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ECOSYSTEM SERVICES IN THE APPRAISAL OF THE ECONOMIC PERFORMANCE OF URBAN REGENERATION PROJECTS EXEMPLIFIED BY THE JESSICA INITIATIVE

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ABSTRACT: The purpose of this paper is to indicate the valuation importance of externalities derived from the urban ecosystem services (UES) in terms of their applicability in the appraisal process of urban regeneration projects co-financed from European funds. Specifically, it examines the impact of UES on the project's economic performance, and thereby on human quality of life. Using the discounted cash flow method, this paper estimates the project's economic performance indicators including the identified UES upon their prior valuation. The valuation was carried out on the basis of the benefit analysis, contingent valuation method – "willingness to pay" – and benefit transfer method, as recommended by Bernaciak, Wojcieszak (2014) and Zawojska et al. (2016). Results show that urban projects including UES are characterised by the higher values of the economic performance indicators and they should be assessed higher than projects with little or no UES because of their stronger contribution to the sustainable development of urban areas. In spite of the fact that there are limitations due to the UES valuation techniques used in the study, the presented approach could be an important tool for the project's appraisal.

KEY WORDS: urban ecosystem services, environmental externalities, economic performance, urban regeneration, JESSICA initiative

Introduction

Many Polish cities have faced economic hardships in recent years, mainly due to structural changes in the national economy. The most common problem is the relatively high levels of socio-economic disparities, which are proving to be a major challenge in urban areas. The existing inequalities, arising from the progressive degradation of the material substance as well as adverse demographic changes, have had a negative impact on the local labour market and discourage businesses from investing (OECD, 2011). In order to counteract this tendency, a considerable number of regeneration projects have been implemented aimed at supporting sustainable urban development through an integrated approach that takes up the social, economic, demographic and environmental challenges of urban areas.

Dealing with multiple aspects of sustainable development, all urban projects need to face the challenge of protecting the environment and promoting a more efficient and responsible use of natural resources. It means that individual projects should pursue operations to upgrade the physical environment on the one hand, but, on the other, they may also use the components of nature in a safe and responsible manner to improve resilience and quality of life in cities. All kinds of benefits that derive from the environment through natural processes, commonly known as ecosystem services (ES), should be taken into account when planning urban regeneration activities (Markandya, 2016). However, each project is subject to specific rules and assessment procedures to make sure that it is in line with general environmental objectives and provides the expected economic and social benefits. For instance, all the projects co-financed from European funds are assessed in the view of both the financial profitability and the economic performance. This entails, in turn, quantifying all possible ES and expressing their value in purely monetary terms, so that they could be included in the economic performance indicators.

A limited amount of available financial resources, combined with the relatively large-scale needs in urban areas, resulted in creating a new instrument, i.e. the JESSICA initiative (Joint European Support for Sustainable Investment in City Areas). JESSICA, contrary to traditional grants, consists of the use of revolving instruments (loans, guarantees) that allow for achieving a multiplier effect of the actions implemented (Musiałkowska, Idczak, 2018a). The JESSICA regulations indeed provide that the projects should not only ensure financial viability, but should in particular achieve socio-economic and environmental returns. Put simply, the projects should contribute substantially to the quality of life by generating broadly defined benefits that

enrich communities as a whole. In this sense, ES may be considered as a special type of externalities that spill over from the regeneration projects and affect the society at large. Thus, the main aim of the study is to demonstrate the valuation importance of externalities derived from the urban ecosystem services (UES) in terms of their applicability in the appraisal process of urban regeneration projects. In order to achieve this aim, we will focus on identifying those urban ES which can be recognized, with regard to regeneration projects, as appropriate for enhancing people's living conditions in cities. Subsequently, the identified ES will be valued. As a next step, with the use of the cost-benefit analysis indicators, the ES impact on the economic performance of regeneration projects will be assessed. The study builds on the data in principle on all projects implemented within the framework of the JESSICA initiative in Poland during the 2007–2015 period. However, the research sample covers five projects, one from each region implementing the JESSICA.

This study contributes to the debate on UES and, by showing their complex and valuable nature, highlights that they should be an area of particular interest for policy-makers, especially in the fields of sustainable urban development.

An overview of the literature – ES as urban environmental externalities

Ecosystems provide a great variety of basic functions that are essential for the sustainable use of the natural resources and thus serve the purpose of safeguarding the earth's capacity to sustain life in all kinds of its diversity. It seems intuitive to start by defining ES. De Groot, Wilson, Boumans (2002, p. 394) argue that ecosystem functions are the results of natural processes and components which provide goods and services that, in turn, satisfy human needs, directly or indirectly. Along their line of thought, these functions give rise to ES which subsequently may be utilised by human beings. Boyd, Banzhafa (2007, p. 619) consider ES as "components of nature, directly enjoyed, consumed, or used to yield human well-being". The major point here is that only the end-products of nature can be seen as ES and not intermediate services or goods. Fisher, Turner, Morling (2009, pp. 644-646) extend this concept and note that ES are all aspects of ecosystems which can be utilised in an active or passive manner by humans to produce their well-being. Hence, ES are, apart from goods, both functions and processes as well if there are humans that benefit from them. Many other researchers also refer to this approach and define ES in a wide sense as the overall benefits that people receive from ecosystems (Mizgajski, 2010; Mrozik, Idczak, 2017; Poskrobko,

2010; Solon et al., 2017; Żylicz, 2010). Thus, it is argued that ES are all those services which make humans beneficiaries of ecosystems.

When dealing with ES, a particular attention in the literature is drawn to urban ecosystem services. The functioning of cities depends to a large extent on a healthy natural environment that, on the one hand, still provides many benefits, i.e. ES, whilst – on the other hand – it determines their development by indicating the carrying capacity (more details on this topic can be found in for instance: Carey, 1993; Idczak, Mrozik, 2017). A central aspect of these writings is the emphasis on sustainable urban development because ES have a positive and lasting impact on human well-being and economic activities which, in principle, should be consistent with a sustainable social and physical environment (Lorek, 2015, pp. 102-103). Urban ecosystems are shaped mostly by the green and blue spaces that may be found in urban and peri-urban areas including parks, gardens and yards, cemeteries, business settings, urban allotments and forests, single trees, green roofs, wetlands, streams, rivers, lakes, ponds, etc. (EEA, 2011, pp. 30-36). In this respect it should be underlined that the quality of life in cities depends on urban ecosystem services (UES). They offer spaces for instance for social interactions and places for children's play in the neighbourhood. Moreover, they provide opportunities for stress recovery, physical activity and leisure time, and play an essential role in protecting health. In addition, UES contribute substantially to preventing flooding and reducing the urban heat island effect (EEA, 2011, pp. 40-47; Kronenberg, 2012, pp. 16-27). In sum, there is a rationale for UES as natural benefits that are economically viable and sustain human communities.

As regards urban ecosystems, there are strong arguments that they may be considered as positive environmental externalities. Laffont (2017) referring to the general equilibrium theory claimed that externalities are indirect effects of activities on "agents other than the originator of such activities which do not work through the price system". This means, in other words, that someone's performance (e.g. in production or services) depends on factors that are outside her or his control, but are determined by other producers or humans. What is more, the benefits or costs of these factors cannot be omitted from someone's activity (Krugman, Wells, 2012, pp. 765-798; Stiglitz, 2013, pp. 253-286). However, in contrast to many researchers (Capello, Faggian, 2002; Hołuj, 2018; Paradowska, 2006; Regnier, Legras, 2018; van den Bergh, 2010; Verhoef, Nijkamp, 2008) who explore environmental externalities mainly as negative effects arising from the ongoing increase in levels of urbanisation, urban ecosystems that go hand in hand with urban sustainable development may provide a range of benefits for city's residents. This, in turn, suggests that the provider of these benefits cannot receive any compen-

sation, that is, they are non-market benefits. Nevertheless, these benefits can occur as direct or indirect outcomes of measures or concrete projects implemented in urban areas, and consequently can be used for the appraisal of their total welfare effects on society (Fiedor, 1990). Thus, the positive environmental externalities (benefits provided by UES within the framework of urban projects may induce positive side-effects not only on the environment but also on society. These are then known as positive social externalities. In this study, however, we do not split the positive externalities into these two categories) provided by UES can be applied in the assessment of the economic efficiency of urban projects in which the environmental aspects have an important relevance (Máñez, Cerdà, 2014, pp. 19-22). It should be added that they are often neglected in the assessment analysis because they are difficult to measure and, more importantly, often difficult to value.

The JESSICA initiative to support sustainable urban development

The JESSICA initiative was introduced to the EU Cohesion Policy by the European Commission, the European Investment Bank (EIB)and the Council of Europe Development Bank in order to increase the amount of funds for the sustainable development of urban areas. The initiative is based on a revolving mechanism that employs the use of loans or guarantees under one of the structural funds – the European Regional Development Fund. It was an innovative and experimental approach to the planning of activities and projects by many entities, namely: regional authorities responsible for designing the scope of operational programmes (which are crucial documents for implementing the Cohesion Policy), EIB – being a so-called holding fund for the JESSICA allocations, Urban Development Funds (mainly private or semi-public institutions such as banks or development banks, e.g. Bank Ochrony Środowiska, Bank Zachodni WBK S.A., Bank Gospodarstwa Krajowego) that together with EIB introduce the elements of risk assessment and the market approach to the public intervention projects, and local authorities that are in charge of the delimitation of regeneration areas in the cities and are main stakeholder interested in solving the problems on degraded urban areas. It aimed at starting the multiplier effect, financial leverage, catalyzing public-private partnerships and the exchange of know-how between private and public partners (see figure 1) (Memorandum of Understanding, 2006). In Poland, the JESSICA initiative has been implemented since the very beginning – the 2007-2013 EU financial perspective. Five Polish regions: Mazowieckie, Pomorskie, Śląskie, Wielkopolskie, and Zachodniopomorskie

decided to include the initiative into their regional operational programmes. The scope of projects eligible for obtaining a loan was very broad and included e.g.: urban infrastructure (including for transport, water and sewage systems or power), heritage or places relevant to the culture (contributing to the development of tourism or other permanent use), development of brownfield sites (including cleaning and decontamination of the areas), creation of new commercial premises for small and medium-sized enterprises, development of information technology and research and development works, expansion of university buildings, and improving the energy efficiency (European Commission, 2013).

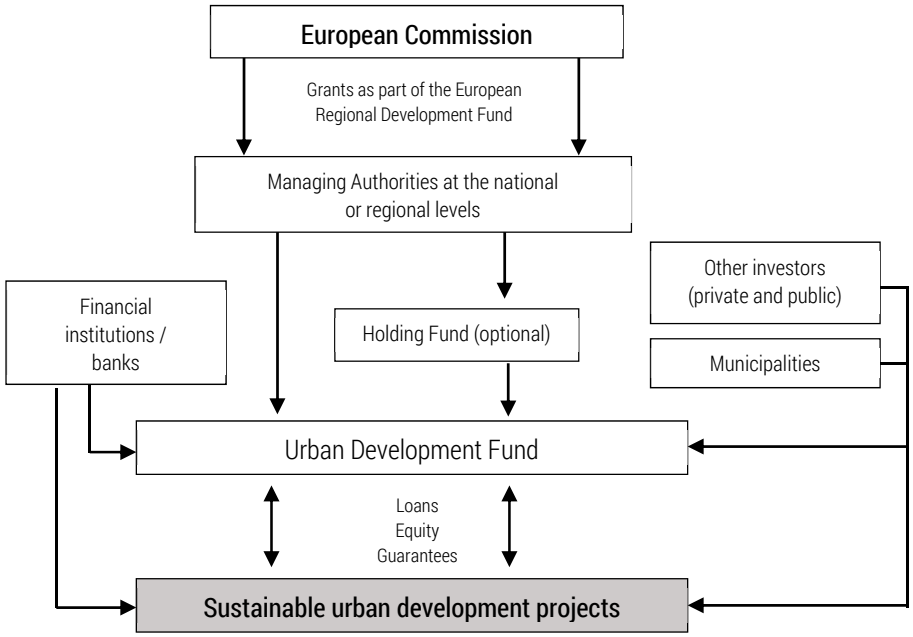

Figure 1. JESSICA implementation system

Source: Dąbrowski, 2014.

JESSICA had to be implemented through an integrated approach, which meant that "the measures concerning physical urban renewal should be combined with measures promoting education, economic development, social inclusion and environmental protection" (European Commission, 2014b). The urban projects executed within the framework of JESSICA were expected to render positive externalities for urban inhabitants, particularly in areas having substantial needs for a long period (reducing of negatives states, and increase in the quality of the life and work of citizens). The JESSICA projects

should incorporate all the driving factors considered as important for determining sustainable urban development and take into account urban problems in a coordinated way so as to be sustainable for themselves and for the entire city (Nadler, Nadler, 2018). Thus, each project required a comprehensive approach i.e. one tailored to the local needs, combining various aspects on a case-by-case basis: economic development, social integration, education culture, environmental issues, spatial planning, etc. (Musiałkowska, Idczak, 2018b). Only such projects have the potential to achieve results with regard to sustainable urban development and deliver a real added value.

Assessment of the economic performance

JESSICA projects must demonstrate not only a financial profitability that shows a project's ability to generate profits from its operations and determines return on investment (Musiałkowska, Idczak, 2018a), but also an economic efficiency that points out the project's contribution to welfare. Hence, the economic performance provides information to what extent a particular project, through its economic, social and environmental aspects, will contribute to the creation of social well-being. It covers as far as possible all the social and environmental externalities generated by the projects. This is possible because an economic analysis is made on behalf of the whole of society instead of just the project owners, as in the financial analysis (European Commission, 2014a, pp. 61-65). Economic analysis is one of the steps of the cost-benefit analysis (CBA) that provides the methods to be used to value all the benefits against all the costs created by the project and thereby constitutes an effective instrument for decision making on the co-financing of projects from public funds (including European funds). The CBA techniques are also recommended as useful tools to assess projects or policies aimed at improving the natural environment or other actions that affect certainly the environment as an indirect consequence (Atkinson et al., 2018, pp. 32-36; Kryk, 2003, pp. 71-108). In this sense, the importance of including ecosystem service values in the assessment analysis of projects or policies is significant and conducive to making decisions of greater benefits to society (Markandya, 2016).

CBA takes into account the advantages or disadvantages of an investment including tangible and non-tangible benefits (or costs) which cannot be valued in monetary terms in order to assess the project's economic performance (Kryk, 2013). These benefits can also generate positive non-market impacts and this is the reason why they, in the context of CBA, need special attention to be covered by the assessment. The impacts defined here as UES that spills

over from the project towards society must be expressed in measurable terms. The most common way to do this is to monetise the benefits and, by doing so, to obtain comparable financial values. Following this, these monetised benefits are used at the stage of the economic analysis to correct the financial cash flows by inserting their values to the cash flow statement. As a result, it is possible to measure the economic efficiency by calculating the economic performance indicators (for more, see next section). A project that is characterised by higher values of economic performance indicators, i.e. shows higher economic profitability, is more desirable because it provides goods or service, including also UES, which are more relevant for society.

Research methods

This section of the study seeks to examine empirically the importance and impact of UES in the appraisal of urban regeneration projects co-financed from European funds. This section outlines in particular the methods used to assess the impact of UES on the economic performance of this kind of projects. The research design is guided by the existing literature exploring links between ES and the urban perspective which was discussed in the previous sections. The empirical framework configured here consists of four stages that are discussed below.

1. *Identification of UES.* Firstly, we identified those urban ecosystem services which can arise along with implementing particular urban projects, and can be recognized, with regard to analysed projects, as appropriate for improving their economic efficiency through a positive effect on economic performance indicators. To do this we used in particular the concept of ecosystem services for Poland set out by Mizgajski and Stępniewska (2012, pp. 63-64).
2. *Valuation of UES*. This refers to putting a value on previously identified UES. As a result, the monetary valuation of UES provides evidence which can be incorporated into a project's financial accounts. Admittedly, in carrying out this ambitious task we confined our works to applying methods delivered by existing studies. More details on this will be given in the next section.
3. *Inclusion of UES in the project's cash flows*. This procedure aims at adding up the monetised UES to the economic cash flows. By doing so, we received economic performance indicators that include the impacts of UES on human quality of life. The economic analysis was made with the use of the discounted cash flow (DCF) method. The following rules were adopted (European Commission, 2014a):

- only cash inflows and outflows were considered,
- economic discount rate (EDR) – 5%,
- time horizon of the cash–flow forecasts covers 30 years,
- analysis carried out in constant (real) prices, i.e. fixed at a base–year,
- prices were net of VAT.

Economic performances were measured by two indicators – the Economic Net Present Value (ENPV) and the Economic Rate of Return (ERR) that are defined as follows:

$$ENPV = \sum_{t=0}^{n} a_t(S_t + UES_t^m) = \frac{(S_0+UES_0^m)}{(1+r)^0} +, \\ + \frac{(S_1+UES_1^m)}{(1+r)^1} + \cdots + \frac{(S_n+UES_n^m)}{(1+r)^n}, \tag{3}$$

$$ENPV = \sum_{t=0}^{n} \frac{(S_t+UES_t^m)}{(1+ERR)^t}, \tag{4}$$

where: S is the balance of cash flows at time t, and a_t is the economic discount factor chosen for discounting at time t. UES_t^m, in turn, denotes the monetised volume of the urban ecosystem services that were identified in urban projects at time t. Finally, r indicates the economic discount rate.

4. *Interpretation of the economic performance indicators*. The last step consists in comparing two options of results obtained from the use of the DCF method, where one option means "no UES in the cash flows", and another option involves adjusting the cash flows through the incorporation of UES. Projects including UES should indicate higher values on the economic performance indicator and thereby make a stronger contribution to the sustainable development of urban areas.

The empirical analysis presented in this study builds on a dataset containing details on all projects implemented within the framework of the JESSICA initiative in Poland during the 2007-2015 period. The data were provided by the Marshall Offices of all regions implementing the JESSICA initiative and also institutions acting as managers of the Urban Development Funds. The dataset was further completed with information derived from our own examination of other sources such as project descriptions, policy reports, official websites and field studies. All data on particular JESSICA projects stemming from various sources were merged for the purpose of this study and therefore enable studying the effect of UES on the project's economic efficiency.

Results of the research

The key empirical findings stemming from the study are summarised in table 1. However, before interpreting our results, we would just like to present in detail a few additional assumptions made during the research which underpin these findings. First of all, five projects were selected for the examination, that is, one from each of the regions in the analysis. The main criterion for the choice of projects for the purpose of this study was simple – those projects were taken which permitted the identification of UES in a clear and unambiguous manner. As a result, we have pointed to the two main groups of UES, where the first refers to the urban microclimatic regulation provided by trees and green areas, and the second covers the recreational (social) function. In order to estimate the economic value of the benefits, we used the minimum service value approach – which means that only those benefits are included in the valuation whose quantity and value can be calculated most precisely (Bernaciak, Wojcieszak, 2014, pp. 190-193). As for the benefits supplied by trees and green areas, we valued the absorption of carbon dioxide, oxygen production and water retention. To this end, we applied reliable techniques based on the recommendations of Bernaciak and Wojcieszak (Bernaciak, 2015; Bernaciak, Wojcieszak, 2014). When it comes to the valuation of the recreational (social) function, we used a similar procedure as described for instance by Lupa (2013); however, this was apart from the fact that the prices in the method (*Contingent Valuation Method – Willingness to Pay*) were taken from other studies, and do not result from the survey. This is since the procedure refers to the benefit transfer technique following the study of Zawojska et al. (2016) which provides a brief overview of how to extrapolate the results of other studies. It is also worth noting that the valuation of EUS as such was not the subject of the study but only a significant means to achieve the study objectives.

Returning to the findings, it is now possible to state that UES may have a significant impact on the given project's economic efficiency. The results displayed in table 1 confirm our expectations, and illustrate that the incorporation of the monetised UES into the given project's cash flows leads to an increase in the level of economic performance indicators – see the two last columns. A closer look at the values of these indicators reveals an evident increase of their value in all the projects analysed. However, what also clearly emerges from these columns are distinct differences in the level of the indicators between the first two projects and the other. The first two projects deal directly with the natural environment by creating the conditions conducive for people's physical activity and health, while preserving the natural resources and ensuring the need for their sustainable use. For instance, the

Table 1. JESSICA projects: the identified urban ecosystem services and their valuation

Region	Project's name	Project's value	CICES Section*	Ecosystem Services Class	Benefits**	Value of provided benefits a year	Increase of ENPV by PLN	Increase of EIRR by p.p.
Mazowieckie	Enhancing the quality of life of the inhabitants of the city of Legionowo through the construction of the "Health Park" in the urban regeneration area	2 941 176.47	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and green areas	1220.52	576 009.84	3.18
			Cultural	Cultural landscapes	recreational (social) function	45 000.00		
Pomorskie	Land use at Sikorski street through the construction of the sports and recreational facilities in Pruszcz Gdański	1 742 484.87	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and shrubs	18 732.86	345 612.73	4.97
			Cultural	Cultural landscapes	recreational (social) function	9000.00		
Śląskie	Providing new functions of the hospital and its green areas through the creation of a place for the leisure and relaxation facilities and the reconstruction of a part of the hospital's building aiming at the establishment of the dialysis clinic in Jastrzębie Zdrój	3 379 102.03	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by green areas	1453.00	74 187.54	0.38
			Cultural	Cultural landscapes	recreational (social) function	4500.00		
Wielkopolskie	Development of the Poznań Industry and Technology Park – stage II	30 360 000.00	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and green areas	6384.41	79 563.80	0.04
Zachodnio-pomorskie	Reconstruction of the old "Goplana" cinema into the Cultural Centre in Połczyn Zdrój	5 567 205.98	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees	9037.47	174 937.93	0.54
			Cultural	Cultural landscapes	recreational (social) function	5000.00		

* CICES – The Common International Classification of Ecosystem Services

** AofCD – the absorption of carbon dioxide, OP – oxygen production, and WR – water retention by trees and green areas

Source: author's own work.

increase of EIRR amounted to 3.18 percentage points for the project implemented in the Mazowieckie region and 4.97 p.p.s for the project executed in the Pomorskie region. Conversely, the other projects covered investments in the infrastructure of buildings where the environmental components were used – in a way – as additional or supplemental elements of the whole, but required by general provisions and the law. These projects supported nature by establishing new green areas and/or providing some recreational opportunities for inhabitants. The increase of EIRR, however, does not exceed 1 p.p., and in the case of the project implemented in the Wielkopolska region, it amounted to only 0.04 p.p.s. This does not necessarily mean that this particular project provides only little UES. But one possible explanation for this is that the range of benefits provided by the project is disproportionate in view of its "infrastructural core". In this respect, it appears clear that projects which are more concerned with the natural environment, and thereby also provide much more benefits in terms of UES, will distinguish themselves with higher economic performance indicators.

Interesting insights come also from the analysis of the kind of UES identified in reference to projects included in the study. All the benefits were classified in two sections, e.g. Regulation and Maintenance, and Cultural. These findings indicate that urban projects can deliver benefits (non-material and non-consumed outputs of ecosystems) that affect the performance of people and their activities, and have a cultural or intellectual significance. This fact contributes, in turn, to explaining why the inclusion of UES for the appraisal of urban regeneration projects is so important. Urban projects providing UES regulate the widely defined physico-chemical and biological environment of people's life and constitute the basis for satisfying their spiritual, emotional and psychological needs. Thus, urban projects including UES, that is, characterised by a higher value of ENPV and EIRR, would be assessed higher than projects with little or no UES and, more importantly, they support a more sustainable pattern of urban development.

Conclusions

The analysis of the economic performance is an essential tool for the given project's appraisal in the light of the project's contribution towards achieving the significant objectives of urban policy. The EU Cohesion Policy stresses the urban dimension and provides that the urban development should be achieved through an integrated approach which meets the existing and new needs of urban areas. This implies that actions concerning physical urban renewal should be combined with measures promoting education,

economic development, social inclusion and environmental protection. It is, however, clear that such an objective can be achieved only by implementing comprehensive urban projects that are tailored to the local needs and bring together various aspects of urban life.

An important observation made during the analysis is that the UES generated by a particular project can be seen as positive environmental externalities and contribute to the creation of social well-being. More specifically, UES can be used in the assessment of the economic efficiency of urban projects, which illustrates the performance obtained without isolation from the environmental and social context. The economic performance indicators demonstrate, then, the given project's overall impact on human quality of life because they also take into account the value of UES, upon their prior quantification and monetisation. Thus, these indicators give a real indication of whether or how much benefits provided by projects involving UES outweigh the benefits provided by projects without UES. In this sense, the proposed approach provides a decision-making tool with a broad environmental and societal perspective. Tracking these indicators, in turn, appears to be especially valuable to policy makers, both in terms of assessing whether to intervene and what kind of intervention will be of greatest benefit to society. All in all, the economic performance indicators that take account of UES may serve, at the appraisal stage of the regeneration projects, as a baseline for prioritising investments (projects) in deprived urban areas by informing on their overall contribution towards the creation of wealth and growth. They can be not only an important tool for the given project's appraisal but also a stimulus for further sustainable urban development.

Finally, this study has hence several limitations that should be addressed in future studies. It analyses the impact of UES on the economic performance of the urban projects. However, it uses at the same time a loose approach to the quantification and monetisation of UES, drawing on attributes provided by the literature. Needless to say, measuring and valuing UES is a somewhat difficult and contentious undertaking. Future studies on this topic are therefore required in order to overcome these difficulties and to determine more objective and accurate procedures of UES valuation, which consequently make it possible to objectively compare in the appraisal the economic priority of different urban projects. Despite this, we believe our findings add to a growing body of knowledge of the ecosystem services and their application in decision-making.

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The contribution of the authors

Piotr Idczak – 50% (concept of the paper, literature review, data collection, data analysis and interpretation, drafting the text).

Ida Musiałkowska – 30% (concept of the paper, literature review, data collection, data analysis, drafting the text).

Karol Mrozik – 20% (concept of the paper, literature review, data interpretation, drafting the text).

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