

Impact of urban green and water belts on the city economy: A review of valuation aspects

Olga Medvedeva^{1*} and *Andrey Artemenkov*^{2,3}

¹State University of Management (SUM/GYY), Department of Economic Policy and Economic Measurements, 99 Ryazanski Prospect, 109542 Moscow, Russia

²TEAM University, 146 Temur Malik St., Tashkent, Uzbekistan

³Ariel University, 3 Kiryat HaMada, 40700 Ariel, Israel

Abstract. The purpose of the study is to review available economic methods for the incorporation of urban green belts and water spaces into the city development control system. The paper aims to identify economic subjects of analysis, provide a definition of approaches, and methods for ensuring the rendering of decisions in a monetized form, and outline the main directions of work for creating the legal and methodological frameworks for the formation of urban green belts. The findings indicate that the valuation treatment of urban green water belts requires them to be split into tangible and intangible asset components, with the valuation of the former amenable under the cost approach, and the valuation of the latter requiring the application of sociological (contingent) and regression-based valuation methods. We conclude with suggestions on how valuation estimates obtainable for such assets can be used in the context of urban zoning and financial municipal administration decisions.

Key words: Urban green and water belts and water spaces (UGWB); Green and water infrastructure; Ecosystem services; Tangible assets; Intangible assets.

1 Introduction

Analysis of numerous publications shows that urban green and water belts (UGWB) have become the newest system for shaping the urban environment and the world trend of urban management. The admission of this circumstance is now perceived as a matter of fact.

The green and water belts in this framework have already been created in the cities of North America, Europe and Southeast Asia. In China, the creation of urban ecological belts is planned for 300 cities. At the vanguard of this process are such cities as Barcelona, Amsterdam, Copenhagen, Thessaloniki, Vienna, Hong Kong and Singapore, Wuhan and a number of German cities. In recent times, the same approach is also taking over in a number of Russian cities. These include Kazan, Perm, Sevastopol, Krasnodar, Novosibirsk and others. The trend is expanding, though it is still in the process of being formalized at the

* Corresponding author: medvedeva_o@list.ru

official level, and mostly continues experimentally.

The factors underlying the latest urban green and water belt practices are largely in the background of an analysis. In our opinion, the explanation for the ongoing processes is the concept of technological change [1]. Nowadays the economy is shaped by the transition to the sixth technological paradigm, which is recognized as the main paradigm of human development for the 21st century [2].

A feature of the current 6th technological paradigm that is directly related to the formation of urban green and water belts, is the sharp growth in the last decade of the share of intangible assets in the capital of the leading firms (Fig. 1).

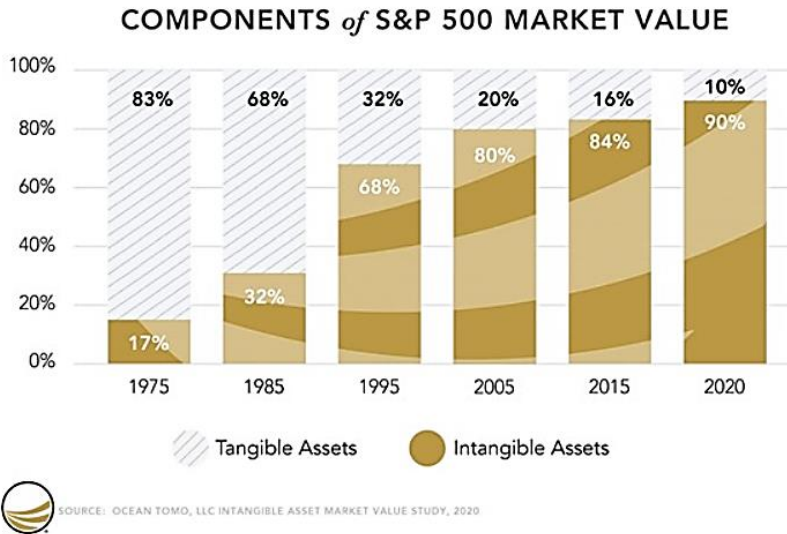


Fig. 1. Share of intangible assets in the asset value of public companies with the highest capitalization (S&P 500 index) (1975–2020).
Source: [2].

Ecosystem services generated by UGWBs are essentially intangible assets. Ecosystem services are benefits that people receive from functioning ecosystems [4]. They have their own monetization, just like physical assets. But this is not yet reflected in any way and anywhere. The quality of people's living environment conditioned by the state of the natural environment (water, air, climatic and other parameters), as well as the surrounding landscapes of the urban environment, become the key factor of development on par with the newest innovative branches of the economy.

The comfortable environment created by UGWBs is an intangible asset of the public sector, which belongs to everyone, but is not legally formalized. This creates big problems for its valuation in the context of adequate decision-making for the development of the urban environment, including on the national level [12]. But it is this very asset that creates a high capitalization for cities on par with built assets and a good engineering infrastructure.

UGWBs create tangible and very significant financial flows, which are mainly received by private individuals, companies and developers bypassing city budgets [14]. They create additional surpluses as a part of ecosystem service rents associated with UGWBs. These financial flows are usually not considered in any way in urban planning and other decisions related to territorial development, which leads to the erosion of

investment advantages of cities, the under-funding of such works and significant budget losses, not to mention jeopardizing the achievements of the goals of the Federal Program on creating a comfortable urban environment in Russia.

At the same time, the return on investments in the green infrastructure of territories is very high. This is evidenced by Moscow's experience and international experience. In Moscow, investments into landscaping are among the most profitable investment projects, their payback period constitutes just 1–2 years [5]. In the USA, two billion dollar worth of investments of budget funds into the national parks, which create similar intangible assets to UGWB, generates more than 18 billion dollars of revenue, that is, the return is 900% [6, 10].

The main factor behind the current situation is the absence of officially recognized methodological and legal support for the inclusion of economic valuations of the UGWB assets into the urban planning decision framework and a lack of linkages with the allocation of funds for territorial improvements. That is why most of the city-planning decisions and decisions in the area of territorial zoning, which encapsulate UGWB and ecosystem service issues, are taken without due economic justification [11].

The resolution of this problem can be helped by the identification and classification of the subjects of economic valuation pertaining to UGWB assets and the development of methods for their valuation, allowing substantiated management decisions on territorial development in economic terms.

2 Materials and methods

The main research methods were the analysis of literary and other information sources, including articles published in scientific journals devoted to the formation of green water belts and ecological frameworks, as well as information found on specialized websites revealing the influence of green infrastructure on the value of urban real estate. Publications related to asset valuation methods and normative government documents were also used in the work and reflected the methods of regression analysis. Based on the analysis, the economic problems associated with the formation of green water belts in cities were identified, and ways towards their resolution were proposed.

3 Results

3.1 Analysing the subject of valuation

In this article, UGWBs are understood to be green plantations and water bodies organized in a special way along with their surrounding embanking territories, which serve to create comfortable living conditions for the population due to their structure, spatial arrangement and diverse composition of flora (vegetation and habitat). Water and green infrastructure are the material basis, or material assets, for UGWBs. However, there is no official definition for this term. Green infrastructure includes all types of urban green spaces, including natural and artificially created urban ecosystems, namely: parks, forested areas, urban forests, green squares and lawns, wild undeveloped territories (commons, meadows, swamps, etc.), specially protected urban natural territories, valleys and floodplains of watercourses flowing through urban territories, as well as vertical green walls and others. All water objects and watercourses belong to the water infrastructure, both with and without embanked territories. Sometimes, in addition to the actual green and water infrastructure, urban agricultural land is also attributed as a part of UGWBs.

This material basis creates ecosystem services that are mostly intangible assets. An

intangible asset is a non-monetary asset that manifests itself through its economic properties. It doesn't have a physical substance but provides rights (interests) and economic benefits to the owner – in this case, the public entity, not a private individual [7]. Intangible assets are inseparable from the base (carrier) asset, but unlike it, they do not have a physical substance.

Thus, subjects of economic valuation related to UGWBs can be tangible asset components comprising them and the associated intangible assets.

3.2 Benefits

These assets create very significant economic and non-economic benefits to their institutional owner – in this case to communes of residents of cities and settlements. Thus, for example, in the city of St. Petersburg, the value of residential properties located near parks and green spaces is 25–35% higher than that of comparable properties sited outside of the green zones. The price of apartments commanding views of green parks is 10–15% higher than that of other apartments. In Pushkin, Pavlovsk, or Sestroretsk settlements, the attribute of walking distance to the park can increase the value of housing by 20–30%. In the centre of the city, the price of apartments with a view of green zones is at least 10% higher than the average price in a residential complex. At the same time, on average, only 3–5% of the total project construction costs are invested in the landscaping and greening of residential complex grounds. Therefore, the creation of green zones in housing projects has become a new trend in premium and mass construction segments. Where there are no parks and green zones, developers create them themselves. In St. Petersburg, the cost of greening housing estates can reach up to 3–5 thousand rub. (\$30–50) per sq.m. in the mass segment and 7–15 thousand rub. (\$90–180) in the premium segment. These costs are included in the financial models of housing projects and are considered by banks [8]. In Moscow, the same trend is prevalent as in St. Petersburg. Here developers apply the “+20%” rule. That is, 20% is added to the average listing price of apartments for houses located in proximity to popular parks, because the value of apartments in housing towers near parks is usually 20–30% higher [8].

The main benefit from UGWBs accruing to city administrations is to increase the investment attractiveness of the city due to the creation of beautiful and aesthetic urban landscapes, improving the comfort of living, reducing the morbidity of the population and generating other benefits.

The non-monetary benefits generated by the parks include the creation of favourable climatic conditions and a comfortable living environment for citizens, protection from smoke during forest fires, the creation of noise-reducing screens, aesthetically attractive urban landscapes, outdoor recreation spaces, etc. There are also tangible heat-abatement effects: according to some estimates, during the hot period, the temperature decrease in cities due to the presence of UGWBs can reach up to 3–4C, which is very significant [16].

However, the understanding of differences in the subject of valuation constituting parks and their ecosystem services as tangible and intangible assets doesn't yet exist in Russia –neither among environmental economists, nor among lawyers, though such an understanding and its terminological encapsulation will be required for the development of practical methods for assessing their value, since valuation methods for these assets can differ.

3.3 Valuing UGWBs as a set of tangible assets

When park ecosystems and their individual components are subjected to valuation as tangible assets, then it becomes possible to apply the cost approach methods, and the obtained estimates can be used to establish payments for authorized felling of trees in urban areas, as

well as penalties and fines for illegal felling and destruction of green infrastructure objects. This approach has been utilized in Moscow since the end of the 1990s. At the same time, in order to determine the efficiency of territorial development projects and establish tax and remediation payments for developers, as well as the efficiency of investments into the development of UGWBs themselves, it will be more appropriate to consider the valuation of the ecosystem services proper, which represent the intangible assets of UGWBs.

While in the first instance the valuation methodology looks simple and clear and boils down to the estimation of costs to re-create the green infrastructure, which can be done at market rates, e.g., landscaping services [9]; in the second instance, it will be necessary to use methods relying on sociological and other research data (e.g., the contingent method of valuation), as well as applying the cost-benefit analysis (CBA) methodology to evaluate both commercial and public efficiency of projects related to the creation of UGWBs and territorial development [13].

3.4 Valuing ecosystem services as intangible assets

To undertake the valuation of ecosystem services, it will be expedient to subdivide the benefits generated by UGWBs into benefits receivable by private individuals and companies, and benefits receivable by the public, including the city authorities. That is, it is expedient to identify and distribute financial flows between the private and public sectors and then apply to them the traditional methods of income capitalization and analysis of project costs and benefits in the form of a comparison of monetized benefits and costs associated with the implementation of the project, including environmental and social cost externalities.

The private sector includes private individuals and companies. The private sector receives benefits that are calculable in a cash flow form and influence commercial decisions. The principal monetizable income of the private sector is:

- the added value of developer's projects, mainly in the housing sphere;
- income of the private sector associated with recreation and commercial activities taking place within the bounds of UGWBs.

The public sector includes city residents, city authorities and their administrative structures. The public sector receives benefits that are not readily magnetisable by cash flows and that do not affect the management decisions taken by the city. The principal revenues of the public sector non-monetizable at present are:

- additional income from real estate in connection with its capital gain (the property tax and rent payments);
- reductions in public health costs for city authorities, caused by the reduction in morbidity;
- income from the increased flow of tourists (taxes);
- income from increasing the investment attractiveness of urban territories (promotion of investment projects in an attractive environment and accommodating landscape);
- income from commercial activities in parks (taxes);
- reduction in the costs of engineering infrastructure caused by functions performed by UGWBs (for example, absorption of storm water run-offs by unsealed soils);
- economic multiplier effects due to the creation of new jobs and new production in upstream and downstream industries.

At the same time, existing management systems rely largely on economic initiatives, the consequences of which can readily be estimated in terms of the cash flow. Therefore, without a proper economic valuation for parks and other UGWB entities and ecosystem services created by them, the preservation of these territories will always lose out to those decisions the commercial benefit from which lends itself to an easy monetization based on the observable market prices and the behaviour of market participants [15].

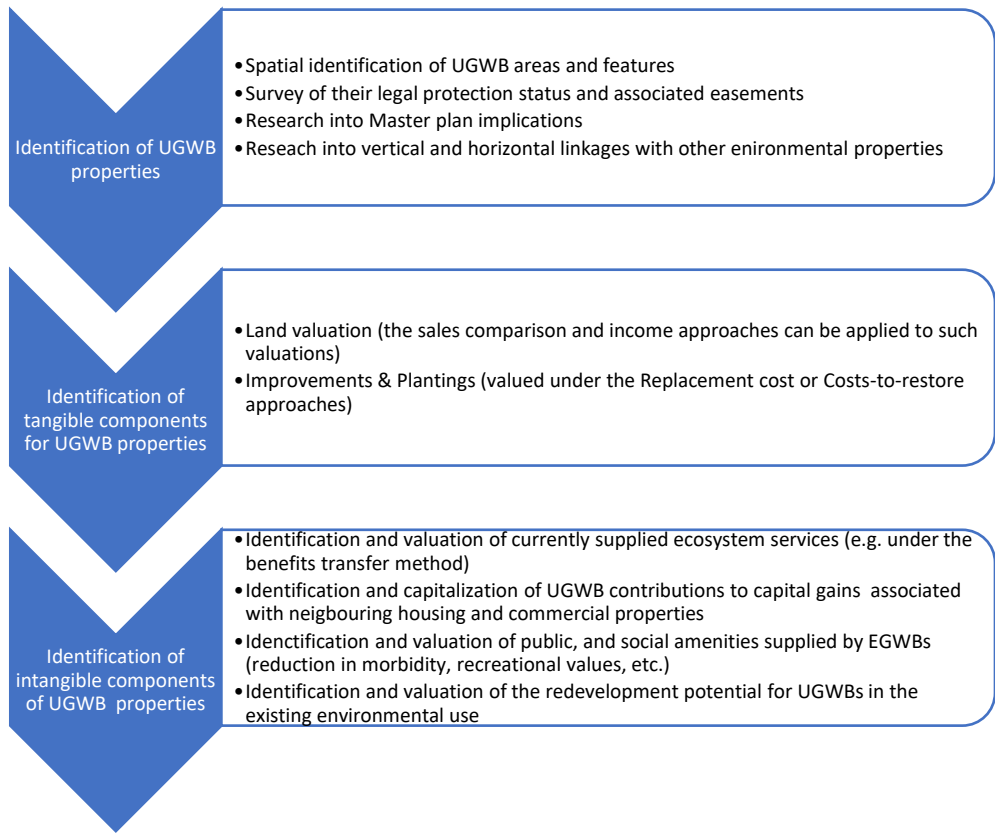


Fig. 2. Flow chart for the suggested UGWB asset identification and valuation process.

3.5 Scope of economic valuations

Areas, where such sustainable economic valuations can be applied, include the six main spheres:

- I. Formation of income sources, leading to the creation and functioning of UGWBs:
 - equitable property taxation for improvements and land parcels sited in the zones of UGWB influence;
 - rent escalation for improved property and free land plots located in UGWB territories and in the zones of their influence;
 - tax increases from recreational and other commercial activities on the UGWB territories;
 - compensatory payments from builders whose activities affect the UGWB areas and zones of their influence;
 - green finance (green housing bonds and loans).
- II. Financial consequences for violators of environmental legislation:
 - compensation and reimbursement in the monetary form of damages caused to UGWB assets;
 - administrative fines.
- IV. Works to create estimation manuals and rates associated with the maintenance of UGWB objects.

V. Economic justification for accepted urban planning and zoning decisions based on the methods of economic analysis:

- cost-benefit analysis;
- evaluation of economic efficiency and performance.

VI. Evaluation of public economic efficiency for investment projects and territorial development projects:

- at a macro-level (master plans of settlements);
- at the level of planning quarters;
- at the local level, for inclusion in Feasibility studies of the property development projects.

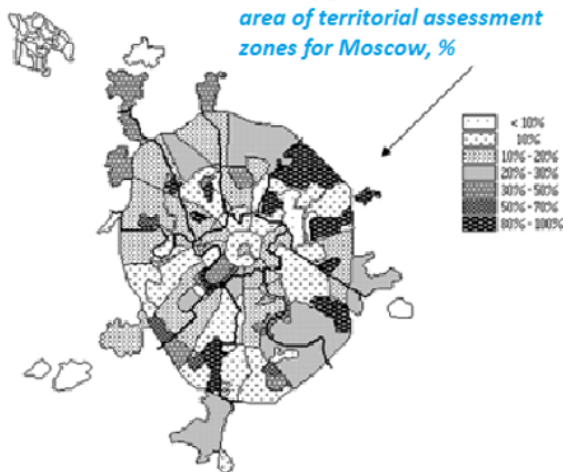
There already exists such an experience of using valuation estimates in town-planning management [13, 14].

An example of this is Moscow's experience in adjusting rent rates for urban land influenced by green infrastructure zoning based on the increase in the value of land parcels. The mechanism to apply such an economic valuation included the escalation of rent rates to the extent of an increase in the market value of property conditioned by the presence of green areas. In the study [17], it was discovered that the actual rental rates do not take into account the value-enhancing effects associated with the presence of green plantings. For the quantitative measurement of this influence, a multivariate regression was developed charting the dependence of the value of land parcels in the territorial assessment zones of Moscow on the share of green areas in the total area of the zone. It was established that the "green" component tended to increase the value of land parcels by 7–10% on average, which correlates well with the current data obtained for the associated value-enhancing effects for built residential properties. The current rent rates for the land have been increased to this amount by the Decree of the Government of Moscow, and the received income was purposely directed towards the maintenance of city parks and other green spaces (Fig. 3).

Dependency of land values on the share of green belts in the total area of the territorial assessment zones for Moscow

$$P_i = -1926 + \frac{6538}{I_i}$$

Share of green belts in the total area of territorial assessment zones for Moscow, %



Source: author's estimates

Fig. 3. Dependence of the value of land parcels (P_i) in the territorial economic assessment zones of Moscow on the share of land under green plantings (I_i).

3.6 Problems

To make economically informed decisions on urban territorial planning, the knowledge of value estimates for public goods delivered by parks and other UGWB assets is necessary, such that these can be compared with the benefits associated with alternative commercial land uses and the most acceptable course of territorial development can be chosen.

It is possible to cite two main reasons for not carrying out such assessments in Russia when implementing territorial planning: legal and economic. The legal reasons include the complete lack of legal precedents for incorporating similar calculations in the project documentation and the territorial planning output. The estimation of «project damage» (that is, the damage expected in the future from the permitted destruction or reduction in the area of green plantings and reflected in the project materials), as well as the analysis of associated public benefits from the creation or preservation of UGWB assets, are not mandated by any normative documents.

Of course, some estimates are made, but they mostly take into account only the expected commercial benefits from the adoption of such or another course of action. If the development of a certain territory with residential houses, commercial real estate or transport infrastructure objects is planned, the value of the planned property for construction can be determined based on the currently prevailing market prices or rental income.

Usually, multiplier economic effects, such as the creation of new jobs, time savings for commuters and companies when developing transport infrastructure, the convenience of amenities for residents, and other public effects accompanying the planned construction will not be included in such estimates. That is, public benefits macroeconomic benefits, as well as social costs, are completely disregarded. This state of affairs also spills over to the consideration of effects from the preservation of existing and creation of new parks and the delivery of the associated ecosystem services in the context of territorial zoning and urban planning decisions.

The main problem of such accounting lies in the objective estimation of non-market values of the created parks. While the commercial benefit from other types of land use is sufficiently perceptible and manifests itself in transactions of a market nature (income from rent and sale of property, income from trade, etc.), the benefits generated by ecosystem services on these territories are public goods deliverable to all urban residents, and they are not generally monetized due to their universal availability and perceived lack of scarcity. Ignoring those public benefits and expenses usually designated as environmental damages leads to the uncontrolled destruction of parks and green spaces.

Also, the thesis about the inefficiency of commercial investments in parks is constantly advanced by city authorities because of their exceptional cost, which does not always reflect the actual state of affairs. Unlike for developers, the costs of creating urban green infrastructure tend to be treated as “unrecoverable” at the level of the city administration. They are considered by city budgets as expenses, which does not exactly help “promote” the idea of creating UGWBs. Unfortunately, the national legislation does not have the concept of public sector assets and the concept of public interests in relation to people's living environment. This complicates the adoption of an economic and legal framework for the creation of UGWB assets, hampering the movement of budgetary capital into the development and maintenance of UGWBs. The cohesive management system for tangible and intangible assets associated with UGWBs is yet to be formed since many issues in the economic and management science pertaining to this area are new and remain unsettled on conceptual and methodological levels.

4 Discussion

Issues surrounding methods for identifying UGWB asset components and valuing them are still fraught in methodological and practical terms. This is due to the fact that this direction in Urban development is new, it is just beginning to emerge and hasn't yet developed fully either its conceptual apparatus or the generally accepted and standardized methodology for economic valuations of UGWB assets, including such concepts as the split of the UGWB items into their tangible and intangible assets.

5 Conclusion

1. UGWB ecosystems represent an important intangible asset that makes a significant contribution to the economy and social spheres of urban life. However, this contribution is not measured in monetary terms in any way and is not properly taken into account in management decisions.

2. Therefore, presently the main objective of UGWB asset management is to understand, evaluate, capture and purposefully redirect financial flows associated with UGWB assets to the purpose of their development and maintenance.

3. To do this, it is necessary to introduce into the legislative field such concepts as "public value" and legislate, or officially recognize, the methods for its assessment in the form of guidelines or other methodological documents for its assessment in monetary terms.

References

1. S.Y. Glaziev, *On urgent measures for strengthening the economic security of Russia and the transition of its economy towards the trajectory of advance development. A Report* (The Institute for Economic Strategies, 2015)
2. C. Perez, *Camb. J. Econ.* **34**, 185 (2010)
3. Markables 2022. Global Intangible Assets Valuation Service Market Research Report (2022), <https://www.markables.net/global-intangible-assets-valuation-service-market-research-report-2022>. Accessed 3 June 2023
4. IUCN CEM Ecosystem Services Thematic Group. <https://www.iucn.org/our-union/commissions/group/iucn-cem-ecosystem-services-thematic-group>. Accessed 3 June 2023
5. Sobyenin discusses the payback of green infrastructure projects. *Izvestiya Daily* (18 July 2018), <https://iz.ru/768064/2018-07-18/sobianin-rasskazal-pro-okupaemost-moskovskogo-blagoustroistva>. Accessed 3 June 2023
6. National Park Service. <https://www.nps.gov/subjects/socialscience/economics.htm>. Accessed 3 June 2023
7. IVSC, *The International Valuation Standards* (London, 2020)
8. P. Nikiforov, N. Burkovskaya, *Green belts: How the parks increase the value of nearby housing* (St. Petersburg Business, 2019), https://www.dp.ru/a/2019/09/23/Zelenij_pojas. Accessed 3 June 2023
9. Guidelines for valuation of green areas and estimation of damages associated with their partial or complete destruction on the territory of Moscow city, The Decree of Moscow's mayor of 14 May 1999 No. 490-PM, <http://www.valnet.ru/m5-m.phtml?p=36>. Accessed 3 June 2023
10. P.C. Sutton, S.J. Anderson, *Ecosyst. Serv.* (2016) <https://doi.org/10.1016/j.ecoser.2016.04.003>
11. Y. Laurans Yanns, L. Mermet, *Ecosyst. Serv.* (2014) <https://doi.org/10.1016/j.ecoser.2013.10.002>
12. Y. Yang, Y. Jia, S. Ling, C. Yao, *Ecosyst. Serv.* (2021)

- <https://doi.org/10.1016/j.ecoser.2020.101233>
13. C. Giaino, C. Salata. Ecosystem Services Assessment Methods for Integrated Processes of Urban Planning. The Experience of LIFE SAM4CP Towards Sustainable and Smart Communities. IOP Conf. Ser.: Earth Environ. Sci. 290(1) 012116 DOI: 10.1088/1755-1315/290/1/012116
 14. T. Mexia, J. Vieira, A. Príncipe, A. Anjos, P. Silva, N. Lopes, C. Freitas, M. Santos-Reis, O. Correia, C. Branquinho, P. Pinho, Environ. Res. (2018)
<https://doi.org/10.1016/j.envres.2017.10.023>
 15. M. Kieslich, J.M Salles, Ecol. Econ. (2021)
<https://doi.org/10.1016/j.ecolecon.2020.106857>
 16. I. Buharina, A. Shuravleva, O. Bolshova, Urban plantations: Environmental aspects. (Udmurt University Pibl., 2012)
 17. S. Gribovsky, E. Ivanova, D. Lvov, Property valuation (Interreklama, Moscow, 2003)
<http://profiocenka.ru/f/otsenkastoimostinedvizhimosti.2003.pdf>