

Visualizing and analyzing urban ecosystem services' values for municipal planning in greater Stockholm (Nacka), Sweden

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Summary

Our natural environment is under increasing pressure from urbanization, globally and locally. In order to help local decision makers visualize and include ecosystem services in community and urban planning, the global initiative TEEB (The Economics of Ecosystem and Biodiversity) has produced a set of general guidelines.

We have followed TEEB's workflow by performing an initial set of stakeholder analyses within a pilot area in greater Stockholm (Nacka), Sweden, this by arranging workshops followed by a visualization of the stakeholders' mapping and appraisal of the local ecosystem services. Nacka's comprehensive plans regarding greenspace, coastal waters and cultural environment were used as background material. The results were digitized in order to model and visualize the results in a GIS (geographical information system). One important result was how to translate existing analog and digital background material for valuation in GIS that corresponds to the TEEB method. Ecosystem services can be divided into four categories: Provisioning, supporting, regulating and cultural services. The most relevant services in the pilot area were the regulating and cultural ecosystem services. This occurred by using an evaluation tool to assess the number of services as well as their potential levels. The area's cultural ecosystem services concern mostly physical recreation, social contact, mental and physical public health. The regulating services deal mostly with nutrient retention and stormwater runoff.

As for the cultural ecosystem services, a valuation method in GIS was developed built on MapAlgebra, weight matrix tables and multicriteria analyses. In addition to the stakeholders' mapping, the method was based on the already digitized "experience values" and was implemented in a GIS model. So as to produce a joint weight analysis, this model also took into account the number of people living within close range to areas with ecosystem services. The extent of valuable services was analyzed and presented through a set of thematic maps and summary tables of obtained "ecopoints". Given a specific built-up area development the GIS model indicated an ecopoint decrease of 11% of the cultural ecosystem services between the years 2014 and 2030. By this method it is therefore possible to test how the point value sums are affected depending on different housing development alternatives.

For the two regulating services, two calculation methods were tested: One was InVEST which calculates nutrient retention and monetary values, another was MIKE Urban used for assessing stormwater runoff services. These models identify which ecosystem services are favored or disfavored by a proposed development in the area while generating thematic maps showing monetary appraisal, nutrient content or runoff ecopoints. Based on the assumed development the calculation methods indicated that the point value indeed falls in areas where buildings are constructed on greenspace but also that the value might increase where new housing is built on property with previously intensive infrastructural land use.

The study shows that the three valuation models provide guidance where construction in greenspace areas is unsuitable but also where new greenspace areas can be created, in order to maximize the ecosystem services' total value within the pilot area. An additional conclusion can be drawn that the process using model scenarios might by itself increase the stakeholders' appreciation for the ecosystem services' dynamic and various sensibility to urbanization forces.

Keywords: ecosystem services, nature-based solutions, urban planning, TEEB, InVEST, GIS, multicriteria analyses, valuation models