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RAINSOLUTIONS

Improving landscape, environmental and water quality aspects of urban water resources

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Content

Terms and abbreviations

BHD = Birds & Habitats Directives
CC = Climate Change
CW = Constructed Wetlands
EBS = Ecosystem-Based Solutions
EEA = European Environment Agency
ES = Ecosystem Services
EP = Environmental Planning
FD = Floods Directive
GI = Green Infrastructure
GR = Greem Roofs
MA = Millennium Ecosystem Assessment
NA = Natural Capital
NBS = Nature-Based Solutions
TEV = Total economic value
UA = Urban Agenda
UWWTD = Urban Waste Water Treatment Directive
WFD = Water Framework Directive

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Background information

The present report is produced in the frames the Water Joint Programming Initiative Water Challenges For A Changing World 2018 Joint Call Closing the Water Cycle Gap, according to the terms of the contract between the Lead Partner (Lund University) and The WaterWorks2017 Follow-Up Secretariat

The report, entitled "Improving landscape, environmental and water quality aspects of urban water resources" was prepared by the following partners of the concortium DDNI, WUR, VESI, UJ and ULUND.

This report provide the results obtained during the first year of implementation of the project and is focused on the identification of the appropriate up-to-date indicators for evaluation of ecosystem services of key NBS implementation. Ecological characteristics of the sites was assessed and a review of knowledge about ecosystem restoration in urban water as well as their success and failure from the ecosystem point of view was performed. Connectivity between existing, modified and new ecosystems as well as restored and rehabilitated ecosystems have been the focus. Indicators to measure the positive impacts of the selected blue-green solutions on the urban ecosystems was identified, and include water purification, water supply, habitat improvement, aquatic flora and fauna enhancement, microclimate regulation, food and organic matter production, waste disposal, as well as the improvement of green and blue corridors.

Our main concern in the elaboration of the present report was to provide scientifically robust datasets and methodologically validated which can gives to the local and regional authority's suitable information on the NBS. The report aims to be comprehensive with regard to the ecosistem services but not only.

1. INTRODUCTION

According to European Environment Agency (EEA), most European cities have at least one river or lake crossing their urban landscape. In recent decades, and after a gradual improvement in water quality due to wastewater treatment and reduced industrial activities, urban rivers and lakes have become increasingly important in the planning of urban ecology, green infrastructure, green areas and climate change adaptation in European cities. In the European Union, there are also several policy processes that act as drivers for managing urban rivers and lakes in a more integrated way. This relates to several directives such as the Urban Waste Water Treatment Directive (UWWTD), the Water Framework Directive (WFD), the Floods Directive (FD), and the Birds and the Habitats Directives (BHD), as well as other policies such as the EU Strategy on Adaptation to Climate Change (CC), the EU Strategy on Green Infrastructure (GI) and, more recently, the Urban Agenda for the EU (UA). (***, 2016a).

In recent years, social, economic, and environmental considerations have led to a reevaluation of the factors that contribute to sustainable urban environments. In this context, besides the quality of inhabitants life and management of the aquatic systems of the city and its catchment ((Tandyrak et al 2016), urban ecosystems as green spaces and green infrastructures are increasingly seen as important components of urban areas (Grunewald et al., 2017; ***, 2016a). Urbanization as an ongoing phenomenon, with a progressively larger proportion of humans moving into urban areas, that are likely to expand, contributes to the occurrence of the the „crowding effect” (Loo C., 1975; Chin Choi et al., 1976; Gao et al. 2017). Due to this phenomenon, city residents may come to suffer from progressively limited access to nature and decreased quality of the nature experiences (van den Berg et al, 2007; Hughes et al. 2014; ***, 2016-2018), while urban green space suffer from a continuous pressure coming from potential investors who are interested in it for construction (Chiriac et al. 2009; Colesca et al. 2011).

Increased demand for clean air, water security, climate change or threatens that disrupt the function of the ecosystems raises concerns regarding deterioration of ecosystems services and tendency of ‘‘human well-being’’ (Luck et al., 2003; Summers et al., 2012; ***, 2015a).

Against the backdrop of population growth, an adequate environment has been created to find solutions that will enable the achievement of objective 6 of the 2030 Agenda for sustainable development. An essential step to ensuring this goal is to harness the natural processes that regulate various elements of the nature, which have become collectively known as Nature-Based Solutions (NBS) (***, 2015; Eggermont et al. 2015; Cohen-Shacham et al., 2016; Pauleit et al. 2017; Albert et al., 2017; ***, Raymond et al. 2017a; Raymond et al. 2017b; 2018; Zwierzchowska et al., 2019)

By validating these solutions, it is promoted that the adopted measures become an integral part of the general design of the specific policies, measures, actions and challenges in the field of conservation and development that humanity is currently facing (Vignola et. al, 2009; ***, 2015; Jacobs et al. 2016; Pauleit et al. 2017; Zwierzchowska et al. 2019).

From the point of view of city management, the concept based on NBS seems to be a very interesting one, offering multidimensional benefits. NBS s are recognized as being cross-disciplinary by interconnecting green infrastructure (GI), natural capital (NA), ecosystem services (ES) and environmental planning (EP) (Albert et al., 2017; Zwierzchowska et al. 2019).

To address the challenges associated with climate change, health and well-being in urban areas, current policy platforms are shifting their focus from Ecosystem-Based Solutions (EBS) to NBS. NBS resulting in improving the attractiveness of the place, health and quality of life and the creation of environmentally friendly jobs.

There are few networks for the recognition and evaluation of the value of the benefits that NBS brings, or for the cross-sectoral orientation, respectively for the design and implementation of policies and projects of this type (Raymond et al. 2017a).

Assessing the effectiveness of NBS actions is a complex process that requires:
(i) specialists from academia, practitioners and entrepreneurs;
(ii) cross-disciplinary work and different fields or disciplines;
(iii) applying different indicators and methods to solve economic, environmental and social challenges (Raymond et al. 2017a).

In this respect, during the implementation of Work Package 2 there will be performed a review of knowledge about indicators for ecosystem services that can be used in supporting NBS for urban water and urban planining, as well as for the assessment of their success and failure from the ecosystem point of view.

EEA experts indicate that there are three key components determining the success of an assessment: credibility (= scientific and technical believability), salience (= ability to address user concerns), and legitimacy (= the political acceptability or perceived fairness of the development process) (Eckley, 2001). Credibility, saliency, and, particularly, legitimacy can be ensured by thorough stakeholder involvement throughout the indicator development process (Czúcz et al., 2016). Therefore, the participation of interest groups (for example, local communities, civil society organizations, local or regional authorities) that can benefit from the implementation of NBS, will be essential for the success of this assessment.

As a data delivery tool to support the other work packages, the main concern in relation to this report is that such approach should be as accurate, meaningful and useful as possible.

2. KEY NATURE BASED SOLUTIONS

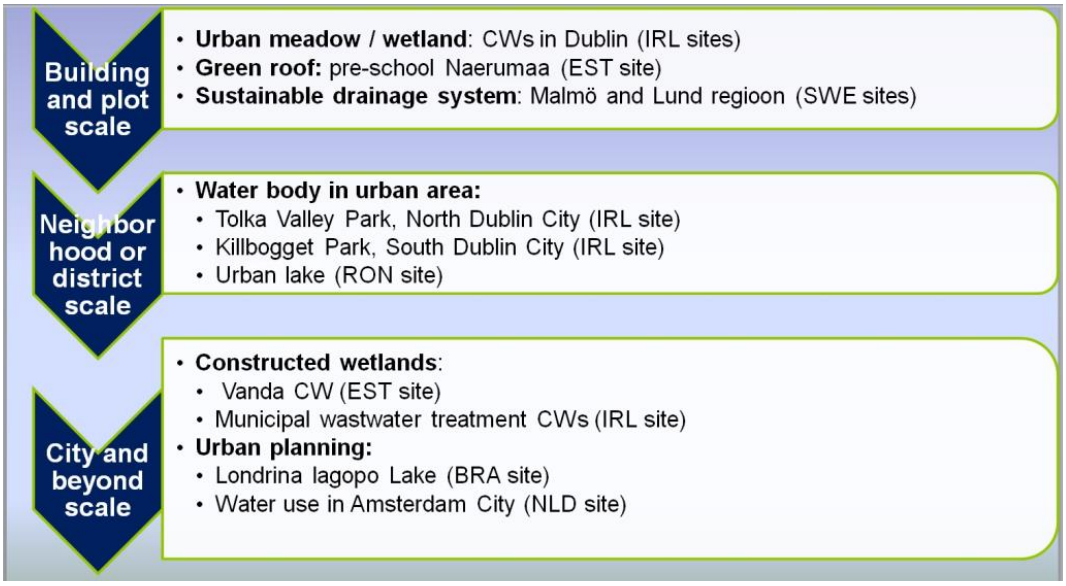

Figure 1. Key NBSs - RainSolutions' sites

2.1. Neighborhood or district scale: water body in urban area

<u>Urban lakes</u>

An urban lake or a pond is an inland body of surface water surrounded by an urban environment. Lakes and ponds are distinguished by their size: a lake is larger than a pond, which has an area between 25 and 20,000 m² (Persson J., 2012).

Urban lakes are natural or man-made. The urban lakes could be located:

- ✓ entirely within city limits and directly surrounded by urban and industrial development, with some recreational facilities limited to the shoreline area (beaches, parks, playgrounds);
- ✓ partially located within the city limits;
- ✓ attached to part of a town, but receiving city's wastes as the predominant factor in their water quality formation. Their drainage basins are dominated primarily by urban population and their activities (Barica, 1992).
- ✓ in park contexts, a pond is distinguished in turn from a pool: whereas a pond often has a natural shape with waterside planting, a pool often has a geometric form (Persson J., 2012).

Intensive investigations have shown that the importance given to urban lakes and ponds has begun to rise from the industrialization of cities. At first, their main purpose was to add aesthetic qualities in parks and improve the health of city dwellers. Since the 1970s and 1980s, arise the vision that urban lakes can purify water and prevent flooding.

Today, urban lakes and ponds are planned and developed so that they acquire multifunctional values (Carse er al. 2006; Gao et al. 2017; Persson J., 2012; ***, 2016a; ***, 2016b). as follows:

- social and economic values, such as shaping and spreading city images for aesthetics point of view or recreation. Researches in environmental psychology have been established the importance of this type of lakes for sustainable development and well-being of urban residents for the modern society (van den Berg et al, 2007; Qiao et al, 2009),
- biological values, as a wetlands urban lakes have a role in maintaining eco-balance, protecting biodiversity, preserving fresh water resources, regulating and storing flood waters, adjusting the climate, replenishing underground water, degrading pollutants, and providing important resources for our life, production and social development (Qiao et al, 2009;...)
- technological values like the fact that the systems can clean water and reduce flooding.

Taking into consideration the above mentioned aspects, urban lake use and conservation are important issues that must be taken into consideration for a sustainable development of the city.One way to solve the problem generated by the effective use of urban water and the protection of the quality of this water is through a smart urban planning. Planning promotes a balance between human use and the natural ecology of lakes creating more harmonious coexistence between humans and lakes (Pitkänen 2008).

Recreational activities are becoming one of the most important functions of urban lakes. The lake recreational pressure being associated with population spatial distribution and urban lake accessibility and for attenuation of this pressure must be allocated management and protection resources (Gao et al. 2017).

In the face of increasing pressures on natural systems and increasing extent and intensity of urbanisation, a more comprehensive appreciation of the challenges and opportunities provided by urban ponds could play a substantial role in driving sustainable urban development (Hassall, 2014).
Urban lakes are under increased pressure of residential development. The riparian and nearshore zones of lakes, in the residential areas or nearby those areas, are affected by installing retaining walls and, by reducing riparian vegetation, shoreline complexity, and snags, in turns alter fish and macroinvertebrate assemblages. (Hughes et al. 2014). Lake water quality, shorelines, and ecosystem characteristics are elements that attract peoples and if these natural attributes deteriorate, the lakes are rarely visited and considered unfavorable for recreation (Gao et al. 2017).

Romania has a relatively low degree of urbanization - about 52%, and according to the report to the European Commission, is one of the lowest rates of urban expansion compared to the European average (e.g., an increase of 6.84% from 2006 to 2009) (***, 2019). Nevertheless, the urbanization process bears the mark of the relations between the natural environment which, although is narrow in size, but extremely varied and with complementary resources and population, characterized by continuous and intense human anthropic pressure .

Romania's urban network is made up of 320 cities. The network of localities in Romania presents a balanced spatial distribution but it is strongly polarized by Bucharest, which has over 3 million inhabitants in the area of influence. (***, 2017). Other cities, less extensive than the capital, are also present and predominantly gravitate around centers with macroterritorial functions and concentration of the economic-financial resources, which present their own specific hierarchical structures and different subordination relationships from one city to another (Săgeată, 2010, 2014; Mitrică et al. 2014).

Romania's legislation defining and regulating urban space has undergone significant changes over the last 12 years. From Act no. 47/2012 in which the bodies of water inside the cities were not mentioned (***, 2012a) to Act L582/2018, in which Romania recognizes and includes in the category of urban green spaces the banks of water, wetlands, marshes and ponds. In this way, the meaning of „urban ecosystem" includes urban forest, gardens and yards, landfills road trees, green roofs, and walls, surface waters (lakes, rivers, swamps and others aquatic surfaces), as well.

Even if, some of these spaces are already typically considered in planning practice and its presence are recognized to be related to provisioning of a range of services to both the people and the wildlife living in urban areas, often their contribution to urban or blue green space networks is not well understood or appreciated (Cobzaru et al., 2008; Grunewald et al., 2017; Hansen et al., 2017; Ioja et al., 2017).

In this context, the selection of reconstructed lakes: Ciuperca Lake (Fig. 2) and Gheorghieni Lake (Fig. 3), and undergoing rehabilitation process Binder Lake (Fig. 4), for analyzing the implementation of NBS in Romania, seems to be the most appropriate choice for RainSolutions.

Figure 2. Ciuperca Lake, Tulcea, Romania

Figure 3 Gheorghieni Lake, Cluj - Napoca, Romania

Figure 4 Binder Lake, Sibiu, Romania

2.2. City and beyond scale

Urban planning

Nature Based Solutions for mitigating Urban Flooding

Ever increasing urbanisation have lead to vast changes in the natural terrain of the environment. The increasing amount of paved surfaces and builtup area have reduced the natural capacity of the terrain to cope with incident rainfall. Additionally, with urban areas having to serve large and dense population, which has increased pressure on resources, with water being one of the most impacted. Amsterdam, the capital city of Netherlands has had no exception to this impact of urbanisation. Increasing urbanisation has put strain to the urban surface waters for its functions of consumption (water for drinking and household use) and recreation (swimming and boating). With climate change, its apparent impact on the city has been through urban pluvial flooding, with the city's infrastructure unable to handle large and intense downpours, which are predicted to be more frequent in the coming years. One such event that prompted much attention was the cloudburst over Amsterdam on 28 July 2014, which caused much flooding over most of Amsterdam including connecting motorways disrupting mobility and transportation to a vast extent.

This study on mitigating urban flooding will focus on increasing the capacity of the urban area to cope with rainfall through nature based solutions. Which will focus on understanding the limit of NBS using Amsterdam as a case study. This will be done by building a digital twin (model) of the urban space and studying its behaviour to various rainfall scenarios. A part of the urban area of Amsterdam is chosen for this purpose as shown highlighted in Figure 5.

The study area of Amsterdam has a mix of separate storm sewers and combined sewers (storm + domestic waste water) as well as the old city part and a newly developed part. The area also includes many urban drainage infrastructures, which also includes many nature based solutions. A mix of different urban infrastructures in a small space gives a good reflection of the current urbanized space in the Netherlands, which could serve to expand the model to cater to different cities in the country. Netherlands as such, including Amsterdam, has a near zero elevation gradient. The built up area predominantly remains flat and much of the city is below the average mean sea level. This particular feature makes the management of water important. The city has many canals for this purpose to manage water and mobility with it. The combination of these features, makes for a high groundwater table. The is flanked by major rivers, and with a close proximity to the sea brings a fluctuating concentration of salty sea water into some of its canals.

Managing water in the city is therefore not new. There have been many different solutions implemented to solve the various water realted problems that have had impacts on the city. Nature based soltuions have also been an intrinsic part of these solutions. With the rapid change in climate, the resilience of the city is being tested. In order to combat future threats from heavy cloudbursts, the infrastructure in the city is required to be scaled up. With understanding the limits of nature based solutions, realistic urban planning can be made to mitigate urban flooding.

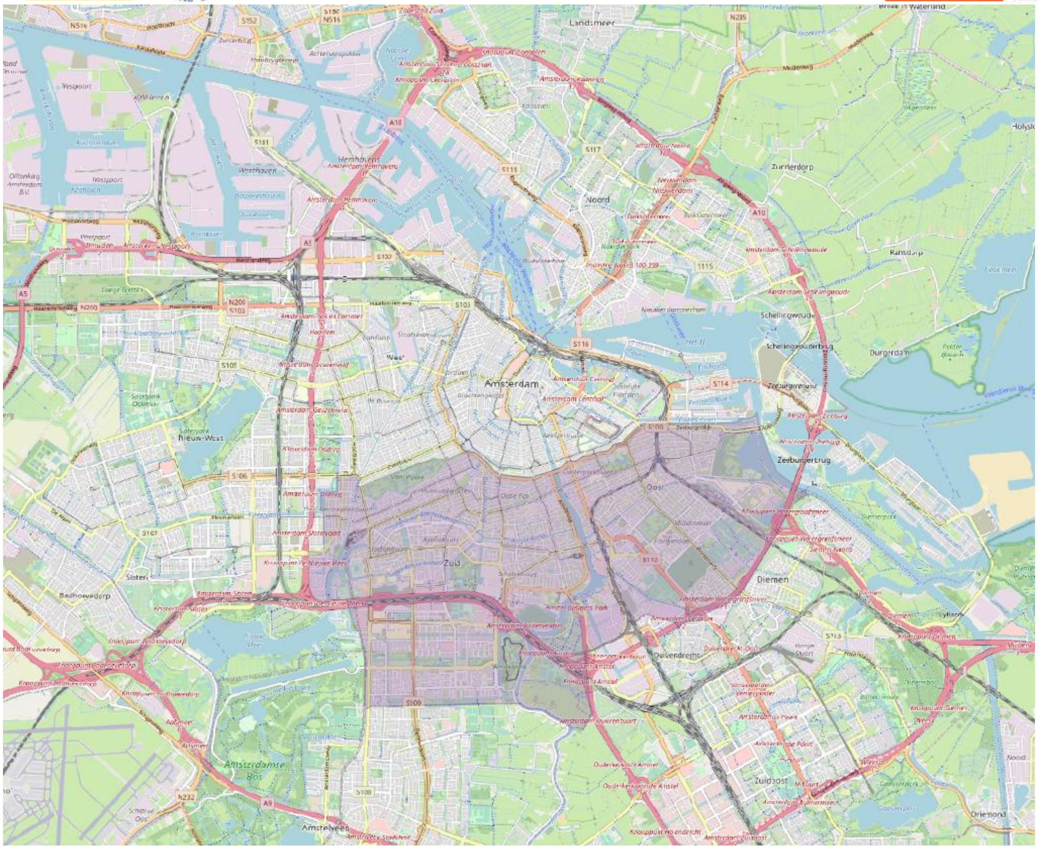

Figure 5: Case study area highlighted in purple.

3. INDICATORS FOR ECOSYSTEM SERVICES (ES) USED FOR EVALUATION OF THE SELECTED NATURE BASED SOLUTIONS

There are several systematic reviews which give an overview on indicators for ecosystem services that can provide relevant information on the complex flow of ES from nature to society (Czúcz et al., 2016).

The Millennium Ecosystem Assessment (MA) classifies the services that ecosystem can provide into *provisioning services* such as food, water supply, biodiversity; *regulating services* such as flood, disease control, atmospheric composition and climate regulation, treatment and handling of waste; *cultural services* such as provision of aesthetic features, spiritual, recreational, cultural benefits and education; and *supporting services*, such as nutrient cycling, soil formation and processes, pollination or energy that maintain the conditions for life on Earth. These categories illustrate the diverse ways in which ecosystems contribute to human well-being (Alcamo J. [et al.] & Bennett E. M. [et al.]., 2003; Pagiola et al., 2004; Breuste et al., 2013; Maes et al., 2014). By following the definition of MA, Pagiola and colaborators listed six main ecosystem services from urban area: food, biodiversity regulation, air quality and climate, human health, detoxification, cultural and amenity (Pagiola et al., 2004).

WP2 used those indicators that can measure the positive impacts of selected blue-green solutions on urban ecosystems, as well as those that will provide useful information about the ecosystem services gained through the implementation of selected case studies, in order to express the benefits of NBS.
The RainSolutions will seek to evaluate the selected case studies under specific scenarios.

As nature conservationists and protectors, we share the concerns and motivation that economic value of the ecosystem are not only a matter of money and market but also a matter of utility, importance, people's preference for the aesthetic value of nature and biodiversity as the basis for life and long-term economic viability (Gomez-Baggethun et al., 2015).

Constructed wetlands and green roofs, as ecosystems service provider in cities, neighborhoods or district areas, consist of multi-structural infrastructures with different properties, which satisfy direct or indirect needs of the people.

Provisioning services **in relation to NBS**

Provisioning Service are the products obtained from ecosystems. Most provisioning services' usage will be reflected in increased extraction or output quantities (e.g. food produced, hydropower) (Badura et al. 2017; Sullivan et al. 2017). Some other of this products, such as fresh water being a linkage between different services, in this case between provisioning and regulating services (Alcamo J. [et al.] & Bennett E. M. [et al.], 2003; Harrington et al. 2010).

Table 1. Indicators and methods for provisioning services related to NBSs sustainability dimension and quality of life

Indicators	Value	Aplicability	Method	Sustainability dimension & quality of life
Water Quality Control	Direct used	Constructed wetlands, Urban planning (water use)	the annual cost to purify the same amount of water using traditional treatment system diversity and productivity	Ecology (integrity of the biotic and abiotic components that contribute to ecosystem service provision) , health and safety, improving outdoors activities, nature experience and recreational activities
Water re-use capacity	Direct used	Constructed wetlands, , Urban planning (water use)	annual cost	hydrological management, provision of water for economic or comercial activities
Biodiversity	Non-used: existence value	Constructed wetlands,	Biodiversity index	Ecology (new habitats), provision of genetic resources, urban health (clean aer)

***Regulating services* used in relation to NBS**

These are the benefits obtained from the regulation of ecosystem processes including: air quality maintenance, climate regulation, water regulation, erosion control, water purification and waste treatment, regulation of human diseases, biological control, pollination, storm protection (Alcamo J. [et al.] & Bennett E. M. [et al.]., 2003; Harrington et al. 2010).

The usage (and value) of many regulating generally increase with the number of people in the relevant area (e.g. flood protection, air and water purification) (Badura et al. 2017) .

Table 2. Indicators and methods for regulating services related to NBSs sustainability dimension and quality of life

Indicators	Value	Aplicability	Method	Sustainability dimension & quality of life
Flood Control	indirect used	Constructed wetlands	The annual cost / drainage area wetland versus total costs / storage capacity	Social and economic dimension, protection of life and goods
Water saving	indirect used	Constructed wetlands; urban planning	total costs / storage capacity	Economic dimension, accessibility

***Cultural services* used in reltation to NBS**

These are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (Alcamo J. [et al.] & Bennett E. M. [et al.]., 2003; Harrington et al. 2010). Natural ecosystems provide almost unlimited opportunities for spiritual enrichment, mental development and leisure. Nature is, therefore, a vital source of inspiration for science, culture and art, and provides many opportunities for education and research (de Groot et al. 2002).

As in case of regulating services, the usage (and value) of many cultural services generally increase with the number of people in the relevant area (e.g. recreation) (Badura et al. 2017) .

People can appreciate the NBS for future generations. The value gained through implementation may be significant, but probably the benefits associated with ecosystem services may not always be captured as monetary value. (Caparrós et al., 2017; Sullivan et al. 2017).

First and foremost, the value of the cultural services due to the implementation of some NBS in certain regions will be obtained by methods based on the concept of social value and methods of evaluating the preferences based on surveys (Tab. 3.).

However, one of the standard procedures of the RainSolutions team will be to select a random sample of the population, who will be challenged to answer a questionnaire in which they must declare the availability to pay to support a program that involves implementation to a NBS which could contribute to the environmental services in their region.

Table 3.. Indicators and methods for cultural services related to NBSs sustainability dimension and quality of life

Indicators	Values	Aplicability	Method	Sustainability dimension & quality of life
Recreations	direct used	Constructed wetlands urban lakes	Social attractiveness indicator (SA)	Social dimension, recreation and stress reduction
Aesthetics	option used	Constructed wetlands, urban lakes,	Interest index score (IS)	Social dimension, cultural heritage, beauty of the environment
Education	option used	Constructed wetlands, urban lakes,		Social dimension, historical legacy, intellectual endowment
Scientific research	option used	Constructed wetlands, urban lakes,		Social dimension, intellectual endowment, communication

Social attractiveness indicator (SA) is used to evaluate the aesthetic, recreational and educational value of the NBS and should be observed in the light of three sub-indices of social attractiveness dimensions: “accessibility”, “habits in leisure time” and “recreational satisfactions” (Krunoslav, 2017).

The selection of the indicators and statistical variables are based on the following categories: age, gender, health status (active person or sedentary ones), educations, social networks, previous knowledge of the benefits provided by urban lakes (***, 2019) or constructed wetlands and the importance of the those areas for the local community and different stakeholders.Accessibility sub-index will be expressed as a value based on the required travel time depending on the way of transportation chosen (on foot, by bicycle, by car). Recreational satisfaction will be associated with habits in leisure (alone or accompanied, group activities, educational activities, scientific activities, etc.) and time consuming for outdoors activities (Tab.4).

Table 4. Ranking value for accessibility, habits in leisure time and recreation satisfactions

Accesibility	Habits in leisure time	Recreation satisfactions	Value
fast (e.g. few minutes)	various activities and long time for outdoors activities	very satisfied	4
relatively quick	various activities and relative long time for outdoors activities	pleased	3
acceptable	little time for outdoor activities	unconcerned	2
relatively long period	interest in the area is present, but no time is allocated for activities in the area	dissatisfied	1
long period (e.g. more de 1 hour)	did not show interest in the area	very dissatisfied	0

The diagnosis will be scored by:

- age categories: young (children and adolescents) up to 25 years of age; adults up to 45 years of age; adults over 45 years of age;
- gender (male and female) and education (low and high level).

The results of survey will be used for setting the values of area or of the Case study.

According with the success of the survey, the comparability across the case studies and communities groups will be performed.

Interest index score (IS) approach in evaluating the ecosystem services generated by the constructed wetlands should be based on the utility, aesthetic value and willingness to pay for implementation of these NBSs (Tab. 5).

The questionnarire design is based on "yes-no" questions included in a interview format.

Table 5. Ranking value for utility, aesthetic value and willignes to pay for green roofs and constructed wetlands

Utility	Aesthetic value	Willigness to pay	Value
Direct & indirect benefits	yes	yes	1
No benefits	no	no	0

The survey could be applicable at the level of authority and local communities.

In order to be able to proceed with a meaningful quantitative analysis, to check their dimensionality and to produce a composite „IS" the communities groups will be divided into low-interest, mediu-interest and high-interest depending on the value of the index.

Supporting services **used in relation to NBS**

Supporting services are those that are necessary for the production of all other ecosystem services (Alcamo J. [et al.] & Bennett E. M. [et al.], 2003; Harrington et al. 2010).

In the case of ecological processes, changes in the primary producers' structure will be recorded as a response to the changes occurring in the nutrient cycle and as the main supplier for the resilience of the NBS, being able to reflect the recovery trajectory and self maintenance of the ecosystems.

Table 6. Indicators and methods for supporting services related to NBSs sustainability dimension and quality of life

Indicators	Values	Aplicability	Method	Sustainability dimension & quality of life
Degree of nutrient removal	Indirect used	urban planning (water use)	Annual cost	Economic dimension
Biodiversity indicator (BI)	Non-used: existence value	Constructed wetlands, urban lakes	the analysis of the presence of groups sensitive to environmental changes (e.g. algae, aquatic vegetations, amphibians and aquatic mammals) before and after the implementation of an NBS for the case study.	Ecology, health and safety, improving outdoors activities, nature experience and recreational activities
Cultural heritage	Non-used: bequest value	Constructed wetlands urban lakes,	The contingent valuation method (CVM)	Social dimension

4. ECONOMIC VALUE OF NBS

The economic assessment depends on the possibility that ecosystem services may or may not be traded on the market, respectively on the component of the value that is measured (Grădinaru, 2013). This is accomplished using a variety of methods and techniques (Fig. 5.).

The most popular criteria are based, on the one hand, on the existence or not of market prices and on the other hand on the way in which preferences are expressed. Market-based methods take into account revealed preferences, while methods that quantify that ecosystem services without market prices are mainly used by stated preferences in relation to a series of scenarios that describe a hypothetical market (Grădinaru, 2013).

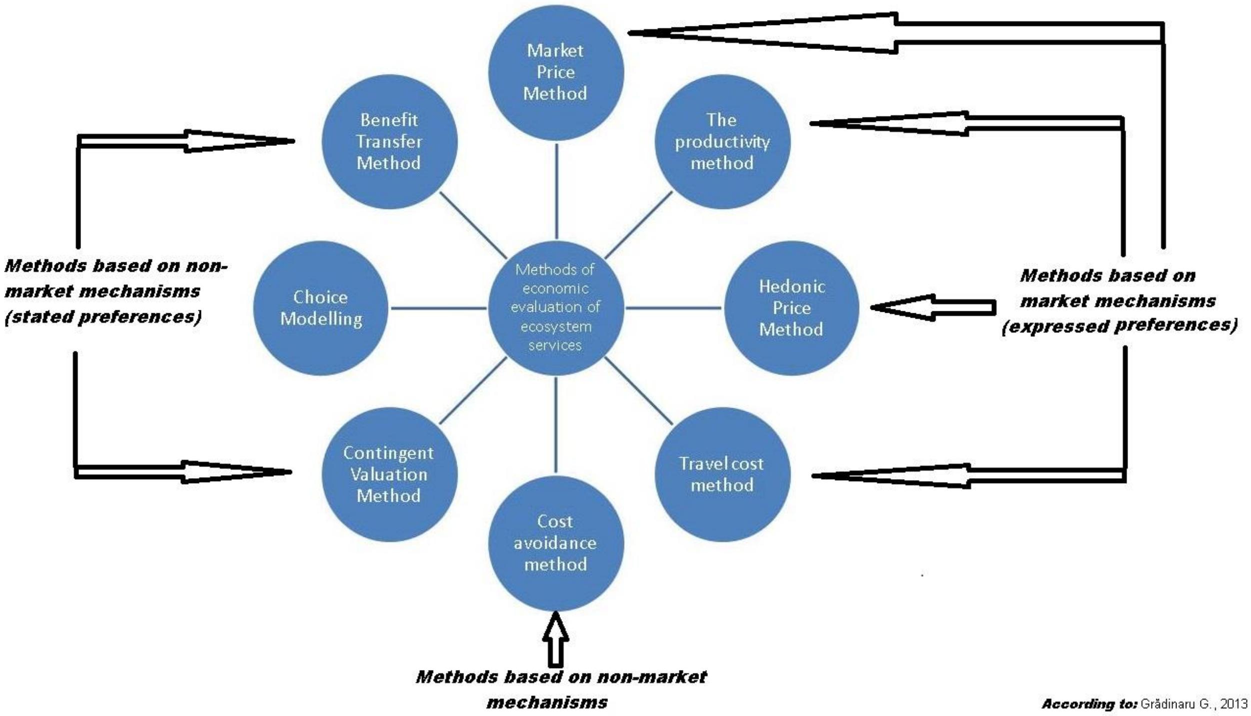

Figure 5. Methods and techniques for quantifying the economic value of ecosystem services

Total economic value (VET)

In order to understand the contribution of the NBS (e.g. green roofs or constructed wetland sites) to the society; to identifiy who are the stakeholders and what they have to gain or lose by implementing those solutions; to evaluate if the NBS is economically worthwhile and financially sustainable, RainSolutions approach has to answer the following sepcific questions:

1. How valuable is the selected NBS for local or regional level?
2. What are the ecosystem services provided by implementing such solutions?
3. Would the benefits of the selected NBS justiy its costs?
4. How the perception of the costs and benefits are distributed among different groups of stakeholders?
5. What are the sources (e.g. privat, local, regional or national budget) of financing?

Providing answers to the above mentioned questions will help to find the most appropriate way for guiding the decision-makers in the process of knowing and taking different courses of actions for the implementation of NBS at local or regional level.

Economists typically classify ecosystem goods and services according to diverse benefits and costs associated with ecosystems. Total economic value (TEV) is the main framework for valuing environmental assets being comprise by the sum between used and non-used values (Pagiola et al., 2004; Yang et al., 2008; ***., 2015a). Use value refers to the value of ecosystem services that are used by humans for consumption or production purposes. Non-use values are also usually known as existence value (or, sometimes, conservation value or passive use value). Humans ascribe value to knowing that a resource exists, even if they never use that resource directly. (Alcamo et al., 2015).

Taking into consideration, the many valuable ecosystem services that can be provided by wetlands or green infrastructures, as well as the limitations due to data collection, the total economic assessment is an important challenge. As a consequence, the evaluation of NBS's VET for the present study is based on the experts' opinion, regarding the most appropriate indicators for the selected case studies (Fig. 6.)

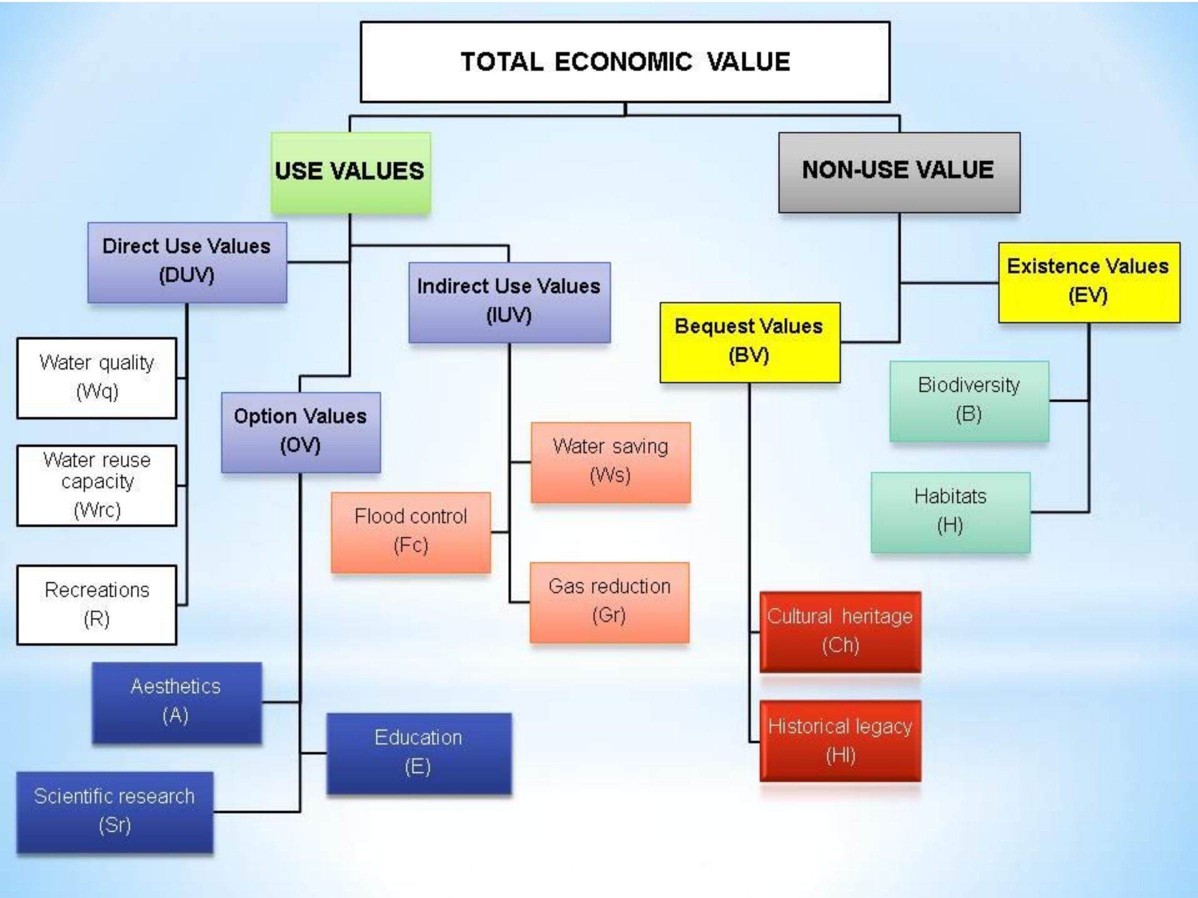

Figure 6. Schematization of the proposed economic evaluation for the selected case studies

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