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## D4.4 – Web-based tool development to forecast social and economic trade-offs and benefits for NBS implementation in cities

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# Table of Contents

|   |           |
|---|-----------|
| <b>Table of Contents</b> .....  | <b>4</b>  |
| <b>List of Figures</b> .....  | <b>5</b>  |
| <b>List of Tables</b> .....   | <b>6</b>  |
| <b>Glossary</b> .....   | <b>7</b>  |
| <b>Executive Summary</b> .....  | <b>8</b>  |
| <b>1. Introduction</b> .....  | <b>10</b> |
| 1.1. Background and purpose .....   | 10        |
| 1.2. Objectives .....   | 12        |
| 1.3. Contribution of partners .....   | 13        |
| 1.4. Target audience .....  | 14        |
| 1.5. Relation to other tasks of Nature4Cities .....                                       | 14        |
| 1.6. Report structure .....   | 16        |
| <b>2. Description of the Decision Support System (DSS)</b> .....                          | <b>17</b> |
| 2.1. Design of the system dynamics model for the DSS.....                                 | 18        |
| 2.2. Building of the DSS.....   | 22        |
| 2.3. Steps to operating the DSS.....  | 24        |
| 2.4. DSS Outputs.....   | 26        |
| <b>3. DSS testing phase</b> .....   | <b>27</b> |
| 3.1. Pre-calculation of urban forest archetypes and scenarios (archetypes database) ..... | 27        |
| 3.2. Application of the DSS to Valdebebas Park .....                                      | 32        |
| <b>4. Discussion and Conclusions</b> .....  | <b>35</b> |
| <b>Appendix I</b> .....   | <b>38</b> |
| <b>Appendix II</b> .....  | <b>40</b> |
| <b>References</b> .....   | <b>42</b> |

## List of Figures

|  |    |
|--|----|
| Figure 1 Diagram of relations between Task 4.4 and task from other WPs in Nature4Cities. ....  | 14 |
| Figure 2 Schematic diagram of Design, Building and Operation stages of the DSS including generation of outputs .....   | 17 |
| Figure 3 Outline of the main components of the DSS (including the type of outputs) and their relationships; SD = system dynamics; API = application programming interface; CBA = costs-benefits analysis; ES = ecosystem services.....   | 22 |
| Figure 4 NBenefit\$ web user interface, components and description. ....   | 25 |
| Figure 5 Online report and graph visualisation generated by the web user interface. ....   | 26 |
| Figure 6 Disaggregated archetypes and scenarios for the urban forest NBS. Each scenario includes a row of perennial species and a row of deciduous species. The legend identifies the species selected.....  | 28 |
| Figure 7 Illustrative visualisation of the average biophysical values for local climate regulation (potential transpiration) for all the archetypes and scenarios along an entire operational life. A) Shows long-term changes in benefits for the month of January. B) Shows short-term (seasonal) changes for a specific year. ....  | 29 |
| Figure 8 Illustrative visualisation of the standard deviation biophysical values for local climate regulation (potential transpiration) for all the archetypes and scenarios along an entire operational life. A) Shows long-term changes in benefits for the month of January. B) Shows short-term (seasonal) changes for a specific year.....  | 30 |
| Figure 9 Illustrative visualisation of the average monetary values for local climate regulation (potential transpiration) for all the archetypes and scenarios along an entire operational life. A) Shows long-term changes in benefits for the month of January. B) Shows short-term (seasonal) changes for a specific year. In both cases, the monetary values are adjusted for the purchasing power of Euro at 2017 and taken into account a standard discount rate of the 3%. .... | 31 |
| Figure 10 a) site boundary of Valdebebas Park in Madrid with the zone of the park used as a case study; b) division of the case study by cells and identification of cells with trees under paved and non-paved conditions.....  | 32 |
| Figure 11 Average monetary values for local climate regulation for the case study of Valdebebas Park. A) Results for Young Clean Parks; B) results for Young Green Park. Small variations occur between both scenarios that in terms of accumulated value can only be distinguished in the long term. In both cases, the monetary values are adjusted for the purchasing power parities to Euro at 2017 and taken into account a standard discount rate of the 3%. ....                | 33 |
| Figure 12 Illustrative costs-benefits analysis synthetic reports of A) Young Clean Park and B) Young Green Park scenarios. ....  | 34 |

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## List of Tables

|  |    |
|--|----|
| Table 1 Benefits and costs, the modelled processes influencing them, and inputs for modelling included in the Urban Forest SDM (further details on this can be found in the deliverable D4.2).....                               | 19 |
| Table 2 Definition of the type of conditions, specific variables defining each condition, and set of values considered per variable whose individual combination provide a defined scenario .....                                | 20 |
| Table 3 Archetypes of urban forest for early, intermediate and advanced stages. 1st and 2nd level aggregated archetypes correspond to detailed land use/cover classes as the ones used in early planning and design stages. .... | 21 |
| Table 4 Illustrative comparison between NBenefit\$ and other well-known DSS tools to perform ecosystem service (ES) assessments. ....  | 37 |

## Glossary

| <u>Acronym</u> | <u>Full name</u>   |
|----------------|--|
| <b>API</b>     | Application Programming Interface                          |
| <b>CICES</b>   | Common International Classification for Ecosystem Services |
| <b>LCC</b>     | Life Cycle Costing   |
| <b>DSS</b>     | Decision Support Systems                                   |
| <b>ES</b>      | Ecosystem Service(s)                                       |
| <b>GUI</b>     | Graphical User Interface                                   |
| <b>MAES</b>    | Mapping and Assessment of Ecosystems and their Services    |
| <b>MIMES</b>   | Multiscale Integrated Modelling of Ecosystem Services      |
| <b>NBS</b>     | Nature-based Solutions                                     |
| <b>PPP</b>     | Purchasing Power Parity                                    |
| <b>SDM</b>     | System Dynamics Model                                      |
| <b>TEEB</b>    | The Economics of Ecosystems and Biodiversity               |
| <b>UC</b>      | Urban Challenge  |
| <b>UES</b>     | Urban Ecosystem Service(s)                                 |
| <b>USC</b>     | Urban Sub-Challenge  |
| <b>UN</b>      | United Nations   |
| <b>WP</b>      | Work Package   |

## Executive Summary

The concept of ecosystem services (ES), i.e. the benefits that people obtain from nature, is gaining relevance for planning, design and decision making in urban contexts. This relevance have been particularly pushed forward by policy makers, built environment professionals, and researchers with the application into urban studies of nature-based solutions (NBS). The study of ES helps indeed to internalize natural benefits, usually considered an externality, into the decision-making process.

As part of the efforts to operationalize the ES concept, its implementation in real practice and decision-making, many ES assessment methods, models and tools have been developed so far. However, in many cases these instruments are framed in a local manner, are not cost-effective, and/or provide qualitative outputs only, making more difficult the operationalization of ES. Consequently, generalizable methods, transferable to a broad range of settings, have started to be developed in the form of modelling tools that act as decision support systems (DSS). These can allow decision-makers assessing specific ES supply as well as trade-offs and synergies among ES in a quantitative form, and using monetary assessment techniques.

In this regard, NBS by definition need to be cost-effective. In urban contexts, NBS are part of complex urban interventions that require the collaboration of several built environment professionals like architects, landscape architects, urban designers, environmental engineers or urban planners. To optimise the work of these professionals, DSS for NBS need to be integrated early in their workflows with a minimum additional effort from their side. Hence, to advance the operationalisation of ES and NBS in urban contexts, user-friendly DSS shall be designed, built, and operated for NBS to support built environment professionals from early project stages and costs-benefits analyses.

The present report illustrates the structure and functionalities of “MIMES-LIST”, a DSS tool developed within the framework of Task 4.4’s activities in the Nature4Cities project. The aim of Task 4.4 was to build a visualization web interface where the end-user (decision-maker, urban planner, etc.) is asked to create spatial and time-dependent scenarios of possible implementation of NBS in cities, and then run simulations to quantify the potential socio-economic impacts associated with those scenarios (in terms of site-specific biophysical and climatic conditions and land management characteristics), using archetypal NBS (i.e. pre-parameterized models of NBS types, e.g. urban forests, green walls/roofs, urban wetlands, ...). In so doing, the purpose of MIMES-LIST is to inform built environment professionals and decision makers about the cost-effectiveness of different NBS alternatives from early to advance planning and design stages.

Despite developed independently as a stand-alone visualisation instrument, MIMES-LIST will be incorporated in the Nature4Cities Platform as the operational module to allow performing socio-economic assessments in compliance with the user-scenarios and archetypes defined in the platform. Deliverable D4.4 thus includes a technical description of the approach undertaken to create the DSS tool and an explanation on how to pre-calculate the archetypes and scenarios

(archetypes database) to run the software, together with an illustration of the posterior use of the DSS for a case study of a real urban forest by built environment professionals.

While “MIMES-LIST” was the initial name given to the tool when designing its integration in the Nature4Cities Platform, the LIST team has officially renamed the DSS “NBenefit\$”, which stands for “Web-based (geo)tool for monetary and biophysical valuation of ecosystem services supplied by nature-based solutions”. NBenefit\$ is therefore a novel web-based prototypal DSS to enable predictive simulations and visualisation of socio-economic impacts associated with NBS. The tool implements an original modelling approach (based on a multiscale spatially-explicit and integrated system dynamics framework) for the assessment of ES associated with NBS in cities. It allows selecting urban challenges and/or urban ES, filtering NBS alternatives and visualizing impacts (costs and benefits in terms of physical and monetary ecosystem service values at different spatial and temporal conditions).

More specifically, NBenefit\$ employs pre-calculated archetypes and scenarios making use of a system dynamics modelling framework of NBS developed in the Tasks 4.1 and 4.2 of Nature4Cities. As anticipated above, the methodological approach underpinning the DSS is illustrated in this report making use of a specific NBS model of urban forest (as a proof-of-concept) previously introduced in the deliverable D4.2. This model calculates ES supplied by urban NBS in biophysical units later transformed into monetary units, which can be used as inputs in costs-benefits analyses. Additional costs and externalities along the life cycle of NBS are also accounted for and incorporated as inputs of the costs-benefits analysis. To overcome current data limitations the model balances data requirements against accuracy of outputs. The Nature4Cities team developing the socio-economic assessment module expects that this, together with the user-friendly interface underpinning NBenefit\$, will encourage built environment professionals to integrate NBS evaluation in their early workflows and demonstrate to decision makers the utility of detailed urban monitoring based on ES analysis.