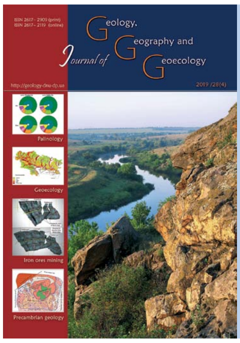

Journal of Geology, Geography and Geoecology

Journal home page: geology-dnu-dp.ua

ISSN 2617-2909 (print)
ISSN 2617-2119 (online)

Journ.Geol.Geograph. Geology, 28(4), 795–803.
doi: 10.15421/111974

Eco-service potential of sustainable development of small towns

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Received: 27.05.2019
Received in revised form: 06.08.2019
Accepted: 18.11.2019

Abstract. The purpose of the study is to determine the ecosystem services potential and capacity for ecological stability of the five nearest small towns to Kyiv by comparative analysis of their territories by the number of ecosystem services provided per unit area and per capita. The researched towns have a similar history of development, but differ in area, number and density of population, industrial development and land use structure. The research is conducted on the basis of public indicators of the master plans of the small towns using the transfer method and relative values. The cost of ecosystem services in the territories of the small towns is calculated according to the categories of the land fund by agricultural land, forest and water. Ecosystem services per 1 ha of each land use category are adjusted for transfer coefficient into USD, taking into account the purchasing power parity factor for Ukraine. The cost of ecosystem services per capita and 1 ha of territory of each town is calculated for the current state of towns and for a 20-year perspective. It was established that the total cost of ecosystem services in Boyarka, Vyshgorod, Bucha and Irpin towns exceeded that of the ecosystem services of Vyshneve by 3.6, 5.8, 10.6 and 25.7 times respectively The cost of ecosystem services per capita in Irpin exceeds by 28.8 times the same indicator of Vyshneve, due to the small number of water bodies, forests and agricultural lands in the territory of the latter town, as well as due to its extremely high level of development. An analysis of the dynamics of the cost of ecosystem services per unit area of the small towns shows that the maximum cost of ecosystem services per 1 hectare of urban territory is borne by Vyshgorod and Irpin, and in the long run – the maximum will be increased by 2.9 and 3.0 times in Vyshgorod and Boyarka respectively. These dynamics are due to the expansion of the urban area. The results of the study indicate the need to adjust the master plans of urban development in terms of expanding the environmental component of Irpin and Bucha.

Keywords: ecosystem services, land use, cost transfer coefficient, eco-balance development.

Екосервісний потенціал сталого розвитку малих міст

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Анотація. Метою дослідження є визначення екосервісного потенціалу та потенційної екологічної стабільності п’яти найближчих до Києва малих міст шляхом порівняльного аналізу їх територій за кількістю екосистемних послуг, що надаються одиницею їх площі та на одного жителя. Досліджувані міста мають подібну історію розвитку, але різняться за площею, кількістю жителів, щільністю населення, промисловим розвитком і структурою землекористування. Дослідження проведене на основі загальнодоступних показників Генеральних планів малих міст з використанням трансферного методу та відносних величин. Вартість екосистемних послуг на території дослідних малих міст розрахована за категоріями земельного фонду сільськогосподарськими угіддями, лісовими масивами і водними поверхнями. Екосистемні послуги на 1 га кожної категорії землекористування скориговані переведенням у долари США з урахуванням коефіцієнту переносу вартості за паритетом купівельної спроможності для України. Вартість екосистемних послуг на одного мешканця і на 1 га міської території кожного міста розрахована для сучасного стану міст і на 20-річну перспективу. Встановлено, що загальна вартість екосистемних послуг міст Боярка, Вишгород, Буча та Ірпінь відповідно у 3,6; 5,8; 10,6 і 25,7 рази перевищує екосистемні послуги міста Вишневе. Вартість екосистемних послуг на одного жителя м. Ірпінь перевищує у 28,8 рази аналогічний показник м. Вишневе, що пояснюється малою кількістю водойм, лісів і сільськогосподарських угідь, а також надзвичайно високим рівнем забудови. Аналіз динаміки вартості екосистемних послуг на одиницю площі малих міст показав, що максимальна вартість екосистемних послуг у розрахунку на 1 га міської території належить Вишгороду та

Ірпеню, а в перспективі – максимально зросте у Вишгороді та Боярці, відповідно у 2,9 і 3 рази. Така динаміка зумовлена розширенням міської території. Результати дослідження свідчать про необхідність коригування генеральних планів міського розвитку в частині розширення екологічної компоненти для міст Ірпінь і Буча.

Ключові слова: екосистемні послуги, землекористування, коефіцієнт переносу вартості, екозбалансованість

Introduction. An important role in the implementation of the New Urban Development Program, adopted at the UN Habitat III Conference in 2016, has been given to ecosystem services (ES), and urban planning has been identified as the main tool for managing the urban environment (Sulkarnaeva, 2017). Ecosystem services contribute to offsetting the negative effects of urban functioning, support environmental safety, sustainable development and human well-being (Xu et al., 2018).

Extension of the built-up area can have irreversible consequences for the environment, biodiversity and ecosystem services (Andrade-Nunez & Aide, 2018). Rapid changes in urban land cover are one of the major environmental issues. Such changes include the transformation of green spaces into an impervious surface and, as a consequence, increases in the temperature of the earth cover (Wu & Zhang, 2018). Quantitative analysis of urban land structure dynamics is important for determining the cost of ecosystem services, which facilitates ecosystem conservation decisions (Lin et al., 2018; Greenhalgh et al., 2017). Quantifying ecosystem services in cities is difficult, but it must be taken into account in their planning (Kim & Coseo, 2018).

Land-use optimization is an effective tool for streamlining its structure to provide the expected ecosystem services, as the reduction of eco-stabilizing lands leads to a loss of green space in the city (Wang et al., 2018). Land use plans are widely used to guide urban development, which can affect the diversity and spatial distribution of urban ecosystem services (Lam & Conway, 2018).

The theoretical underpinnings of urban ecosystem services are less well defined than agricultural or forestry services (Bastian et al., 2012). They are often seen as grey services (not happening) or white cells (undefined, meaning no information is available). However, urban ecosystem services are closely correlated with land use and more related to climate regulation, carbon sequestration and recreation.

Arnold et al. (2018) assessed global and local regulation by urban green space of climate, water cycles, air pollution, food production, recreation, and concluded that the potential provision of regulative ecosystem services is spatially limited by land use types. The cost of ecosystem services related to energy conservation, property value, carbon retention, improved air quality and storm water runoff per street tree has been calculated (Wang et al., 2018). Urban ecosystems are particularly important for the provision of services with a direct impact on health and safety, such as air purification, noise reduction, urban cooling and runoff mitigation (Bolund & Hunhammar, 1999). Which ecosystem services are most relevant in a given city depends on its environmental and socio-economic characteristics (Gómez-Baggethun & Barton, 2013).

Analysis of publications on the assessment of urban ecosystem services revealed that most of the research was conducted in Europe, North America and China. However, few research findings have been incorporated into land use policies (Haase et al., 2014). Analyzing ecosystem service research for 1997-2011, Seppelt et al. (2011) found that 50% of surveys were conducted in six countries (mainly in the US and China), while the cost of all ecosystem services in these countries was only 23.5% of the total (Kasimov D. & Kasimov V., 2015). The vast majority of research has been done in industrialized countries of the Northern Hemisphere, less in developing countries. The interdisciplinary analytical design of urban ecosystem services provides an opportunity to synchronize human impact and sustainability of urban environmental resources.

The first known experience of global ecosystem services assessment was conducted by Costanza et al. (1997) by complex indirect methods. As a result, the global cost of the ES was $33 trillion/year on average. Total global ecosystem services in 2011 were already $125-145 trillion/year, and the loss of environmental services over the period from 1997 to 2011 as a result of land-use change was $4.3-20.2 trillion/year (Costanza et al., 2014). Rosenberg (2014) considers that the easiest way to estimate ecosystem services for a given territory is to determine its share in the total area of the Earth and, in proportion, in the total cost of the ES ($33 trillion).

The assessment of ecosystem services of landscapes is carried out taking into account the area occupied by a certain type of land, as well as changes in the quantitative and qualitative characteristics of individual components. Hossein (2016) has developed a method for economic assessment of urban forests based on the concept of alternative cost of nature use, which reflects the potential return on all possible but not realized options for using the resource. The main problem of assessming forest ecosystem services is the lack of data available for calculation. In most cases, these are physical rather than economic indicators. Data collection is a very time-consuming and long-term process. But even from insufficient data it is clear that in the long run, the economic effect of forest conservation and restoration, calculated taking into account the smallest ecosystem services, is twice the total value obtained from the sale of timber or/and the transformation of these lands (Strokov & Poleshkina, 2016).

A method has been proposed for assessing urban cultural ecosystem services by using only two variables: the size of the green zone and the rent for land. In this way, cultural and regulative services are integrated into the common ecosystem services, as urban green areas have almost no provisioning services (Chang et al., 2017). In general, complex cost estimation of ecosystem functions is complicated by their diversity, and the dependence of estimates on the location of the research complicates their distribution to other territories.

Sulkarnaeva (2017) considers the best approach to the assessment of urban ecosystem services, to be that applied in the project "Towards Green Cities: The Values of Urban Biodiversity and Ecosystem Services in China and Germany", which allows one to identify not only the areas with the highest and lowest potential for the production of ecosystem services and areas that need conservation and protection but also identify in the course of the benchmarking the production volumes and needs of ecosystem services and the planning decisions required.

Assessing ecosystem services dynamics in response to land-use change is an effective method of developing land-use management and environmental policies (Xue & Ma, 2018). The importance of carefully designing urban green spaces in urban plans in terms for ecosystem service delivery is emphasized (Derkzen et al., 2015).

Burkhard et al. (2012) developed an evaluation system based on the matrices linking land cover, ecosystem integrity, service supply, demand and budgets. This valuation approach creates relative units of supply and demand for each service. According to Hansen & Pauleit (2014), the methods of analysis need to be adapted to the access of data and the ability to obtain it. Neverov & Andrushko (2016) believe that it is necessary to improve the method of evaluation of ES to adequately reflect their social significance and changes over time. They group all types of land into three categories: natural, natural-anthropogenic (rural regions) and anthropogenic (built-up).

Urban ecosystem services can increase the resilience of a city, which is directly dependent on the quantity, quality and diversity of the green infrastructure that produces them. On a regional scale, ecosystem service delivery is threatened by an increasing anthropogenic load on urban development and, as a consequence, the decline of urban green spaces (Calderón-Contreras & Quiroz-Rosas, 2017). The purpose of assessing urban ecosystem services is to support and enhance the ability of urban ecosystems to provide material services and to further reduce the risks of unstable cities (Tang et al., 2018). Recently, ecosystem services assessment methods, their spatial and temporal nature have been reviewed in 116 publications (Atif et al., 2018).

The purpose of the study is to evaluate and compare the environmental potential of several small towns in Kyiv region at the cost of ecosystem services received in their territories and to provide recommendations on how to improve the most promising plans and eco-balanced development.

Material and methods of research. The research object was five selected small towns of Kyiv region located near the capital and near to each other ,with a population in the range of 10 to 50 thousand inhabitants and with intensive development. Their choice was made on the basis of the availability of up-to-date (newly developed) publicly available master planning materials. This choice is justified by the lack of population censuses, urban green space inventory, availability of data on small urban areas and ease of use (Yukhnovskyi & Zibtseva, 2018).

At present, the legal uncertainty of the mechanisms for the prospective development of small towns and the lack of consideration of their specificities aggravate not only socio-economic but also environmental problems in their territories. The studied towns are located in the immediate area of influence of Kyiv, at a distance of 1.5 km (Vyshneve) to 32 km (Bucha) (Fig. 1).

The towns were surveyed during 2010-2012 and characterized by the highest population growth rates, which amounted 3.73; 3.35; 3.28; 2.1 and 1.1% in Bucha, Irpin, Vyshgorod, Vyshneve and Boyarka , respectively (Bondar, 2014). These towns are characterized by satisfactory (Vyshneve, Boyarka, Vyshgorod) and moderately favourable (Irpin, Bucha) living conditions, different population densities (from 1,050 inhabitants/km^2 in Bucha to 6,604 inhabitants/km^2 in Vyshneve) and different (from 151.4 in Vyshneve) up to 952.7 (in Bucha) amounts of urban land per capita (Table 1).

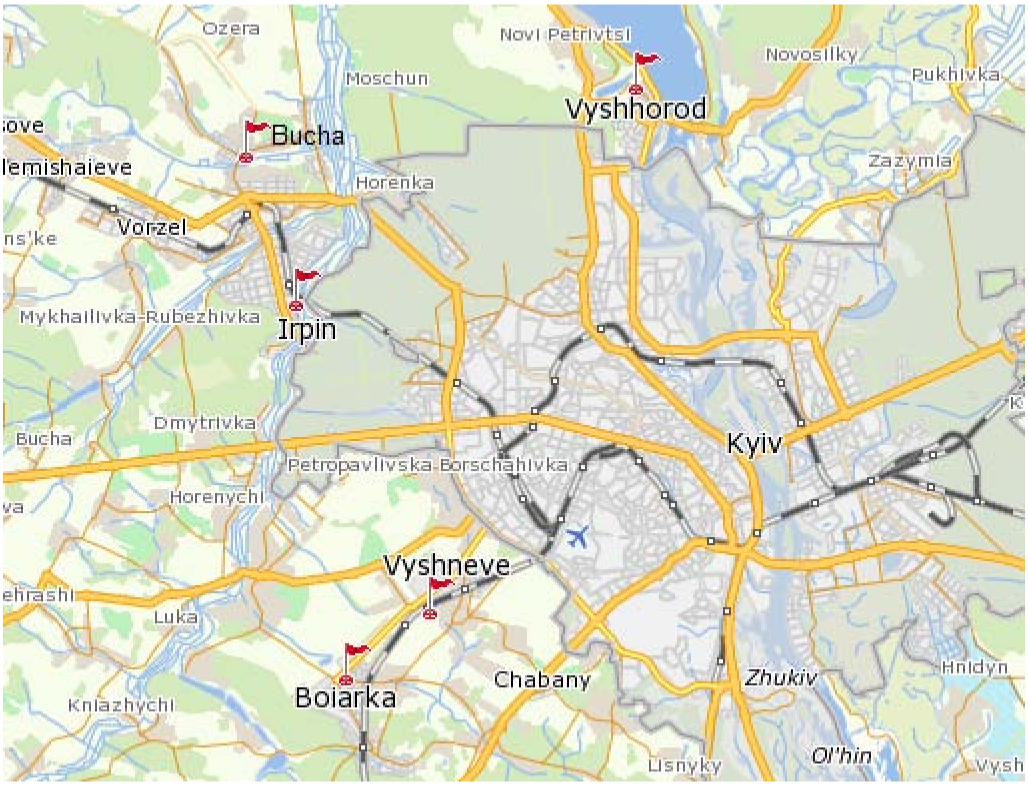

Fig. 1. Location of small towns of Kyiv region relative to Kyiv

Population growth is due to the suburbanization of cities. The socio-demographic situation in the small towns of Kyiv region is correlated with regional and all-Ukrainian tendencies and, despite some exceptions, remains generally difficult. Tomashuk (2014) describes the socio-economic situation of most small towns in Ukraine as a crisis.

The concept of determining of the full cost of urban ecosystem services is currently the most popular. The evaluation of each ecosystem service is carried out by direct and indirect assessment methods. There are four approaches to assessing the economic cost of ecosystem services: the direct market valuation method; indirect market valuation methods; conditional assessment method; group assessment method (Soloviy, 2016).

Indirect market valuation methods include the determination of cost avoidance, alternative cost, factor income and more. These varieties of evaluation are selected based on the specificities and objectives of the study (Groot et al., 2002). Indirect valuation methods include the value transfer (price transfer) method, which is used when information (cost or time) is completely missing to evaluate the service. This method applies the assessment of similar services in other countries, which is adjusted to the conditions of the researched country. The method can be used almost everywhere, where there is no possibility for one's own research.

We have applied this technique using the cost-transfer coefficient defined by the formula (Markandia et al., 2014):

$$V_{tr} = V_1 \frac{GDP_{tr}}{GDP_1}, \quad (1)$$

where V_{tr} is the value of the service in the target country of study, i.e. Ukraine; GDP_{tr} – gross national product per capita in the country of study; GDP_1 is the

Table 1. Characteristics of small towns of Kyiv region

Town	Area, ha	Population, thousand inhabitants	Living conditions	Population density, inhabitants/km^2	Urban land, m^2/capita	Built up area, m^2/capita	Ecological tax, USD/ha
Vyshneve	704.1	46.5	satisfactory	6,604	151.4	137.4	0.97
Boyarka	1,122	35.5	satisfactory	3,164	316.1	251.5	1.59
Vyshgorod	874.1	27.8	satisfactory	3,180	314.4	179.4	4.40
Irpin	3,705.1	41.5	moderately favourable	1,120	892.8	463.1	6.37
Bucha	2,658.1	27.9	moderately favourable	1,050	952.7	645.1	0.28

gross national product per capita in the country where the data chosen from.

Formula 1 uses gross national income per capita in purchasing power parity in USD for 2017: China - $16,760, Ukraine - $8,900, i.e. the GDP_{tr} / GDP_1/ GDP1 cost transfer ratio is 0.53.

The Cen, et al. (2015) method was used to determine the cost of all ecosystem services provided to local people in the small towns, which takes into account land use types. According to the method, urban land is divided into four categories of land use: urban (built-up), cropland (agricultural), forest and water. We applied the adjusted values of the coefficients for the three land use categories (in RMB and converted to $1 while 1 Yuan costs at $0.15 with Formula 1 adjustment). The calculated ecosystem service cost ratios are presented in Table 2.

Results and their analysis. In towns, the state of the ecosystem is closely linked to the type of land use. Land use is a fundamental variable that affects the social and physical aspects of the environment. Changes in land use and land cover are one of the key factors affecting ecosystem services. Their respective coefficients are used to estimate each type of earth's surface (Rai, 2018). The degree of naturalness of land use types provides a differentiated assessment of urban ecosystem services.

Taking into account the calculated ecosystem service cost ratios (Table 2), the total cost of ecosystem services by land uses for the territories of the five small towns at the current stage and for a 20-year perspective was calculated (Table 3).

Table 4 shows the estimated cost of ecosystem services per capita and per 1 ha of urban area of each town now and for a 20-year perspective, as well as their comparative analysis in relation to Vyshneve the town least provided with ecosystem services .

Table 2. Cost coefficients of ecosystem services for different land uses of small towns of Ukraine (by Cen et al., 2015)

Ecosystem services	Land use/cover type categories								
	Cropland			Forest			Water		
	ES, Yuan	ES, USD	Coefficient ES, USD	ES, Yuan	ES, USD	Coefficient ES, USD	ES, Yuan	ES, USD	Coefficient ES, USD
Gas regulation	885.0	132.75	70.36	3,097.0	464.55	246.21	0	0	0
Climate control	1,575.2	236.28	125.23	2,389.1	358.37	189.94	407	61.05	32.36
Water conservation	1,062.1	159.31	84.43	2,831.5	424.73	225.11	18,033.2	2,704.98	1,433.64
Soil conservation	2,584.0	387.60	205.43	3,450.9	517.63	274.34	8.8	1.32	0.70
Loss of health	2,902.7	435.41	230.77	1,159.2	173.88	92.16	16,086.6	2,412.99	1,278.88
Biodiversity conservation	1,256.4	188.46	99.88	2,884.6	432.69	229.32	2,203.3	330.50	175.17
Food	1,770.0	265.50	140.71	88.5	13.27	7.03	88.5	13.27	7.03
Natural materials	177.2	26.58	14.09	2,300.6	345.09	182.90	8.8	1.32	0.70
Recreation and culture	18.6	2.79	1.48	1,132.6	169.89	90.04	3,840.2	576.03	305.29
Total	12,231.2	1,834.68	972.38	19,334	2,900.10	1,537.05	40,676.4	6,101.46	3,233.77

For comparison, the average annual cost of 1 ha of non-urban forest ecosystem services can be $1,093-2,777 (Strokov & Poleshkina, 2016). That is, our rather virtual values are comparable to those of other sources.

The probable differences in the applied absolute values of ecosystem services (in RMB/USD) in our study are offset by the transition in the rating analysis to relative values. The assessment was carried out with the recalculation per 1 ha of urban area and per capita. In the absence of a population census and clear statistics, urban areas and population are dynamically changing in some cities, based on indicators of the current situation at the time of master plans.

In order to better distribute these types of land use, we also included private kitchen gardens and unbuilt on private plots in the category arable land; all categories of planted green perennials were placed in the catogory forest.

Data of Table 4 indicate that the total cost of ecosystem services in Boyarka, Vyshgorod, Bucha and Irpin towns is higher by 3.6; 5.8; 10.6 and 25.7 times respectively than the ES of Vyshneve. The land unit of Vyshneve produces 2.3 and 4.9 times less ecosystem services than Boyarka and Irpin, respectively, and the cost of ES per capita of Irpin exceeds by 28.8 times the cost of ES of Vyshneve town. First of all, this is due to the small number of water bodies, forests and farmland, as well as the extremely high level of development of Vyshneve. The penultimate place for the value of ecosystem services provided to the inhabitants belongs to Boyarka, where there are few water bodies and the smallest area of agricultural lands.

In the long run, the total cost of ecosystem services in Vyshneve will increase by 2.4 times,

Table 3. Assessment of ecosystem services of small towns for land use

Towns	Area now, ha			Area in perspective, ha		
	Cropland	Forest	Water	Cropland	Forest	Water
Area of main land uses, ha						
Vyshneve	0	64.8	0.5	0	153.0	2.0
Boyarka	12.3	206.0	10.9	12.3	2,114.3	10.9
Vyshhorod	78.3	267.6	29.5	95.2	2,197.4	1,941.0
Irpin	602.6	1,060.4	120.4	35.6	1,736.7	110.0
Bucha	476.0	303.4	40.1	0	505.8	40.1
Amount per 1 ha	972.38	1,537.05	3,233.77	972.38	1,537.05	3,233.77
Cost of ecosystem services by land use, USD						
Vyshneve	0	99,600.84	1,616.88	0	235,168.65	6,467.54
Boyarka	11,960.27	31,6632.3	35,248.09	11,960.27	3,249,784.81	35,248.09
Vyshhorod	76,137.35	411,314.58	95,396.21	92,570.58	3,377,513.67	6,276,747.5
Irpin	585,956.18	1,629,887.82	389,345.91	34,616.73	2,669,394.73	3,55,714.7
Bucha	462,852.88	466,340.97	129,674.17	0	777,439.89	129,674.18

Table 4. Comparative up-to-date and prospective assessment of ecosystem services of small towns per capita and unit of area

Towns	Current state			20 years perspective		
	Total cost of ES, USD	Per capita	Per 1 ha	Total cost of ES, USD	Per capita	Per 1 ha
Cost of ecosystem services in absolute terms, USD						
Vyshneve	101,217.72	2.18	143.75	241,636.19	3.72	209.93
Boyarka	363,840.66	10.51	324.28	3,296,993.17	54.95	972.85
Vyshhorod	582,848.14	20.97	666.80	9,746,831.75	108.30	1,961.92
Irpin	2,605,189.91	62.77	703.14	3,059,726.16	55.63	825.81
Bucha	1,058,868.02	37.95	398.36	907,114.07	15.12	341.26
Cost of ecosystem services relative to Vyshneve ES						
Vyshneve	1	1	1	1	1	1
Boyarka	3.6	4.8	2.3	13.6	14.8	4.6
Vyshhorod	5.8	9.6	4.6	40.3	29.1	9.3
Irpin	25.7	28.8	4.9	12.7	14.9	3.9
Bucha	10.6	17.4	2.8	3.7	4.1	1.6

which corresponds to an increase in their number per prospective inhabitant by 1.7 times and by 50% per 1 ha. However, Vyshneve will remain in the last place in the eco-balance of the towns of research.

Currently, the correlation between the total cost of ecosystem services and their cost per capita is 0.97, and per hectare – 0.71, and in the future it will be 0.970 and 0.992 respectively. The correlation between the cost of ecosystem services per inhabitant and 1 ha of urban area is currently 0.74, and in the future it will increase to 0.99, which indicates that the territories will be more balanced in the future. The visibility of this positive dynamic of the cost of ecosystem services per capita is illustrated by Fig. 2.

Data of Fig. 2 shows that according to the master plan, the cost of urban ecosystem services per capita is almost unchanged in the future for Vyshneve, significantly increases for Boyarka and Vyshgorod and decreases for Irpin and especially (at times) for Bucha. It indicates an acceptance of not well-considered prospective planning decisions, and significantly reduces their stable development prospects. In terms of prospective planning, Vyshgorod will be the most environmentally friendly and conducive environment among five pilot cities, where the planned triple population growth will be accompanied by a 5.7-fold increase in land use, and changes in land use will be limited by the special status of historic town and the availability of protected urban areas. The second position belongs to Boyarka (given the unplanned population density in Irpin already), where population growth will be doubled with a three times expansion of the urban area. Planned actions for the future development of Bucha (population increase of 2.2 times due to increase in population density and stable area of the city) will lead to a decrease of 4.2 times the cost of ecosystem services per capita.

The dynamics of the cost of ecosystem services per 1 ha of the towns is shown in Fig. 3.

Data from Fig. 3 indicate that the maximum cost of ecosystem services per 1 ha of urban area belongs to Vyshgorod and Irpin, and in the long run – will increase to maximum in Vyshgorod and Boyarka (by 2.9 and 3.0 times respectively). The analysis

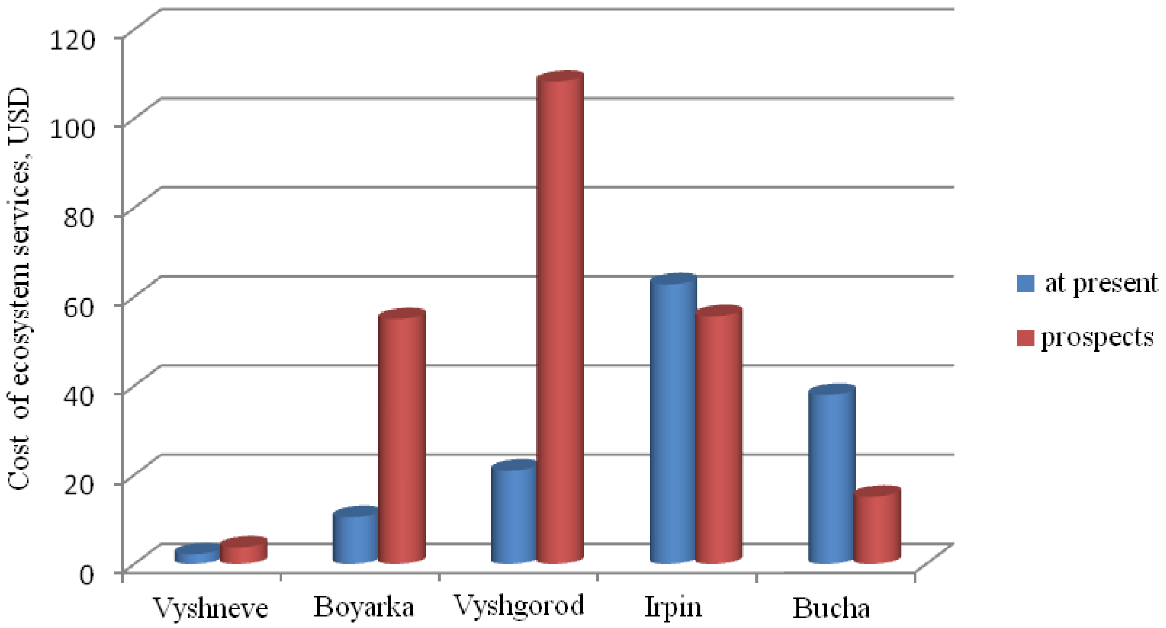

Fig. 2. Dynamics of ecosystem services cost per capita in small towns

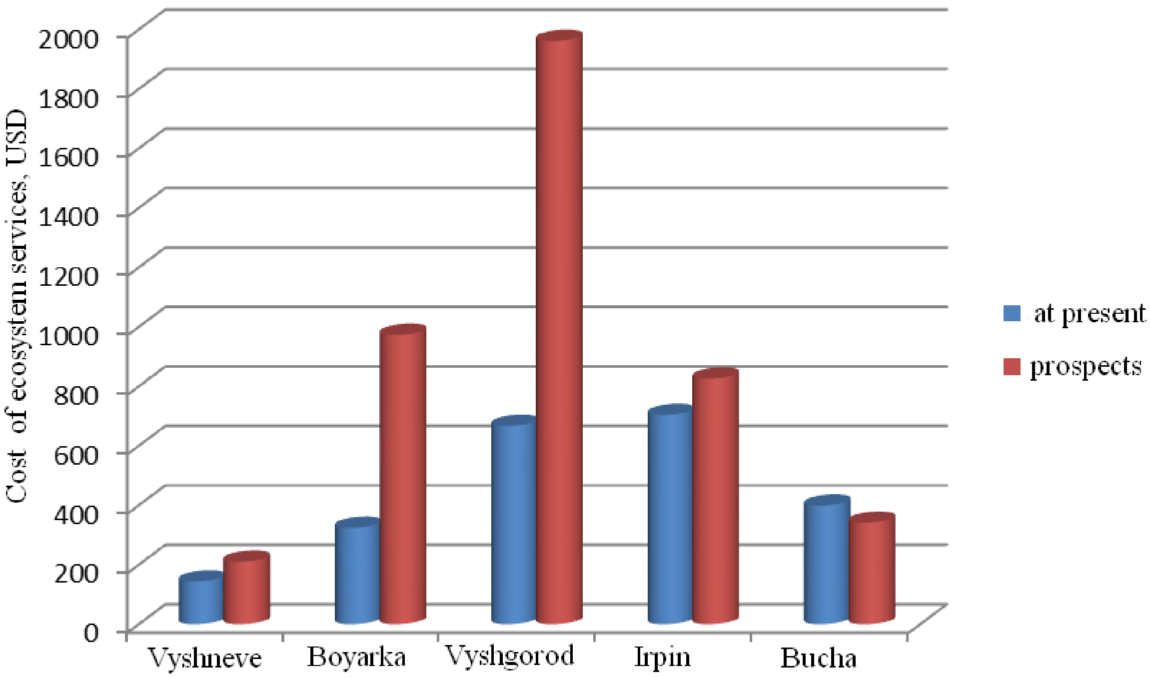

Fig. 3. Dynamics of the cost of ecosystem services per unit area of small towns

shows that such temporal dynamics are caused by the expansion of urban territory. The situation in Vyshneve and Irpin will improve somewhat and in Bucha it will worsen (by 1.2 times).

Conclusions. For the sustainable development of urban ecosystems, it is necessary to take into account their features at the stage of planning of territorial development. Especially important is the design of urban green spaces from the point of view of providing ecosystem services, assessing the current situation and prospects.

Ukraine's plans to implement ecosystem service approaches as standard components of territorial planning are hampered by the difficulty of identifying them. The assessment of ecosystem services by indirect valuation – cost transfer – can serve as a platform for integrating the ecosystem services approach to master planning by transferring into the economic form the degradation process of specific natural-tech urban ecosystems. The application of this method allows one to analyze the directions of development of the territories, to obtain meaningful information on the dynamics of their ecological balance, useful for solving environmental aspects of urban land use planning and improving its efficiency, to predict possible scenarios and to choose the most constructive solutions from the standpoint of sustainable development.

Urban development and, as a consequence, reductions in forest and arable land, which typically result in urban expansion, will further reduce the total amount of ecosystem services provided by urban green infrastructure, as evidenced by our calculated relative values per capita and per unit area of towns.

The calculated ecosystem potential for the current state of towns and over the next 20 years showed that the total cost of ecosystem services for the towns of Boyarka, Vyshgorod, Bucha and Irpin is 3.6; 5.8; 10.6 and 25.7 times respectively higher than the ecosystem services of Vyshneve. The cost of ecosystem services per capita of Irpin is 28.8 times higher than the similar indicator of Vyshneve, which is explained by the small number of water bodies, forests and agricultural lands, as well as the extremely high level of building in the latter.

It has been established that the maximum cost of ecosystem services per 1 ha of urban area belongs to Vyshgorod and Irpin, and in the long run – will maximize growth in Vyshgorod and Boyarka, respectively by 2.9 and 3 times, which is due to the expansion of the territory mainly due to suburban forests.

The results of the research indicate the need to adjust the master plans for the development of the environmental component for the towns of Irpin and Bucha, and the use of the cost estimation of ecosystem services in urban areas provides meaningful information on the dynamics of eco-balance of urban areas and is useful for addressing environmental aspects of urban planning. The proposed algorithm for calculating the cost of ecosystem services in the development of master plans for towns will help to track future trends and avoid ill-considered decisions on sustainable eco-balanced urban development.

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