Community Garden
X3.2= Environmental Education in Community Garden + Citizen Science Project

5.4.3 Calculating goodness-of-fit measures, using DCEtool package in R:

5.4.3.1 Results of Conditional Logit Model For The Worst Options Using The DCEtool Pacakage

Similar to the procedure we did for the answers related to the best option, we continue with the answers for the other option which was the "worst". So again, after entering into the user interface of DCEtool, we upload our edited dataset for the worst option, which has been edited such that it is compatible for our conditional logit analysis. choosing the dependent, independent, and group variables, we have the results for the conditional logit as:

Figure 49 Maximum Likelihood Procedure related to the "worst" option Using DCEtool Package in R

Variables	Coefficient	p-value	Significamce
Increase Sidewalks + Microgreening	-0.347	0.1129	Not Significant
Increase Sidewalks + Extensive Greening	-0.389	0.0653	Not Significant
Cycling Lanes with Green Bike Stations	-0.487	0.0730	Not Significant
Community Garden with Playful Greenary	-0.654	0.0121	Significant
Music Events	0.405	0.0674	Not Significant
Music Events + Trying New Instruments	-0.127	0.5683	Not Significant
Environmental Education in Community Garden	-0.108	0.6522	Not Significant
Environmental Education in Community Garden + Citizen Science Project	-0.092	0.7721	Not Significant

5.4.3.2 Calculating MWTPs for the answers related to the "worst" option

In order to calculate MWTP using DCEtool we have:

Table 23Calculating MWTPs for the answers related to the "worst" option Using DCEtool Package in R

Option	MWTP	Explanation
Increase Sidewalks + Microgreening	-249.85	People are willing to pay €294.85 less for "Increase sidewalks + microgreening" in pleasant walkability.
Increase Sidewalks + Extensive Greening	-279.83	People are willing to pay €279.83 less for "Increase sidewalks + extensive greening" in pleasant walkability.
Cycling Lanes with Green Bike Stations	-350.56	People are willing to pay €350.56 less for "cycling lanes with green bike stations" in cycling facilities.
Community Garden with Playful Greenary	-470.52	People are willing to pay €470.52 less for "community garden with playful greenery" in recreational value.
Music Events	+291.57	People are willing to pay €291.57 more for "music events" in cultural and artistic activities.
Music Events + Trying New Instruments	-91.14	People are willing to pay €91.14 less for "music events + trying new instruments" in cultural and artistic activities.
Environmental Education in Community Garden	-77.62	People are willing to pay €77.62 less for "environmental education in the community garden" in educational trainings.
Environmental Education in Community Garden + Citizen Science Project	-65.91	People are willing to pay €65.91 less for "environmental education in the community garden + citizen science project" in educational trainings.

5.4.3.3 Barplots for the answers related to the "worst" option

DCEtool is also able to plot the figure of MWTP in regards to different variables, for the answers related to the "best" option, we have:

X2= Increase Sidewalks + Micro greening
X3= Increase Sidewalks + Extensive Greening
X1= Cycling Lanes with Green Bike Stations
X1.1= Community Garden with Playful Greenary
X2.1= Music Events
X3.1= Music Events + Trying New Instruments
X2.2= Environmental Education in Community Garden
X3.2= Environmental Education in Community Garden + Citizen Science Project

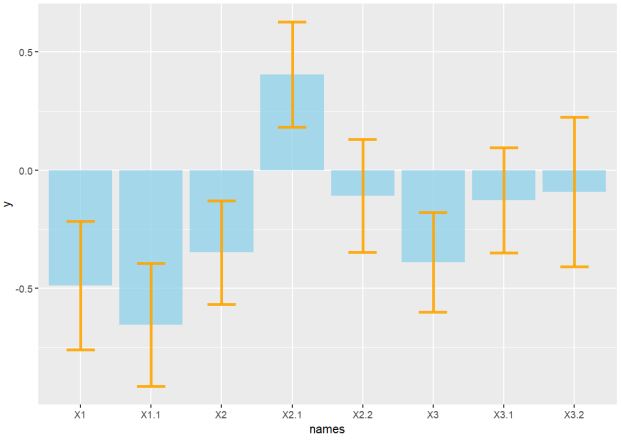


Figure 50Barplotres for the answers related to the "worst" option Using DCEtool Package in R

5.4.4 Interpretation of the data for WTP for the answers related to the "best" option

First of all, the willingness to pay from the basic level to the second level in all attributes are positive, meaning that people are willing to pay more money for the improvement in the facilities that contribute to cultural ecosystem services of the nature-based solutions in the choice set scenario.

Table 24Interpretation of the data for WTP for the answers related to the "best" option

	MWTP	Willingness to Pay (Euro Per Person)
X2= Increase Sidewalks + Micro greening	**357.7**	**6**
X3= Increase Sidewalks + Extensive Greening	**471.1**	**7**
X1= Cycling Lanes with Green Bike Stations	**282**	**4**
X1.1= Community Garden with Playful Greenery	**530.7**	**8**
X2.1= Music Events	**207**	**3**
X3.1= Music Events + Trying New Instruments	**249.5**	**4**
X2.2= Environmental Education in Community Garden	**454.2**	**7**
X3.2= Environmental Education in Community Garden + Citizen Science Project	**190.4**	**3**

5.4.4.1 Pleasant Walkability

According to the maximum likelihood analysis we previously done, both the **"Increase Sidewalks + Microgreening"** and "**Increase Sidewalks + Extensive Greening"** are significant variables in the model.

When we compare 2 rows of the table related to the attribute "Pleasant Walkability", the willingness to pay for improvement of 1→2 is much higher than the willingness to pay for improvement 2→3.

This might indicate that the respondents care about extensive sidewalks, as well as greenery, but not as much care about micro greening or extensive greening. Another reason might be that they are confused by the difference between the words "micro greening" and "extensive greenery", and could not understand the difference by the help of the pictures.

Table 25 WTP related to the Pleasant Walkability attribute and its levels

	Willingness to Pay (Euro Per Person)	Willingness to Pay (Best Option)
1 ➡ 2	6	+6
2 ➡ 3	7	+1

5.4.4.2 Cycling Facilities

According to the maximum likelihood analysis we previously done, the **"Cycling Lanes with Green Bike Stations"** is not a significant variable in the model.

In the table related to the attribute "Cycling Facilities", the willingness to pay for improvement of 1→2 is positive, indicating that generally speaking, the respondents are willing to pay for adding the cycling lanes with green bike station to the city.

Table 26 WTP related to the Cycling Facilities attribute and its levels

	Willingness to Pay (Euro Per Person)	Willingness to Pay (Euro Per Person)
0 ➡ 1	4	+4

5.4.4.3 Recreational Value

According to the maximum likelihood analysis we previously done, the **"Community Garden with Playful Greenery "** is a significant variable in the model.
In the table related to the attribute "Cycling Facilities", the willingness to pay for improvement of 1→2 is positive, indicating that, the respondents value having community garden with playful greenery.

Table 27 WTP related to the Recreational Value attribute and its levels

	Willingness to Pay (Euro Per Person)	**Willingness to Pay (Euro Per Person)**
0 ➡ 1	8	+8

5.4.4.4 Cultural and Artistic Activities

According to the maximum likelihood analysis we previously done, both the **"Music Events** and "**Music Events + Trying New Instruments"** are not significant variables in the model.
When we compare 2 rows of the table related to the attribute "Cultural and Artistic Activities", the willingness to pay for improvement of 1→2 is much higher than the willingness to pay for improvement 2→3 which is only +1 euro.
This might indicate that the respondents care about having cultural events such as music events in the urban green spaces, but generally are not willing to pay much for the added value.

Table 28 WTP related to the Cultural and Artistic Activities attribute and its levels

	Willingness to Pay (Euro Per Person)	**Willingness to Pay (Euro Per Person)**
1 ➡ 2	3	+3
2 ➡ 3	4	+1

5.4.4.5 Educational Trainings

According to the maximum likelihood analysis we previously done, the **"Environmental Education in Community Garden"** is a significant variable in the model, while the "**Environmental Education in Community Garden + Citizen Science Project"** is not.
When we compare 2 rows of the table related to the attribute "Educational Trainings", the willingness to pay for improvement of 1→2 is 7 euros, while the willingness to pay for the improvement 2→3 is negative, which is -4.
This might indicate that the respondents care about having environmental education programs in the community garden, while they are not willing to pay for the additional citizen science project. Another interpretation is that they might get confused about the meaning of the "citizen science

project", even though it has been described prior to the choice sets, or it might be because the respondents generally didn't recognized the added value and therefore not willing to pay for it.

Table 29 WTP related to the Educational Trainings attribute and its levels

	Willingness to Pay (Euro Per Person)	Willingness to Pay (Euro Per Person)
1 ➡ 2	7	+7
2 ➡ 3	3	-4

5.5. Interpretation of the data for WTP for the answers related to the "worst" option

The WTP for the worst option represents the trade-off or preference individuals have between the status quo and the other alternatives. It quantifies the value individuals place on avoiding the worst option and selecting a better alternative.

Table 30 Interpretation of the data for WTP for the answers related to the "worst" option

	MWTP	Willingness to Pay (Euro Per Person)
X2= Increase Sidewalks + Micro greening	-249.85	-4
X3= Increase Sidewalks + Extensive Greening	-279.83	-4.5
X1= Cycling Lanes with Green Bike Stations	-350.56	-5.5
X1.1= Community Garden with Playful Greenary	-470.52	-7.5
X2.1= Music Events	+291.57	+4.5
X3.1= Music Events + Trying New Instruments	-91.4	-1.5
X2.2= Environmental Education in Community Garden	-77.62	-1
X3.2= Environmental Education in Community Garden + Citizen Science Project	-65.91	-1

In the provided table, we have the Willingness to Pay (WTP) values for different attribute level changes in the context of the "Worst" option. Each row corresponds to a specific attribute, and the values represent the change in WTP when transitioning from one attribute level to another.

The negative values in both the "Willingness to Pay" and "Willingness to Pay (Worst Option)" columns indicate that individuals are not willing to pay additional money for the corresponding attribute level changes. This suggests that the attribute levels mentioned in the table do not

significantly impact the perceived value or desirability of the "Worst" option.

Additionally, there are cases where the WTP values for the "Worst" option show positive differences between attribute levels. For example, in the Cultural and Artistic Activities attribute, there is a positive difference of 4.5 Euros when transitioning from level 1 to level 2.

The positive differences indicate that certain attribute level changes contribute to a slightly higher perceived value or desirability.

Table 31 WTP for the answers related to the "worst" option for different attributes and their levels

	Willingness to Pay (Euro Per Person)	Willingness to Pay (Worst Option)
Pleasant Walkability		
1 ➡ 2	-4	-4
2 ➡ 3	-4.5	- 0.5
Cycling Facilities		
0 ➡ 1	-5.5	-5.5
Recreational Value		
0 ➡ 1	-7.5	-7.5
Cultural and Artistic Activities		
1 ➡ 2	+4.5	+ 4.5
2 ➡ 3	-1.5	-6
Educational Trainings		
1 ➡ 2	-1	-1
2 ➡ 3	-1	0

5.6 Net Value of Willingness to Pay between different alternatives and their levels

The positive difference between the WTP values indicates a clear preference for the "Best" option over the "Worst" option. It suggests that individuals are willing to pay a significant amount of money, represented by the positive difference, to select the "Best" option instead of sticking with the status quo. This positive difference signifies the added value and attractiveness of the "Best" option to individuals. For example, we see a negative net value of WTP in the attribute of "Cycling Facilities". This indicates that the respondents are not willing to pay for this attribute.

Table 32 Net Value of Willingness to Pay between different alternatives and their levels

	WTP for option "Best" (Euro Per Person)	WTP for option "Worst" (Euro Per Person)	Net value of WTP (Euro Per Person)
Pleasant Walkability			

1 2	6	-4	2
2 3	7	-4.5	2.5
Cycling Facilities			
0 1	4	-5.5	-1.5
Recreational Value			
0 1	8	-7.5	0.5
Cultural and Artistic Activities			
1 2	3	+4.5	7.5
2 3	4	-1.5	2.5
Educational Trainings			
1 2	7	-1	6
2 3	3	-1	2

The increasing pattern in the Net value column, suggests that as the attribute levels increase, the gap between the WTP for the "Best" and "Worst" options also widens. This implies that individuals generally place even greater value on the higher levels of the attributes and are more willing to pay to choose the "Best" option over the status quo.

5.7 Results and Recommendations:

The results of our WTP analysis, show that the respondents are generally are more willing to pay for attributes with the ranking below:

- **Music Events**
- **Environmental Education in Community Garden**
- **Increase Sidewalks + Extensive Greening**
- **Music Events + Trying New Instruments**
- **Increase Sidewalks + Micro Greening.**
- **Environmental Education in Community Garden + Citizen Science Project**
- **Community Garden with Playful Greenery**
- **Cycling Lanes with Green Bike Stations**

It also suggests that individuals are strongly averse to paying additional money for the attribute combination of "**Cycling Lanes with Green Bike Stations"** compared to the baseline. This might be for the reason that they already expect this option to be present in the cities.

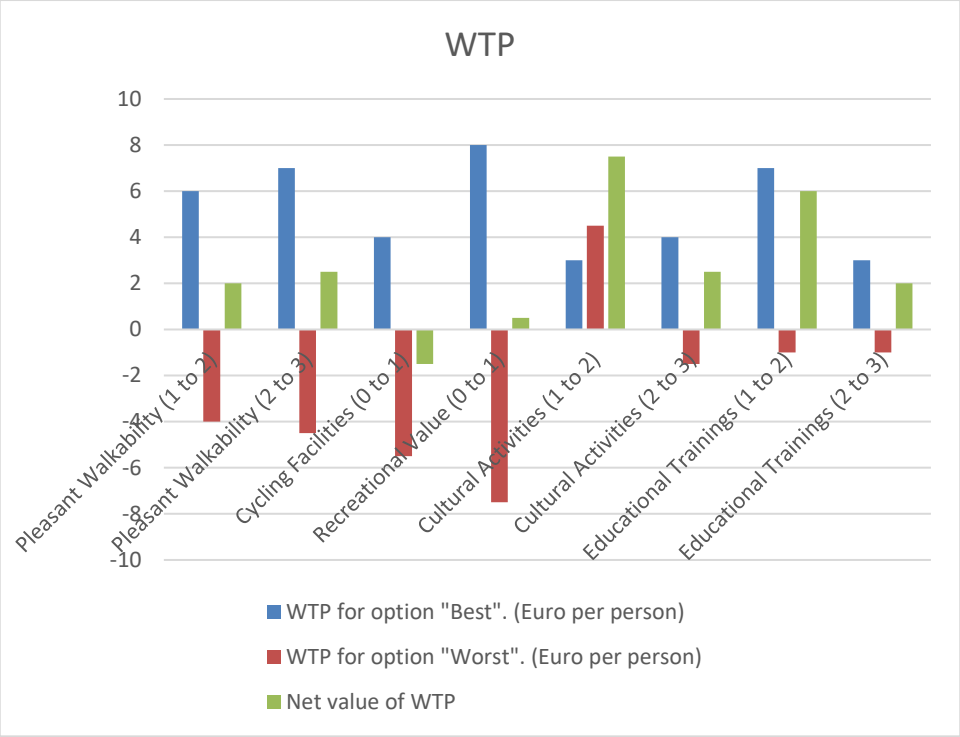


Figure 51 WTP Plot for the best, worst options, and net value of them.

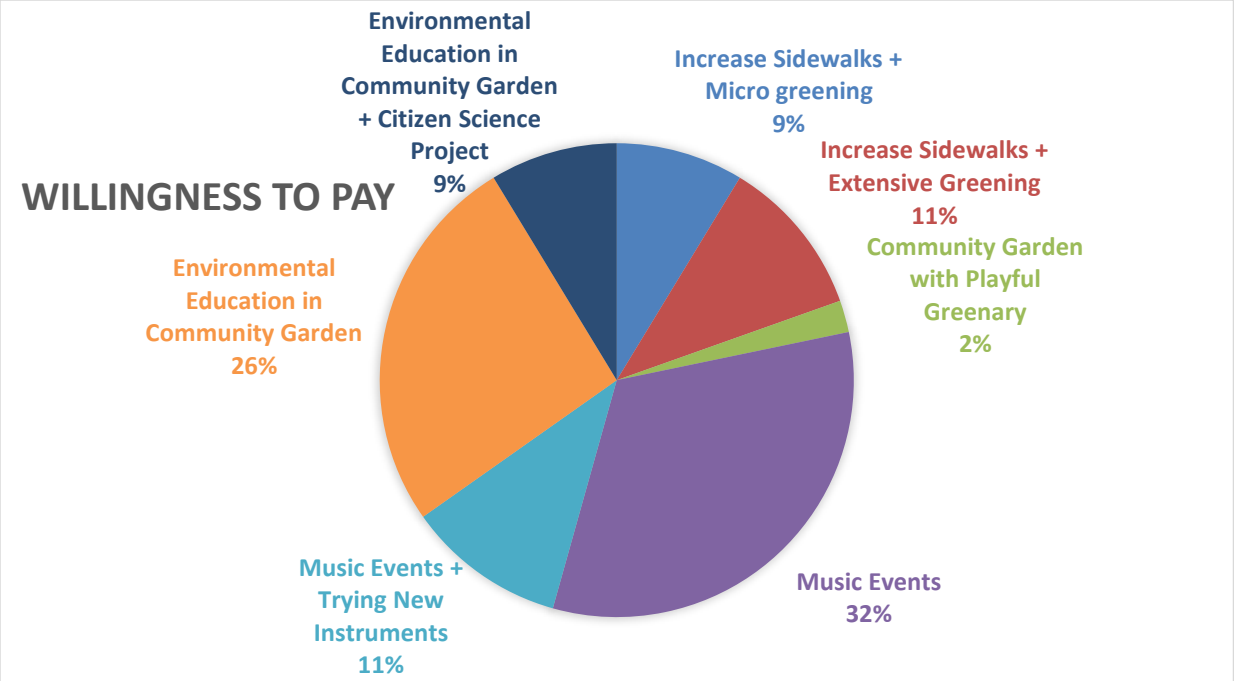


Figure 52 Preference of the respondents in regards of the services they obtain from the green spaces

The above chart shows the preference of the respondents in regards to the services they value more when they are in the urban green space. The results suggest that the majority of the respondents value having the **Music Events** attribute in the urban green space. We can also see the "**Environmental Education in Community Garden**" is also highly valued by the respondents. This results are correlated to the results of the attitudinal questions, since the majority of the respondents were generally rated high in response to the questions concerning the Environment and the Citizen Health and Wellbeing. As it was mentioned before in the previous chapters, the Community Garden with the playful Greenery the attribute "**Recreational Value**, as well as Environmental Education in Community Garden which is related to the "Environmental

Education" attribute, both were related to Social and Environmental Pillars of the sustainability, and the results indicate that the respondents generally put a higher amount of value to these attribute, and it can be implied that following cultural ecosystem services that are provided by the Community Garden with Playful Greenery are valued by the respondents:

1. **Recreation and Leisure**: It offers a space for community members to engage in outdoor activities like gardening, picnicking, and relaxation, promoting well-being and quality of life.
2. **Aesthetic and Spiritual Values**: The garden's design, with playful elements and greenery, creates a visually pleasing and calming environment, positively impacting mental and emotional well-being.
3. **Social and Cultural Interaction**: It serves as a social hub, fostering community interaction, collaboration, and cultural activities such as art exhibitions and storytelling, promoting social cohesion and cultural exchange.
4. **Education and Learning:** The garden acts as an outdoor classroom, providing hands-on environmental education for children and youth, promoting understanding of ecological processes, sustainable gardening, and biodiversity conservation. It can also be a place for workshops, focusing on capacity building and increasing awareness among the citizens towards the value of the nature.

The 4th and 5th variables that got the higher preference from the respondents are related to the second and third level of the attribute "**Pleasant walkability**", indicating that the respondents generally put a high value on having large sidewalks, and also value greenery along the sidewalks. As we mentioned earlier in the chapter 4, the attribute pleasant walkability is also both related to the social and environmental pillars of the sustainability.

This is because as we plan to enlarge the pedestrian sidewalks to improve walkability (**Social Aspect**), we at the same time, improve the healthy lifestyle of walking more and reducing cars, which can help to reduce noise and improve air quality. Therefore, they can have **multiple benefits** to environment and social aspects at the same time. Also this attribute focuses on the co-creating with citizens to green their balcony, which we mention as micro-greening. This act again has multi-benefits to human health and well-being, as well as the environment, since it's proven that the improving in greenery can reduce noise and improve air quality, which as a result improve the health and well being and is good for the environment. Also it improves aesthetics of the city, which is an intrinsic service of the nature, which provides a number of mental health benefits.

On the other hand, "**Community Garden With Playful Greenary**" has not been valued highly by the respondent. This might be due to the fact that it's present in an elementary school and the respondent thought it's not relevant to them.

Finally, the item "**Cycling Lanes with Green Bike Stations"** had not been preferred by the majority of the respondent, and they were not generally willing to pay for this option.

CHAPTER VI

CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

6.1 CONCLUSIONS

In the introduction chapter, five research questions have been posed,

Question 1: What are the innovative nature-based solutions implemented by the VARCITIES project in Gzira, Malta, and how do they contribute to the provision of cultural ecosystem services in the urban context?

There are three innovative visionary solutions planned for Gzira, Malta:

- The first Visionary Solution is focused on micro-greening interventions and improvement of environmental conditions in Rue D'Argens.
- The second Visionary Solution is aimed at bringing more awareness about air and noise quality by involving citizens in the research process. Sensors will be installed in various locations, mostly within Gzira by collecting and comparing data at different geographical points to identify the various pollutants.
- The third Visionary Solution, a Community Garden will be constructed at St. Clare Gzira Primary School, using specific plants and trees that can endure the local climate and attract biodiversity, bringing nature closer to our urban environments. Workshops will be organized with school children, NGOs and an artist to instill ecological awareness into our younger generations and co-design an artistic playscape. The garden will provide an open green space to the public after school hours.

The first visionary solution which is focused on renovating the crowded Rue D'Argens road in Gzira, by citizen co-creation project of micro-greening the balconies along the road, as well as enlarging the pedestrians to improve the walkability in the road, is enhancing the aesthetic value of the urban environment. This contributes to the provision of cultural ecosystem services by creating a "pleasant walkability" which helps for visually appealing spaces that can be enjoyed by residents and visitors, therefore enhancing their well-being and providing opportunities for relaxation and leisure. Additionally, these greening interventions can help for the problem of air and noise quality of Gzira which are pretty much critical at this point, and also reduce the urban heat island effect, as well as improving the biodiversity in the urban area, and therefore enhance the cultural ecosystem services in this way as well.

The second visionary solution, which is about the air and noise awareness of the citizens, through a citizen participation science project, is helping for provision of cultural ecosystem services by involving citizens in the research project and and making them aware of the environmental problems of air and noise pollution in the city of Gzira, and this can create a sense of ownership among the citizens and increase their responsibility towards the environment, and hopefully make them choose a more sustainable lifestyle and mobility option. This can also improve their connection to the environment and make a collective responsibility for the wellbeing of the community, and therefore promote the cultural ecosystem services of social cohesion, civic engagement, and environmental stewardship.

The third visionary solutions is focusing on the community garden of St. Clare Gzira primary school. The community garden, serves as a multifunctional space that contributes to cultural ecosystem services in several ways. First, it provides an open green space that can be used by

the school children and the public after school hours. This green space offers opportunities for recreation, social interaction, and connection with nature, promoting physical and mental well-being. Second, the use of specific plants and trees that can endure the local climate and attract biodiversity contributes to the ecological value of the area. This biodiversity, in turn, enhances the cultural ecosystem services by providing opportunities for educational experiences, ecological awareness, and appreciation of nature's beauty. Finally, the organization of workshops involving school children, NGOs, and artists instills ecological awareness in younger generations and encourages their active participation in co-designing an artistic playscape. This engagement with nature and art fosters creativity, cultural expression, and a deeper connection with the natural environment.

Question 2: How can the cultural ecosystem services provided by the nature-based solutions implemented in the VARCITIES project in Gzira, Malta, be effectively quantified and valued using non-market valuation methods, stated preference survey design, and appropriate attributes and levels specific to the applied project?

In order to quantify the cultural ecosystem services of nature-based solutions using non-market valuation method and stated preference surveys, we need to take the following steps:

1. **Identifying the relevant cultural ecosystem services of the nature-based solution project:**

We need to start by identifying the cultural ecosystem services that the nature-based solutions in Gzira is providing. In this case the visionary solutions were more focused on enhancing the aesthetic value of the urban environment, promoting citizen engagement and stewardship, and providing spaces for recreation, social interaction, and ecological education.

2. **Attribute Selection:**

Then we need to translate these selected cultural ecosystem services of the project into attributes that are relevant to the cultural ecosystem services being evaluated. In our case, following the literature review and the advice of supervisors and organizers of the workshops in Gzira, we selected these 5 attributes: "Pleasant Walkability", "Cycling Facilities", "Recreational Value", "Cultural and Artistic Activities", "Educational Trainings".

"Pleasant Walkability" attribute, is directly related to the visionary solution 1, The "Cycling facilities" and "Cultural and Artistic Activities" attributes, are interpreted from the ideas of citizens who participated in the co-creation workshops about the improvement of the city, as well as the experience of pop-up events in Gzira, and the attitude and preference of the citizens in them. The "Recreational Value" attribute is directly related to the Visionary solution number 3, as it's focused on the community garden in the primary school. And the "Educational Trainings" attribute is related to the visionary solution number 2 and number 3, as it's both focused on the citizen science project, as well as the educational workshops in the community garden.

3. **Attribute Levels:**

In this step we need to define the characteristics associated with each attribute. In our case, we defined the levels for the attributes as below:

- Pleasant Walkability: 1- "Same as Today", 2-"Increase Sidewalks + Micro greening", 3-"Increase Sidewalks + Extensive Greening".
- Cycling Facilities: 0- "Same as Today", 1-"Cycling Lanes with Green Bike Stations"
- Recreational Value: 0- "Same as Today", 1-"Community Garden with Playful Greenery"
- Cultural and Artistic Activities: 1- "Same as Today", 2-"Music Events", 3-"Music Events + Trying New Instruments".
- Educational Trainings: 1- "Same as Today", 2-"Environmental Education In The Community Garden", 3-" Environmental Education In The Community Garden + Citizen Science Project".

4. Survey Design: Develop a stated preference survey questionnaire that presents respondents with hypothetical scenarios and asks them to make choices or express their preferences regarding different attribute levels. The questionnaire should be carefully designed to ensure clear and understandable descriptions of the attributes and levels. In our case, the survey consists of these parts:

- Purpose
- Use of the good or service
- Choice Experiments
- Attitudinal Questions
- Socio-Economic Characteristics

The questionnaire has been revised twice by statistically expert team, and has been tested for getting feedbacks about the design and efficiency in focused groups.

5. Sample Selection: We need to determine the appropriate sample size and selection criteria for the survey. Initially the sample were targeting a group of respondents that represented the local community, however after many endeavours to reach out via email and relevant social media groups, we could not get reasonably enough responses for the analysis. Therefore, for the aims of the thesis and with the advice of the supervisors of the thesis, the sample group changed to non-representative sample colleagues and students from the University of Bologna, to test the questinnare and methodology with enough data.

5. Data Collection: Publishing the survey to the selected sample of respondents. In our case, we sent the Google Forms link of the survey to the Unibo students and colleagues.

6. Data Analysis: : Analyze the survey data using appropriate econometric techniques or statistical models. We used Random Utility Theory and conditional logit model, and we coded the data and used the R packages of support.Ces and DCEtool to analyze the data, and estimate maximum likelihood.

7. Valuation Estimation: Use the data analysis results to estimate the economic values of the cultural ecosystem services. We calculated the willingness-to-pay (WTP) values of the respondents for each attribute.

These values represent the monetary equivalent of the cultural ecosystem services provided by the nature-based solutions.

8. Reporting and communication: Summarizing the findings and communicating the results. the wider community. Presenting the values and their implications in a clear and accessible manner, highlighting the importance of the cultural ecosystem services and their contribution to the overall well-being and sustainability of Gzira.

The resulting valuation estimates can inform decision-making processes, policy development, and resource allocation for the continued development and management of nature-based solutions in the urban context.

Question 3: How do the findings from the validation study, utilizing a non-representative sample of colleagues and students from the University of Bologna, contribute to assessing the applicability of the estimated willingness to pay (WTP) values based on this sample, as well as the effectiveness of using the designed questionnaire as a proxy for gathering real data from local people?

The findings from the validation study utilizing a non-representative sample of colleagues and students from the University of Bologna contribute to assessing the questionnaire's effectiveness in capturing local preferences by comparing responses to expected preferences. It allows for pilot testing and identifies areas for improvement in the questionnaire, ensuring its suitability for

gathering real data. The study also highlights the potential need for methodological adjustments based on identified limitations. This study evaluates the internal validity of the estimated WTP values by comparing them to existing knowledge and estimates from other studies. While the findings may not be directly generalizable, they provide valuable insights that can be considered in other similar studies.

Question 4: How does this assessment of estimated willingness to pay (WTP) values based on the non-representative sample of colleagues and students from the University of Bologna ultimately inform future research aimed at capturing the preferences and willingness to pay (WTP) of the broader local community for innovative nature-based solutions in the VARCITIES project in Gzira, Malta)

The assessment of estimated willingness to pay (WTP) values based on non-representative sample, shows that it's important to include a wider variety of people in future studies to get more accurate results. The assessment also helps identify areas where the survey can be improved to avoid confusion. By making these improvements, researchers can get more reliable estimates of what people are willing to pay. It's also important to involve different groups of people, like residents and policymakers, to get a better understanding of what the community wants. Looking at the policy implications of the estimated values helps decision-makers choose the best solutions for Gzira. By considering all these things, future research can make sure it accurately captures what the local community wants and needs for the VARCITIES project.

Question 5: How does the utilization of stated preference methods and the estimation of willingness to pay (WTP) from citizens contribute to capturing and valuing the non-market values associated with green spaces in our biocities?

Using stated preference methods and estimating willingness to pay (WTP) from citizens helps us understand and put a value on the non-market benefits of green spaces in our cities. By asking people directly about their preferences and estimating how much they are willing to pay for green spaces, we can measure their importance. This helps us understand what people value in green spaces, such as beauty, recreation, mental well-being, and the environment. The estimated WTP values also help us calculate the economic worth of green spaces and make decisions about policies and resources. When citizens are involved in the process, it encourages their participation and allows them to have a say in decisions about green spaces. These methods help us manage and appreciate green spaces in a sustainable way in our cities.

6.2 RECOMMENDATION

6.21 Towards a greener economy:

Cultural ecosystem services are the benefits people receive from ecosystems, such as beauty, cultural heritage, inspiration, and recreation which their value has often been neglected in our economy. While the bioeconomy focuses mainly on the tangible goods and services provided by ecosystems, the cultural benefits are just as important. Holistic approaches towards bioeconomy which include the cultural ecosystem services as well, can help create a greener biocities. To promote cultural ecosystem services in biocities, the following recommendations can be implemented:

1. Raise public awareness: Organize campaigns, workshops, and events to educate the

community about the cultural value of green spaces.

2. Engage stakeholders and residents: Involve them in decision-making to ensure nature-based solutions align with their cultural preferences and expectations.
3. Use a comprehensive valuation approach: Combine surveys and other methods to better understand the economic, social, and cultural benefits of nature-based solutions.
4. Integrate findings into planning and policy: Include cultural ecosystem services in urban planning, green infrastructure, and land-use strategies.
5. Foster collaboration and knowledge sharing: Encourage workshops and conferences to improve research and implementation efforts for cultural ecosystem services.
6. Monitor and evaluate outcomes: Establish a framework to assess the long-term impacts of nature-based solutions on cultural ecosystem services for adaptive management.

By understanding and appreciating the often overlooked benefits of cultural ecosystem services, the bioeconomy can adopt a more complete and balanced approach that values the true worth of ecosystems. This is important for making informed and sustainable decisions in our policies and practices. When we recognize the cultural importance of ecosystems, we can create policies that protect cultural heritage and promote sustainable land management. This approach helps us find a good balance between economic growth and preserving our natural and cultural resources for both current and future generations. By embracing the inherent value of ecosystems, we can build a bioeconomy that values not just the tangible benefits but also the intangible cultural advantages. This leads to a stronger and more harmonious relationship between people and the environment.

6.2.2 Use of WTP and stated preference method in Biocities

It's important to understand the economic, social, and cultural benefits of nature-based solutions in bioeconomy. We can do this by using surveys and other methods to find out how much people are willing to pay for these services. This helps us determine the value of cultural ecosystem services.

To make the most of this information, we need to include it in planning and policy decisions. Urban planning, green infrastructure development, and land-use strategies should consider cultural ecosystem services. This ensures that we prioritize and protect these services in the biocity context.

Taking a holistic approach is essential in the bioeconomy. It means considering not just the economic value of nature-based solutions but also their social and cultural importance. By looking at the bigger picture, we can develop sustainable policies and practices that recognize the true worth of ecosystems.

To track and assess the results of nature-based solutions, we must have a framework for evaluating their long-term effects on cultural ecosystem services. This helps us adapt our management strategies and make continuous improvements based on monitoring feedback.

In conclusion, using a comprehensive valuation approach is crucial to fully benefit from nature-based solutions in Biocities.

6.3 LIMITATIONS AND FUTURE RESEARCH

This study has some limitations to consider.

Firstly, the number of respondents was limited to 64 people. A larger sample size would have allowed us to test more variables, and improve insights.

Secondly, the characteristics of our sample pose another limitation. We collected data from a non-representative sample consisting mostly of colleagues from a research center and university students, which means that most respondents were young and highly educated. It's important to be cautious when generalizing the results because highly educated individuals may have different concerns and be more willing to participate in certain activities, which could lead to an overestimation of the importance of certain attributes.

Another limitation is related to the survey design and the hypothetical bias of stated choice experiments. Since respondents rely on descriptions provided in the survey, they may get bored or not fully read the descriptions, resulting in less accurate responses. In real-life situations, people's choices may be different.

Lastly, it's important to note that our calculated willingness to pay is based on a non-representative sample, so it may not reflect the preferences of the wider population in Gzira. However, it still provides valuable insights into the relevance and significance of different attributes in the survey design. Additionally, it serves as a test and a sample for the holistic valuation method, which can be useful for future studies of a similar nature.

The study will proceed by gathering the real data from Gzira residence in September 2023 and results will most likely be presented in an article by the thesis author.

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APPENDIX A

Calculating goodness-of-fit measures, using DCEtool package in R: Maximum Likelihood Procedure related to the "worst" option

```
> clogout2 <- clogit(RES ~ ASC + X2 + X3 + X1 + X1.1 + X2.1 + X3.1 + X2.2 + X3.2 + cost + strata(STR),
data = datasetworst)
> gofm(clogout2)

Rho-squared = 0.2550333
Adjusted rho-squared = 0.2408108
Akaike information criterion (AIC) = 1067.59
Bayesian information criterion (BIC) = 1112.205
```

```
Number of coefficients = 10
Log likelihood at start = -703.1119
Log likelihood at convergence = -523.7949


coxph(formula = Surv(rep(1, 1920L), RES) ~ ASC + X2 + X3 + X1 +
   X1.1 + X2.1 + X3.1 + X2.2 + X3.2 + cost + strata(STR), data = as.data.frame(cdesmat),
   method = "exact")

 n= 1920, number of events= 640

       coef exp(coef)  se(coef)     z Pr(>|z|)
ASC  -0.830999  0.435614  0.399129 -2.082   0.0373 *
X2   -0.347278  0.706609  0.219073 -1.585   0.1129
X3   -0.388958  0.677762  0.211043 -1.843   0.0653 .
X1   -0.487262  0.614306  0.271740 -1.793   0.0730 .
X1.1 -0.654013  0.519955  0.260500 -2.511   0.0121 *
X2.1  0.405267  1.499703  0.221570  1.829   0.0674 .
X3.1 -0.126687  0.881010  0.222025 -0.571   0.5683
X2.2 -0.107895  0.897722  0.239406 -0.451   0.6522
X3.2 -0.091620  0.912452  0.316392 -0.290   0.7721
cost  0.001390  1.001391  0.004181  0.332   0.7396
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

    exp(coef) exp(-coef) lower .95 upper .95
ASC    0.4356    2.2956   0.1992   0.9524
X2     0.7066    1.4152   0.4599   1.0856
X3     0.6778    1.4754   0.4482   1.0250
X1     0.6143    1.6279   0.3606   1.0464
X1.1   0.5200    1.9232   0.3121   0.8664
X2.1   1.4997    0.6668   0.9714   2.3153
X3.1   0.8810    1.1351   0.5702   1.3613
X2.2   0.8977    1.1139   0.5615   1.4352
X3.2   0.9125    1.0959   0.4908   1.6964
cost   1.0014    0.9986   0.9932   1.0096

Concordance= 0.791  (se = 0.017 )
Likelihood ratio test= 358.6  on 10 df,   p=<2e-16
Wald test            = 297  on 10 df,   p=<2e-16
Score (logrank) test = 368.7  on 10 df,   p=<2e-16
```

APPENDIX B

Calculating MWTPs for the answers related to the "worst" option

> mwtp_worst

	MWTP	2.5%	97.5%
X2	249.85	-1273.64	1410.71
X3	279.83	-1219.45	1540.57
X1	350.56	-1740.28	1878.01
X1.1	470.52	-2086.20	2435.69
X2.1	-291.57	-1628.54	1434.23
X3.1	91.14	-732.37	820.29
X2.2	77.62	-824.33	779.70
X3.2	65.91	-851.54	980.75

method = Krinsky and Robb

Experimental Matrix Design

Selected 10 Choice Cards Are Highlighted By Green Color.

	QES	ALT		ASC	X2	X3	X1	X1.1	X2.1	X3.1	X2.2	X3.2	cost
1	1	1		1	0	0	1	0	0	1	1	0	90
1	1	2		1	1	0	1	0	0	0	0	1	30
1	1	3		0	0	0	0	0	0	0	0	0	0
1	2	1		1	0	0	0	1	0	1	1	0	90
1	2	2		1	0	1	0	1	0	0	1	0	90
1	2	3		0	0	0	0	0	0	0	0	0	0
1	3	1		1	1	0	1	0	0	0	0	1	90
1	3	2		1	1	0	1	1	1	0	1	0	60
1	3	3		0	0	0	0	0	0	0	0	0	0
1	4	1		1	1	0	0	1	0	1	0	0	60
1	4	2		1	0	0	0	1	1	0	0	1	90
1	4	3		0	0	0	0	0	0	0	0	0	0
1	5	1		1	1	0	0	0	1	0	1	0	30
1	5	2		1	0	0	1	0	1	0	0	1	90
1	5	3		0	0	0	0	0	0	0	0	0	0
1	6	1		1	0	1	1	0	0	1	0	1	30
1	6	2		1	1	0	1	1	0	0	0	1	30
1	6	3		0	0	0	0	0	0	0	0	0	0
1	7	1		1	0	1	0	1	0	0	1	0	60
1	7	2		1	0	1	1	1	0	1	0	1	60
1	7	3		0	0	0	0	0	0	0	0	0	0
1	8	1		1	0	0	1	1	0	0	0	0	30
1	8	2		1	0	0	1	1	0	1	1	0	30
1	8	3		0	0	0	0	0	0	0	0	0	0
1	9	1		1	0	1	1	0	0	0	1	0	60
1	9	2		1	0	1	1	0	0	0	1	0	90
1	9	3		0	0	0	0	0	0	0	0	0	0
1	10	1		1	0	0	0	0	0	1	1	0	90
1	10	2		1	0	1	0	0	1	0	0	0	30
1	10	3		0	0	0	0	0	0	0	0	0	0
1	11	1		1	0	1	0	1	0	0	1	0	60
1	11	2		1	0	0	0	1	1	0	0	1	90
1	11	3		0	0	0	0	0	0	0	0	0	0
1	12	1		1	0	0	1	1	1	0	0	1	60
1	12	2		1	0	0	0	1	0	0	0	0	60
1	12	3		0	0	0	0	0	0	0	0	0	0
1	13	1		1	0	1	0	1	0	1	0	1	30
1	13	2		1	0	0	0	0	0	1	1	0	30
1	13	3		0	0	0	0	0	0	0	0	0	0
1	14	1		1	1	0	0	0	1	0	1	0	30
1	14	2		1	1	0	0	0	0	1	0	0	90
1	14	3		0	0	0	0	0	0	0	0	0	0
1	15	1		1	1	0	0	0	0	0	0	1	90
1	15	2		1	0	1	0	1	0	0	1	0	90
1	15	3		0	0	0	0	0	0	0	0	0	0
1	16	1		1	1	0	1	1	1	0	1	0	30
1	16	2		1	1	0	0	0	1	0	1	0	60
1	16	3		0	0	0	0	0	0	0	0	0	0
1	17	1		1	0	0	0	0	1	0	0	1	60
1	17	2		1	0	1	1	1	0	1	0	1	60
1	17	3		0	0	0	0	0	0	0	0	0	0
1	18	1		1	1	0	0	1	0	1	0	0	60
1	18	2		1	1	0	1	1	0	1	0	0	90
1	18	3		0	0	0	0	0	0	0	0	0	0
1	19	1		1	0	0	1	1	0	0	0	0	30
1	19	2		1	0	1	0	0	0	1	0	1	60
1	19	3		0	0	0	0	0	0	0	0	0	0
1	20	1		1	0	1	1	0	0	0	1	0	60
1	20	2		1	1	0	0	0	0	1	0	0	90
1	20	3		0	0	0	0	0	0	0	0	0	0
1	21	1		1	0	0	0	0	0	0	0	0	30
1	21	2		1	1	0	0	0	1	0	1	0	60
1	21	3		0	0	0	0	0	0	0	0	0	0
1	22	1		1	1	0	1	0	0	1	0	0	60

1	22	2		1	0	0	1	0	0	0	0	0	60
1	22	3		0	0	0	0	0	0	0	0	0	0
1	23	1		1	0	1	0	1	0	1	0	1	30
1	23	2		1	1	0	1	1	0	1	0	0	90
1	23	3		0	0	0	0	0	0	0	0	0	0
1	24	1		1	0	1	1	1	1	0	0	0	90
1	24	2		1	1	0	0	0	0	0	0	1	30
1	24	3		0	0	0	0	0	0	0	0	0	0
1	25	1		1	0	0	0	0	1	0	0	1	60
1	25	2		1	0	0	0	1	0	1	1	0	30
1	25	3		0	0	0	0	0	0	0	0	0	0
1	26	1		1	1	0	1	1	0	0	0	1	90
1	26	2		1	0	1	1	1	1	0	0	0	30
1	26	3		0	0	0	0	0	0	0	0	0	0
1	27	1		1	1	0	1	0	0	1	0	0	60
1	27	2		1	0	0	1	0	0	1	1	0	30
1	27	3		0	0	0	0	0	0	0	0	0	0
1	28	1		1	0	1	1	0	0	1	0	1	30
1	28	2		1	0	0	0	1	0	0	0	0	60
1	28	3		0	0	0	0	0	0	0	0	0	0
1	29	1		1	0	1	1	0	1	0	0	0	90
1	29	2		1	0	1	0	1	1	0	0	0	30
1	29	3		0	0	0	0	0	0	0	0	0	0
1	30	1		1	0	0	0	0	0	0	0	0	30
1	30	2		1	0	0	1	0	1	0	0	1	90
1	30	3		0	0	0	0	0	0	0	0	0	0
1	31	1		1	0	0	1	1	0	1	1	0	90
1	31	2		1	0	0	1	0	0	0	0	0	60
1	31	3		0	0	0	0	0	0	0	0	0	0
1	32	1		1	1	0	0	1	0	0	0	1	90
1	32	2		1	0	1	0	0	0	1	0	1	60
1	32	3		0	0	0	0	0	0	0	0	0	0
1	33	1		1	0	1	0	0	1	0	0	0	90
1	33	2		1	1	0	0	1	0	0	0	1	30
1	33	3		0	0	0	0	0	0	0	0	0	0
1	34	1		1	0	1	0	1	1	0	0	0	90
1	34	2		1	1	0	1	1	1	0	1	0	60
1	34	3		0	0	0	0	0	0	0	0	0	0
1	35	1		1	0	0	1	1	1	0	0	1	60
1	35	2		1	0	1	1	0	0	0	1	0	90
1	35	3		0	0	0	0	0	0	0	0	0	0
1	36	1		1	1	0	1	1	1	0	1	0	30
1	36	2		1	0	1	1	0	1	0	0	0	30
1	36	3		0	0	0	0	0	0	0	0	0	0

APPENDIX C - 2

Selected 10 Choice Cards After Randomizing

Question 15 => #1

	alt.1	alt.2
walk	"2"	"3"
cycling	"0"	"0"
recreate	"0"	"1"
culture	"1"	"1"
edu	"3"	"2"
cost	"90"	"90"

Question 34=> #2

	alt.1	alt.2
walk	"3"	"2"
cycling	"0"	"1"
recreate	"1"	"1"
culture	"2"	"2"
edu	"1"	"2"
cost	"90"	"60"

Question 36=> #3

	alt.1	alt.2
walk	"2"	"3"
cycling	"1"	"1"
recreate	"1"	"0"
culture	"2"	"2"
edu	"2"	"1"
cost	"30"	"30"

Question 24=> #4

	alt.1	alt.2
walk	"3"	"2"
cycling	"1"	"0"
recreate	"1"	"0"
culture	"2"	"1"
edu	"1"	"3"
cost	"90"	"30"

Question 25=> #5

	alt.1	alt.2
walk	"1"	"1"
cycling	"0"	"0"
recreate	"0"	"1"
culture	"2"	"3"
edu	"3"	"2"
cost	"60"	"30"

Question 2=> #6

	alt.1	alt.2
walk	"1"	"3"
cycling	"0"	"0"
recreate	"1"	"1"
culture	"3"	"1"
edu	"2"	"2"
cost	"90"	"90"

Question 11=> #7

	alt.1	alt.2
walk	"3"	"1"
cycling	"0"	"0"
recreate	"1"	"1"
culture	"1"	"2"
edu	"2"	"3"
cost	"60"	"90"

Question 4=> #8

	alt.1	alt.2
walk	"2"	"1"
cycling	"0"	"0"
recreate	"1"	"1"
culture	"3"	"2"
edu	"1"	"3"
cost	"60"	"90"

Question 31=> #9

	alt.1	alt.2
walk	"1"	"1"
cycling	"1"	"1"
recreate	"1"	"0"
culture	"3"	"1"
edu	"2"	"1"
cost	"90"	"60"

Question 19=> #10

	alt.1	alt.2
walk	"1"	"3"
cycling	"1"	"0"
recreate	"1"	"0"
culture	"1"	"3"
edu	"1"	"3"

APPENDIX C - 3

Final Design Matrix For The 10 Selected Choice Cards After Randomization

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		BLOCK	QES	ALT	ASC	X2	X3	X1	X1.1	X2.1	X3.1	X2.2	X3.2	cost
2	1	1	1	1	1	1	0	0	0	0	0	0	1	90
3	2	1	1	2	1	0	1	0	1	0	0	1	0	90
4	3	1	1	3	0	0	0	0	0	0	0	0	0	0
5	4	1	2	1	1	0	1	0	1	1	0	0	0	90
6	5	1	2	2	1	1	0	1	1	1	0	1	0	60
7	6	1	2	3	0	0	0	0	0	0	0	0	0	0
8	7	1	3	1	1	1	0	1	1	1	0	1	0	30
9	8	1	3	2	1	0	1	1	0	1	0	0	0	30
10	9	1	3	3	0	0	0	0	0	0	0	0	0	0
11	10	1	4	1	1	0	1	1	1	1	0	0	0	90
12	11	1	4	2	1	1	0	0	0	0	0	0	1	30
13	12	1	4	3	0	0	0	0	0	0	0	0	0	0
14	13	1	5	1	1	0	0	0	0	1	0	0	1	60
15	14	1	5	2	1	0	0	0	1	0	1	1	0	30
16	15	1	5	3	0	0	0	0	0	0	0	0	0	0
17	16	1	6	1	1	0	0	0	1	0	1	1	0	90
18	17	1	6	2	1	0	1	0	1	0	0	1	0	90
19	18	1	6	3	0	0	0	0	0	0	0	0	0	0
20	19	1	7	1	1	0	1	0	1	0	0	1	0	60
21	20	1	7	2	1	0	0	0	1	1	0	0	1	90
22	21	1	7	3	0	0	0	0	0	0	0	0	0	0
23	22	1	8	1	1	1	0	0	1	0	1	0	0	60
24	23	1	8	2	1	0	0	0	1	1	0	0	1	90
25	24	1	8	3	0	0	0	0	0	0	0	0	0	0
26	25	1	9	1	1	0	0	1	1	0	1	1	0	90
27	26	1	9	2	1	0	0	1	0	0	0	0	0	60
28	27	1	9	3	0	0	0	0	0	0	0	0	0	0
29	28	1	10	1	1	0	0	1	1	0	0	0	0	30
30	29	1	10	2	1	0	1	0	0	0	1	0	1	60
31	30	1	10	3	0	0	0	0	0	0	0	0	0	0

APPENDIX D – 1

Stated Preference Survey - Habitual Patterns

Part 1/4. Your Habitual Patterns

1. How frequently do you spend time in a green space for a social activity? (Having fun with friends or family, interacting with others, attending a social event, etc.) *

- (●) Everyday
- ( ) At least 5 times a week
- ( ) At least 3 times a week
- ( ) At least once a week
- ( ) Occasionally

2. How frequently do you go for walks, workouts, photography, etc. in green spaces? *

- (●) Everyday
- ( ) At least 5 times a week
- ( ) At least 3 times a week
- ( ) At least once a week
- ( ) Occasionally

APPENDIX D – 2

Stated Preference Survey - Choice Tasks

Choice Tasks

1/10. *

#1 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Micro-Greening 	Increase Sidewalks + Extensive Greening 	Same As Today
Cycling Facilities	Same As Today	Same As Today	
Recreational Value	Same As Today	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Same As Today	Same As Today	
Educational Trainings	Environmental Education in Community Garden + Citizen Science Project 	Environmental Education in Community Garden 	
One-Time Payment	90 €	90 €	0 €

	A	B	C
Best Option	○	○	○
Worst Option	○	○	○

2/10. *

#2 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Extensive Greening 	Increase Sidewalks + Micro-Greening 	Same As Today
Cycling Facilities	Same As Today	Cycling lanes with Green Bike Stations 	
Recreational Value	Community Garden with Playful Greenery 	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Music Events 	Music Events 	
Educational Trainings	Same As Today	Environmental Education in Community Garden 	
One-Time Payment	90 €	60 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

3/10. *

#3 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Micro-Greening 	Increase Sidewalks + Extensive Greening 	Same As Today
Cycling Facilities	Cycling lanes with Green Bike Stations 	Cycling lanes with Green Bike Stations 	
Recreational Value	Community Garden with Playful Greenery 	Same As Today	
Cultural and Artistic Activities	Music Events 	Music Events 	
Educational Trainings	Environmental Education in Community Garden 	Same As Today	
One-Time Payment	30 €	30 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

4/10. *

#4 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Extensive Greening 	Increase Sidewalks + Micro-Greening 	Same As Today
Cycling Facilities	Cycling lanes with Green Bike Stations 	Same As Today	
Recreational Value	Community Garden with Playful Greenery 	Same As Today	
Cultural and Artistic Activities	Music Events 	Same As Today	
Educational Trainings	Same As Today	Environmental Education in Community Garden + Citizen Science Project 	
One-Time Payment	90 €	30 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

5/10. *

#5 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Same As Today	Same As Today	Same As Today
Cycling Facilities	Same As Today	Same As Today	
Recreational Value	Same As Today	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Music Events 	Music Events + Trying New Instruments  	
Educational Trainings	Environmental Education in Community Garden + Citizen Science Project  	Environmental Education in Community Garden 	
One-Time Payment	60 €	30 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

6/10. *

#6 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Same As Today	Increase Sidewalks + Extensive Greening 	Same As Today
Cycling Facilities	Same As Today	Same As Today	
Recreational Value	Community Garden with Playful Greenery 	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Music Events + Trying New Instruments 	Same As Today	
Educational Trainings	Environmental Education in Community Garden 	Environmental Education in Community Garden 	
One-Time Payment	90 €	90 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

7/10. *

#7 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Extensive Greening 	Same As Today	Same As Today
Cycling Facilities	Same As Today	Same As Today	
Recreational Value	Community Garden with Playful Greenery 	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Same As Today	Music Events 	
Educational Trainings	Environmental Education in Community Garden 	Environmental Education in Community Garden + Citizen Science Project 	
One-Time Payment	60 €	90 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

8/10. *

#8 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Increase Sidewalks + Micro-Greening 	Same As Today	Same As Today
Cycling Facilities	Same As Today	Same As Today	
Recreational Value	Community Garden with Playful Greenery 	Community Garden with Playful Greenery 	
Cultural and Artistic Activities	Music Events + Trying New Instruments 	Music Events 	
Educational Trainings	Same As Today	Environmental Education in Community Garden + Citizen Science Project 	
One-Time Payment	60 €	90 €	0 €

	A	B	C
Best Option	○	○	○
Worst Option	○	○	○

9/10. *

#9 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Same As Today	Same As Today	Same As Today
Cycling Facilities	Cycling lanes with Green Bike Stations 	Cycling lanes with Green Bike Stations 	
Recreational Value	Community Garden with Playful Greenery 	Same As Today	
Cultural and Artistic Activities	Music Events + Trying New Instruments 	Same As Today	
Educational Trainings	Environmental Education in Community Garden 	Same As Today	
One-Time Payment	90 €	60 €	0 €

	A	B	C
Best Option	◯	◯	◯
Worst Option	◯	◯	◯

10/10. *

#10 Which option would you choose?

	Option A	Option B	Option C
Pleasant Walkability	Same As Today	Increase Sidewalks + Extensive Greening 	Same As Today
Cycling Facilities	Cycling lanes with Green Bike Stations 	Same As Today	
Recreational Value	Community Garden with Playful Greenery 	Same As Today	
Cultural and Artistic Activities	Same As Today	Music Events + Trying New Instruments 	
Educational Trainings	Same As Today	Environmental Education in Community Garden + Citizen Science Project 	
One-Time Payment	30 €	60 €	0 €

	A	B	C
Best Option	○	○	○
Worst Option	○	○	○

APPENDIX D – 3

Stated Preference Survey - Attitudinal Questions Attitude Towards The Environment

Attitude Towards The Environment

1. As a Gzira resident, I value workshops that educate me on current sustainability issues and potential actions I can take to help my city achieve its sustainable development goals. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

2. I believe climate change is affecting Malta, as heat waves and weather conditions are becoming more severe. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

3. I am concerned about the conservation of native biodiversity in my city. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

4. I try to reduce my carbon footprint by walking or biking instead of driving. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

5. Environmental protection is one of the most important topics to me, and I am morally committed to it. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

Attitude Towards The Citizen Health and Well-Being

6. I value spending time in natural environments and engaging in outdoor physical activity on a regular basis. *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

7. I feel more relaxed after a walk in an urban park. *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

8. Urban green spaces are important to me since they reduce the city's air and noise pollution. *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

9. My city needs more aesthetically pleasing pedestrian environments because they help to reduce crime and disorder while also improving livability and mental health. *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

Attitude Towards Citizen Co-Creation

Attitude Towards The Citizen Co-Creation

10. I'm inspired to join a community-wide citizen science project to measure air and noise using sensor platforms. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

11. As a Gzira resident, I value actively participating in workshops to discuss city issues and design the services I want to receive. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

12. I enjoy hands-on activities such as shaping and maintaining urban public green spaces. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

13. I'm very interested in contributing to the greening of the urban landscape by greening my balcony. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

14. I enjoy participating in cultural, artistic, and foodie events that allow me to experience and learn new things. *

	1	2	3	4	5	
Strongly Agree	◯	◯	◯	◯	◯	Strongly Disagree

APPENDIX D – 4

Stated Preference Survey - Socio-Economic Characteristics

Part 4/4. Your General Information

Gender *

- ◯ Male
- ◯ Female
- ◯ Other
- ◯ I prefer not to answer

Age *

- ◯ 18 to 24 years
- ◯ 25 to 34 years
- ◯ 35 to 44 years
- ◯ 45 to 54 years
- ◯ 55 to 64 years
- ◯ 65+ years

Please indicate your highest degree or level of school you have completed. *

- ◯ Middle school diploma
- ◯ Technical school diploma
- ◯ High school diploma
- ◯ Bachelor's degree
- ◯ Master's degree
- ◯ PhD and above

Please indicate your annual net income.

- ◯ Less than 10,000 Euros
- ◯ 10,001 Euros to 20,000 Euros
- ◯ 20,001 Euros to 30,000 Euros
- ◯ 30,001 Euros to 40,000 Euros
- ◯ 40,001 Euros to 50,000 Euros
- ◯ 50,001 Euros +
- ◯ Prefer not to answer