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Application of indices for assessing the ecological potential of urban development

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Nowadays, the ecological evaluation of urban development has become compulsory, and a number of environmental indices have been introduced. In the present study, two most common environmental sustainability indices – ecological footprint and environmental sustainability – were applied for measuring the ecological possibilities of urban development. Moreover, the issues of the measuring principles, their disparities and direct application are discussed, and a short comparison of the indices is presented. Also, a favourable assumption is proposed.

Key words: ecology, index, urban development

INTRODUCTION

Sustainability defined in the proceedings of the Brundtland Commission – meeting the needs of today without sacrificing the ability of future generations to meet their own needs – stimulated professionals to find a way how to estimate and assess sustainability, whereas politicians were concerned about how to implement it. Although more than 20 years (according to some scientists and activists even more than 40 years) have passed, sustainable development has not been realized anywhere (Ecosystems…, 2005); furthermore, some countries record sore developmental problems (Al-Damkhi et al., 2008).

In the usual way, sustainable development is implemented equilibrating economics, social development and environmental potential as well as avoiding sharp imbalance. The European Union is firmly committed to sustainable development, it is a key principle for policies and actions (Wackernagel et al., 2005); thus, such a development is the aim in all fields of actions including city planning.

Currently, a number of methodologies have been proposed and a number of different sustainability indices of countries, regions or districts have been published. Each method is reasoned and has exponents; however, not all results coincide. Calculation of indices is impossible without common indicators; therefore, the list of indicators is updated every year for different researches. The final results are modified respectively or even new indices are introduced.

The aim of this article is to familiarize with the most popular methods of evaluating sustainable development and to present its indices, as well as to analyze how the indices could be applied for assessing a single component of sustainable development, i. e. the ecological potential of a city; lastly, to ascertain whether the methods suitable for assessing urban development are known, and if not – to deliberate upon the elaboration of such principles.

MATERIALS AND METHODS

Ecology of urban development

Ecology, one of the components of sustainable development, seems to be such a common, self-explanatory term that is not always considered what is the meaning of ecology in a particular context. Generally, ecology is figured out as it is defined in the dictionary of international words: "a study that explores relationship between organisms and their living surroundings, an interaction between animate and inanimate nature" or as the particle "eco" explanation: "the first part of the compound word meaning connection with home, farm, growing place, environment or farm management". Perhaps

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that is why terms such as "ecological assessment", "ecological product", "ecological development" or "ecological city" are realized as a matter of common knowledge. Commonly, doubts arise when a specialist has to produce a concrete ecological product or to choose a more ecologic alternative. Having no serious, unambiguous reasons but only knowing by intuition or speculation leads nowhere. The best solution, of course, should not be guessed but documented and legitimated. A city planner or an architect, one of those aforementioned specialists, has to assess urban development from the ecological viewpoint, as well as to know which city plan is more ecological and what are the means of ecological planning. A city planner is bound to proceed in such a way in accordance with spatial planning acts; for instance, the Lithuanian spatial planning act says that one of the aims of planning is "to protect, rationally use and restore natural resources, valuables of nature and cultural heritage, inter alia recreational resources". One of the authors of the present paper has analysed the juridical situation of spatial planning in Lithuania and noted that neither methods of assessing the ecological potential of urban development are given nor the ecology of a city is defined (Staniūnas, 2009). This means that the common phrase "the ecology of a city" should be understood individually, thus differently every time.

The world practice shows that there are methodologies allowing development sustainability assessment; thus, it is possible to compute the individual components of sustainability and similarly of ecology. Perhaps the term "ecology of a city" and the principles of its evaluation will become clear after studying the most popular and common methods.

Sustainability indices

The use of indicators for the assessment of sustainability was proposed in 1992 in one of the final documents of the Rio de Janeiro proceedings (Siche et al., 2007). When speaking about sustainability, it is a common practise to use the terminology verified by the OECD (Organisation for Economic Co-operation and Development); an indicator is defined as a variable obtained through measurement and qualifying a single feature of a system, whereas an index is an aggregation of many indicators.

It is worth noting that there exist many sustainability indices such as the wellbeing index, the environmental sustainability index, the ecological footprint, the natural capital index, etc.; however, many of differently named indices take into account the same basic data. This happens because there is a small number of available global sustainability datasets. Global information can be collected only by big organizations such as the United Nations, and are not organizations of such a scale. Consequently, the disparities that occur (despite the same basic data) are due to the calculation methods and assumptions.

Presently, the most common indices for the assessment of sustainability are two: the ecological footprint (EF) and the environmental sustainability index (ESI) (Ewers, Smith, 2007; Mayer, 2007; Siche et al., 2007). In the paper, only these indices are discussed for the purpose of clearness and highlighting how different the results (having only two indices) can be.

The ecological footprint

The concept of the calculation of the ecological footprint is based upon six assumptions: 1) most of the resources people use and the wastes that are generated can be tracked, 2) most of the resource and waste amount can be measured in terms of the biologically productive area, 3) distinct areas can be translated into the common unit of global hectares, 4) demanded area can be calculated adding areas necessary for resources and wastes, 5) demanded area and nature's potential can be compared, 6) demanded area can vary from supplying area, i. e. an ecological deficit or ecological overshoot can occur (Monfreda et al., 2004; Kitzes et al., 2007). The EF is used for assessing the demand of the resources, i. e. the environmental impact generated by people is recalculated into the demanded area: the area necessary for extraction of resources, production of goods and absorption of wastes is calculated. Calculations are based taking into account current technological possibilities. When the average productivity of the world is estimated, it is quite easy to make a comparison between a nation's demand and possibilities. For instance, in Lithuania in 2005 the environmental impact was 3.2 global hectares per capita, while the biocapacity was 4.2 global hectares per capita, i. e. that year Lithuania had an ecological reserve (Ewing et al., 2008). Table 1 shows the world's condition in 2005, i. e. the best 10 nations having the biggest ecological reserve and the worst 10 nations having the biggest ecological deficit. Figure 1 is a graphic expression of part of Table 1; the positive values show the ecological reserve and the negative value show the ecological deficit. It is useful to assess a concrete country within its own boundary that allows to see how this country "steps" on the rest of the world. For this purpose Fig. 2 was elaborated, in which the positive value shows how many times the biocapacity is bigger than the country's footprint, while the negative value shows how many times the footprint exceeds the biocapacity. For a better local orientation, Table 1, Fig. 1 and Fig. 2 incorporate Lithuania, despite the fact that it is neither one of the best nor one of the worst ranked countries.

Scientists notice several advantages of the EF calculation principles: 1) easiness of understanding the information, 2) finiteness of the index, and 3) tracing of the "leakage" effect (Mayer, 2007; Ong, 2002; Siche et al., 2007). The final result of the index is an easily understandable number as the potential of the planet is distributed to everyone personally; in other words, this means that knowing the average environmental potentiality (3 ha in 2007) allows seeing whether or not a country fits into these parameters. As an illustration we can take the USA where a resident requires more than 10 ha, i. e. oversteps his share more than three times. On the other hand, the EF gets also some criticism. The main demerits are as follows: the index is too broad-brush, there are territorial limitations, it does not take into consideration that there are other living forms besides humans, and lastly a too poor estimation of technological differences (Fiala, 2008; Venetoulis, Talberth, 2008).

The calculation of the EF is based on the obvious truth that the Earth has a limited potential. Moreover, the result is finite, as well as it is impossible to use more than the world can produce. However, there is one exception – the so-called "leakage" effect. Chiefly, the "leakage" occurs in rich and well-developed countries with quite a strict environmental policy. Usually, people in developed countries consume more and have bigger demands, thus these countries import resources whose extraction sometimes may be pestiferous, and export

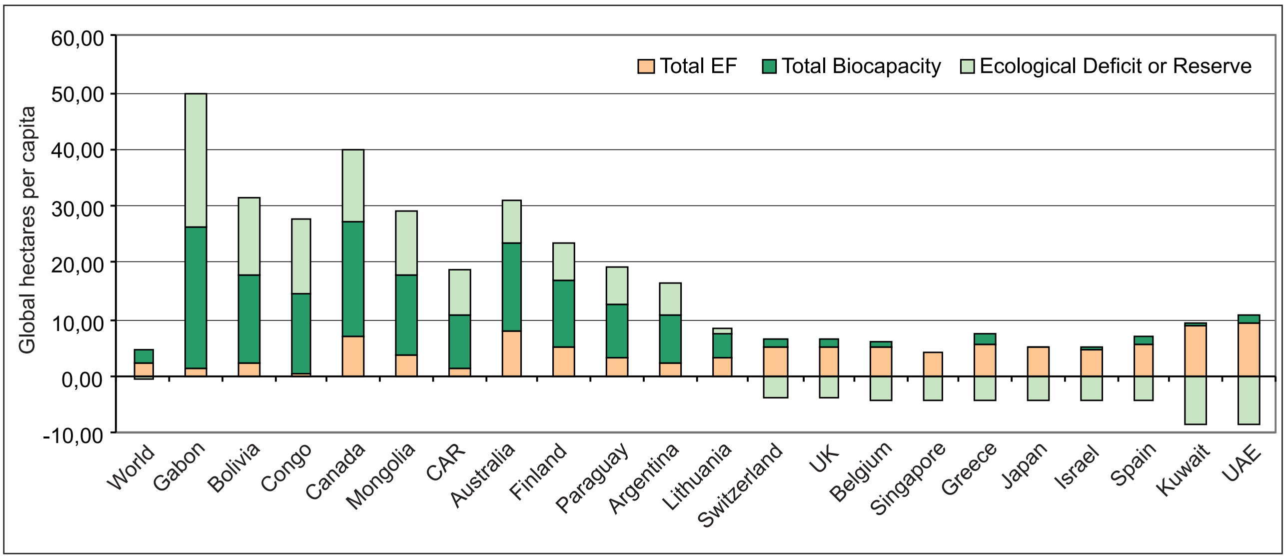

Fig. 1. The ecological footprint 2005
Data from Global Footprint Network, Ecological Footprint and Biocapacity, 2005. The figure is elaborated by authors.

Table 1. **The ecological footprint 2005**

	Population (million)	Total ecological footprint	Total biocapacity	Ecological deficit or reserve
World	6,476	2.7	2.1	–0.6
High income countries	972	6.4	3.7	– 2.7
Middle income countries	3,098	2.2	2.2	0.0
Low income countries	2,371	1.0	0.9	– 0.1
Gabon	1,4	1.3	25.0	+ 23.7
Bolivia	9,2	2.1	15.7	+ 13.6
Congo	4,0	0.5	13.9	+ 13.3
Canada	32,3	7.1	20.0	+ 13.0
Mongolia	2,6	3.5	14.6	+ 11.2
Central African Rep.	4,0	1.6	9.4	+ 7.8
Australia	20,2	7.8	15.4	+ 7.6
Finland	5,2	5.2	11.7	+ 6.5
Paraguay	6,2	3.2	9.7	+ 6.5
Argentina	38,7	2.5	8.1	+ 5.7
Lithuania	3,4	3.2	4.2	+ 1.0
Switzerland	7,3	5.0	1.3	– 3.7
United Kingdom	59,9	5.3	1.6	– 3.7
Belgium	10,4	5.1	1.1	– 4.0
Singapore	4,3	4.2	0.0	– 4.1
Greece	11,1	5.9	1.7	– 4.2
Japan	128,1	4.9	0.6	– 4.3
Israel	6,7	4.8	0.4	– 4.4
Spain	43,1	5.7	1.3	– 4.4
Kuwait	2,7	8.9	0.5	– 8.4
United Arab Emirates	4,5	9.5	1.1	– 8.4

[1] Data from Global Footprint Network, Ecological Footprint and Biocapacity, 2005.

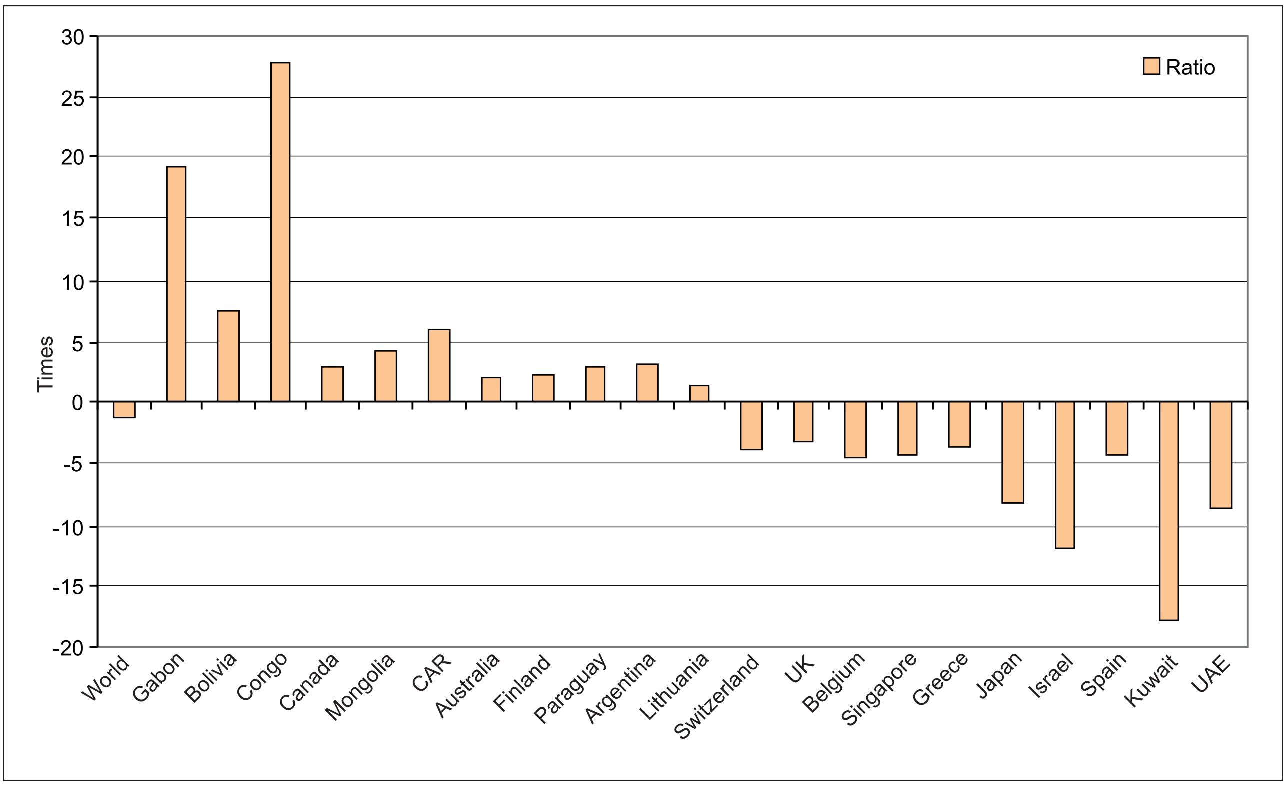

Fig. 2. The ecological footprint 2005
Data from Global Footprint Network, Ecological Footprint and Biocapacity, 2005. The figure is elaborated by authors

wastes noxious to poorer countries; in this way, developed countries remain "clear" (Morse, Fraser, 2005). Table 1 shows that countries having the biggest natural reserves belong to low-income countries; on the other hand, countries producing the biggest pressure on nature are well developed. In fact, the burden of export falls on all countries that demonstrate a natural backlog (such as Latvia, Nicaragua or Paraguay) wherever they are in the world.

How can the EF the benefit ecological potential of urban development? Before answering, it is useful to familiarize with the other – environmental sustainability – index.

The environmental sustainability index

The environmental sustainability index formally was presented only in 2000, almost ten years later than the EF, in Davos, Switzerland. The ESI is an index applied in the evaluation of a nation's sustainability. The ESI is one of the most complicated contemporary sustainability indices: when calculating the ESI, the EF is evaluated only as one of the variables. In general, the calculation of the environmental sustainability index comprises on the following steps: 1) selection of the countries, 2) standardization of the variables allowing a comparison of the countries, 3) transformation of the variables, 4) substitution of missing data by special algorithms, 5) processing of the data, 6) calculation of the final ESI score (Siche et al., 2007).

The first difference of the ESI from the EF is selection of variables as countries with insufficient data are excluded from the calculation. Mostly low-income countries are omitted because they are not capable of gathering and storing statistical data; this in turn implies that the ESI is able to assess only part of the world. Secondly when calculating the ESI, the EF is counted as one of the variables, despite the fact that it is an aggregate index itself. Consequently, the same data may be double-counted. Last but not least, there is the portioning of the impact factors, because the ESI scores all variables with the same weight. It is worth noting that, for instance, when calculating the ESI, a higher oil price or a bigger number of scientific researches per person are treated as a condition ensuring a more sustainable development (Ewers, Smith, 2007; Mayer, 2007). This approach is quite unique as it is widely admitted that sustainability does not mean the equality of components; besides, it is not proven that the relation among all indices is linear and universal. Lastly, using the ESI (at least now) it is impossible to capture the "leakage" effect as countries are evaluated as "isolated" with no relation to other nations (Morse, Fraser, 2005). Thus, countries exporting wastes are rated high (good), because wastes are treated as removed from a country. Such an isolated evaluation does not adequately answer one of the sustainability principles – cooperation on the global level (Strange, Bayley, 2008). Table 2 is based on the ESI results and shows the best 10 nations and the worst 10 nations in 2005. One can see that developed countries are on the top, whereas low-income countries are at the bottom of the list. Nevertheless, some researchers argue that it is not unambiguously proven that the ranking of the ESI is directly linked with a nation's economical potential (Mastny, 2005).

Eventually, instead of speaking about the EF and the ESI separately, it is interesting to make a simple comparison. Table 3 presents the results of the EF and the ESI; the EF results are on the left and the ESI results are on the right side, whereas the yellow colour highlights the biggest discrepancy. Figure 3 shows the same best and the worst ranked ESI countries; however, the ecological deficit or reserve is added. Iceland, Guyana, Yemen and Taiwan are excluded from the comparison as there are no data on their ecological deficit or reserve. Table 3 and Fig. 3 include Lithuania for a better local orientation. The variance occurs mainly due to a different approach to calculations, as the aim of the EF is simply to show the real situation: natural possibilities and human demands (Kitzes et al., 2008), meanwhile the ESI tries to deliver a mean. This is well visible in Fig. 3 where ecological possibilities (deficit or reserve) are "jumping"; for example, Sudan even overtakes the best ones. The principal shortcoming of the ESI is an attempt to substitute unique, finite, natural resources for other variables such as the number of scientific researches, efficiency of management, effectiveness of consumption or the number of women with elementary education. It is possible that the aforementioned components may guarantee sustainability in general; however, to confront irreplaceable resources with seeming values looks like a statistical manipulation but not as a solution of the talking point. Broadly speaking, critics comment unfavourably on prominence of financial components, as well as on the dependence of the results on primary data selection (Ewers, Smith, 2007; Morse, Fraser, 2005).

Table 2. **The environmental sustainability index 2005[2]**

Country name	Population (millions)[1]	ESI rank	ESI score
Finland	5,2	1	75.1
Norway	4,6	2	73.4
Uruguay	3,5	3	71.8
Sweden	9,0	4	71.7
Iceland	–	5	70.8
Canada	32,3	6	64.4
Switzerland	7,3	7	63.7
Guyana	–	8	62.9
Argentina	38,7	9	62.7
Austria	20,2	10	62.7
Lithuania	3,4	22	58.9
Yemen	–	137	37.3
Kuwait	2,7	138	36.6
Trinidad & Tobago	1,3	139	36.3
Sudan	36,2	140	35.9
Haiti	8,5	141	34.8
Uzbekistan	26,6	142	34.4
Iraq	28,8	143	33.6
Turkmenistan	4,8	144	33.1
Taiwan	–	145	32.7
North Korea	22,5	146	29.2

[1] Data from Global Footprint Network, Ecological Footprint and Biocapacity, 2005.
[2] Data from 2005 Environmental Sustainability Index.
– No data.

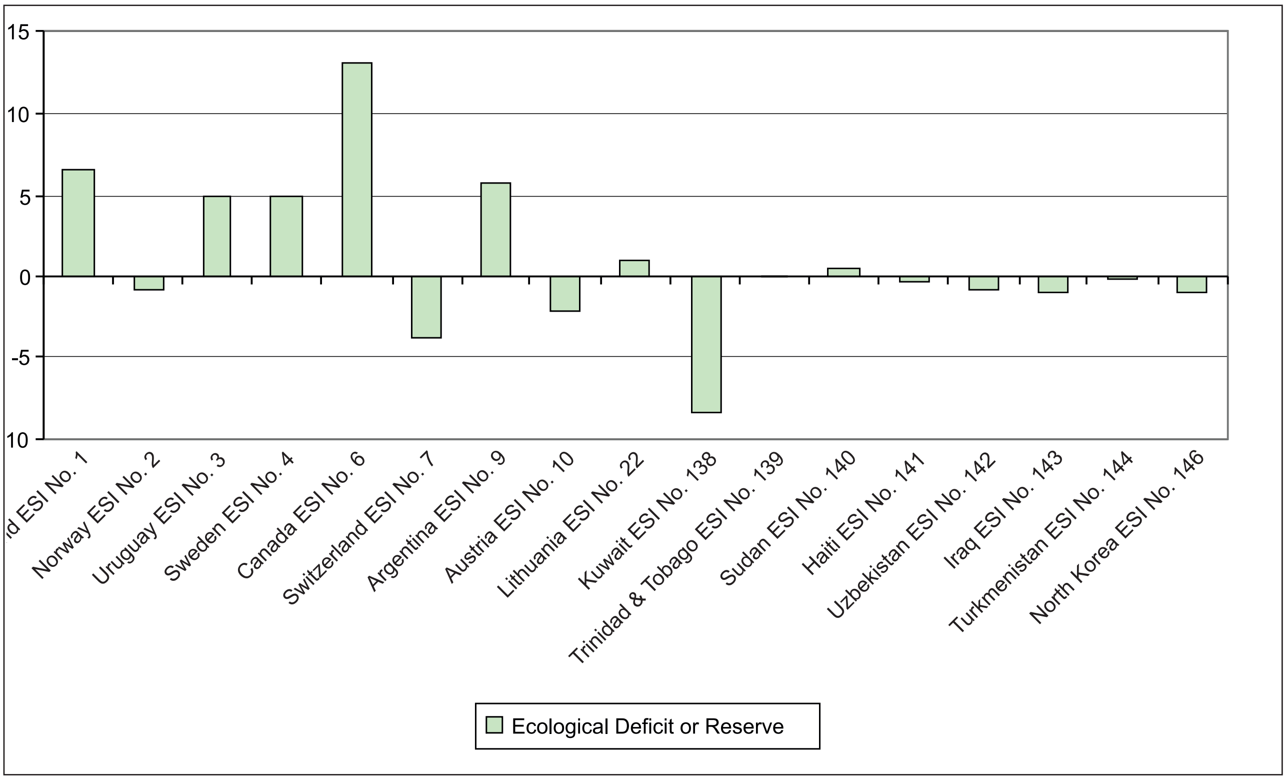

Fig. 3. Comparison of the indices: the EF and the ESI

Table 3. **Comparison of the EF and ESI indices**

Country	Ecological deficit or reserve	ESI rank	Country	ESI rank	Ecological deficit or reserve
Gabon	+ 23.7	12	Finland	1	+ 6.5
Bolivia	+ 13.6	20	Norway	2	– 0.8
Congo	+ 13.3	39	Uruguay	3	+ 5.0
Canada	+ 13.0	6	Sweden	4	+ 4.9
Mongolia	+ 11.2	71	Iceland	5	–
Central African Rep	+ 7.8	25	Canada	6	+ 13.0
Australia	+ 7.6	13	Switzerland	7	– 3.7
Finland	+ 6.5	1	Guyana	8	–
Paraguay	+ 6.5	17	Argentina	9	+ 5.7
Argentina	+ 5.7	9	Austria	10	– 2.1
Lithuania	+ 1.0	22	Lithuania	22	+ 1.0
Switzerland	– 3.7	7	Yemen	137	–
United Kingdom	– 3.7	65	Kuwait	138	– 8.4
Belgium	– 4.0	112	Trinidad & Tobago	139	– 0.1
Singapore	– 4.1	–	Sudan	140	+ 0.4
Greece	– 4.2	67	Haiti	141	– 0.3
Japan	– 4.3	30	Uzbekistan	142	– 0.8
Israel	– 4.4	62	Iraq	143	– 1.1
Spain	– 4.4	76	Turkmenistan	144	– 0.2
Kuwait	– 8.4	138	Taiwan	145	–
United Arab Emirates	– 8.4	110	North Korea	146	– 0.9

– No data.

DISCUSSION

Returning to the issue, it is important to highlight that neither the definition of city's ecology was found nor the conception of ecology was analysed during familiarization with the indices. Chiefly, the most common values whose environmental impact is obvious were assessed, e. g., the concentration of CO_2 or of dust particles. New methods are likely to be developed in the future, as well as new indicators will be introduced. Over time, each method of calculating the indices is improved and new fields of its application are suggested (Best et al., 2008; Du et al., 2006; Herva et al., 2010; Kitzes et al., 2008). The disparity of the EF and the ESI reveals how differently urban development may be directed. If more sustainability indices were discussed, the same divergent results would be achieved. It is clear that more indices bring more differences. However, for the meantime, the indices themselves are not essential, but the principles of their conception and assessment are crucial.

Any city is part of the world, thus it uses the same common, finite, natural resources. The result of the EF may not be perfectly precise, but the approach is a key as in principle it allows allocating the "urban quotas" (a single quota for each city). The whole planet is involved in this distribution, so the calculations may be complex; nevertheless, they would be unambiguous and not speculative. Ecology is immediately concerned with nature which has a limited potential. In assessing the ecology of a city, one stage could be evaluation of the city's participation in the finite natural market. In this stage, the key would be fitting into the international standards without paying too much attention to the city's internal conditions. The national quotas can be adopted from the international agreements such as the Kyoto Protocol or the EU directives.

It is obvious that in cities the generated pressure on nature requires more area than any city occupies (Fiala, 2008; Groc, 2007; White, 2007); in the meantime, no city that functions and completely maintains itself exists. Thus, to limit a city's boundary would be naive and illogical. One of the possible solutions could be assessment of cities with supporting areas hereby allowing partial "leakage" or (and) import of resources. If so, when calculating the "urban quotas" the supplementary areas would appear as part of a concrete city.

The next stage could be evaluation of inner ecological possibilities of a city. In this case, a "natural ceiling" would consist of particular values; exceeding these values leads to an increased health risk of townsmen and puts wildlife in jeopardy. It seems likely that in some cities there are zones with foul air and zones with clean air. However, on average, in spite of inner disparities, the city meets the requirements. In general, it is admitted that sustainable (consequently ecological) development is possible only when there are no big imbalances between the components (White, 2007).

A definite final answer is a crucial condition for assessing the ecological potential of a city. Specialists, including city planners, must get clear data that are easy to use and ensure cross-comparison. Moreover, the result has to be informative so as to allow choosing the necessary planning tools. Currently, for example, the Department of Statistics to the Government of the Republic of Lithuania presents data on the number of foul air days per year, but it is not clear how city planners could (would) use these data.

After discussing the principles of assessment, one question is left unresolved – the question of what to measure. Probably it is the main ecological puzzle of a city's development. Besides, no answer is given even in Lithuanian law. This question or, to be more precise, its absence is raised also in works of foreign researchers (Li et al., 2010). In accordance with the EF, the biggest heed should be given to final indicators; but then, again, what is a final indicator in a city? The answer needs further researches and oversteps the limits of the article; however, without elucidating the answer, to assesss a city's development as ecological or even to demand an ecological assessment of a city is useless and speculative.

CONCLUSIONS

The two most common sustainability indices give different results. Neither of them can be directly applied for assessing the ecological potential of a city as the indices were developed for complex, interdisciplinary aspects. Nevertheless, the principles of the EF can be readjusted as the evaluation methods of urban ecology. The guidelines for the readjustment are as follows:

1. Dual assessment:

evaluation of urban development contribution to the global ecological balance / imbalance;

evaluation of the local impact of a city's development (impact on local ecosystems).

2. Assessment of a city's ecological footprint is to be evaluated together with the supporting areas.

A system for evaluating the ecological potential of urban development should be based on the above principles.

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INDEKSŲ TAIKYMAS VERTINANT MIESTO PLĖTROS EKOLOGINES GALIMYBES

Santrauka

Brundtland komisijos suformuluotas darnios plėtros apibrėžimas – dabartinių poreikių ir siekių įgyvendinimas neapribojant ateities kartų galimybių – tarptautiniu mastu paskatino specialistus ieškoti būdų ir metodų, kaip darnią plėtrą apskaičiuoti ir įvertinti, o politikus – kaip ją įgyvendinti. Šiuo metu sukurta ne viena skaičiavimo metodika ir paskelbtas ne vienas valstybių, regionų, atskirų rajonų darnumo koeficientas ar indeksas, gauti rezultatai ne visada sutampa, tačiau kiekvienas metodas yra argumentuotas ir turi savo šalininkų.

Straipsnio tikslas – supažindinti su šiuo metu populiariausiais darnumo skaičiavimo metodais ir jų rezultatais – indeksais, išanalizuoti, kaip indeksai gali būti taikomi, vertinant vieną darnios plėtros komponentų – miestų plėtros ekologines galimybes, išsiaiškinti, ar jau žinomi metodai, tinkantys vertinant miestų plėtrą, o jei to nėra – apsvarstyti jų kūrimo principus.

Vienas darnaus vystymosi komponentų, ekologija, atrodo savaime suprantamas terminas, todėl dažniausiai nesusimąstoma ir nesvarstoma, ką jis reiškia konkrečiu atveju. Klausimų dažniausiai kyla tam tikros srities specialistui, turinčiam parengti tos srities ekologinį produktą arba pasirinkti tos srities ekologiškesnę alternatyvą. Specialistas negali (neturėtų) gaminti produktų remdamasis intuicija ar spėlionėmis, jam reikalingas tvirtas ir aiškus, geriausia teisiškai reglamentuotas pagrindas. Miestų planavimo specialistas – vienas minėtųjų specialistų, kuris turi įvertinti miesto plėtrą ekologiniu aspektu, turi žinoti, kuris miesto planas ekologiškesnis ir kokios yra ekologiško planavimo priemonės. Straipsnio autorius yra analizavęs susiklosčiusią teisinę teritorijų planavimo padėtį Lietuvoje ir pastebėjęs, kad Lietuvos įstatymuose nepateikiama būdų, kaip apskaičiuoti ir įvertinti miestų plėtros ekologiją, be to, įstatymuose nepaaiškinta, kaip reikia suvokti miestų ekologiją, kas tai yra, tačiau ekologija įteisinta kaip vienas teritorijų planavimo tikslų (Staniūnas, 2009).

Šiuo metu, vertinant darnų vystymąsi, dažniausiai naudojami du indeksai: gamtos apkrovimo (EF) ir aplinkos darnumo indeksas (ESI) (Ewers, Smith, 2007; Mayer, 2007; Siche et al., 2007). Gamtos apkrovimo indeksu matuojamas gamtos išteklių poreikis, t. y. visų žemės gyventojų generuojamas poveikis gamtai verčiamas į atitinkamą žemės plotą: skaičiuojama, kiek ploto reikia žaliavoms išgauti, medžiagoms pagaminti ir atliekoms utilizuoti, naudojant šiuolaikines technologijas. Mokslininkai išskiria kelis EF matavimų principų privalumus: 1) gautos informacijos suvokiamumą, 2) indekso baigtinumą ir 3) „nutekėjimo“ efekto fiksavimą (Mayer, 2007; Ong, 2002; Siche et al., 2007). EF skaičiavimas remiasi akivaizdžia tiesa, kad Žemės galimybės yra ribotos, tai duoda labai tvirtą ir neginčijamą skaičiavimų pradinį tašką, gautas rezultatas taip pat baigtinis – nėra galimybės vartoti daugiau nei yra. Aplinkos darnumo indeksas beveik dešimtmečiu naujesnis už gamtos apkrovimo indeksą, ESI oficialiai buvo pristatytas tik 2000 m. Davose, Šveicarijoje. ESI – vienas komplikuočiausių dabartinių darnumo indeksų, tai gerai parodo faktas, kad, skaičiuojant ESI, gamtos apkrovimo indeksas yra įtraukiamas tik kaip vienas kintamųjų.

Pirmas ESI skirtumas nuo EF yra skaičiuojamųjų kintamųjų atranka, šalys, apie kurias trūksta duomenų, yra neįtraukiamos į skaičiavimus. Antras skirtumas yra tai, kad EF – jau apdorotas rezultatas – įtraukiamas kaip kintamasis, todėl faktiškai kyla rizika, kad duomenys bus įvertinti du kartus. Trečias skirtumas – tas pats „svorio“ koeficientas visiems kintamiesiems skaičiavimo metu. Galiausiai, remiantis ESI (bent kol kas), negalima užfiksuoti „nutekėjimo“ efekto, t. y. valstybės vertinamos kaip savarankiškos miniplanetos, neturinčios daug bendra su išorine aplinka (Morse, Fraser, 2005).

Analizuojant miestų plėtros ekologiją, kol kas vertingi yra ne patys darnumo rodikliai, o skaičiavimo, suvokimo metodika. EF ir ESI skirtumai parodo, kaip įvairiai galima pakreipti miestų plėtrą. Miestas yra pasaulio dalis, todėl jame naudojamos tos pačios planetos galimybės, kurios yra baigtinės. Svarbiausi principai, kuriais reikėtų remtis rengiant miesto plėtros planų pasekmių ekologijai vertinimo rodiklių sistemą:

1. Vertinti du dalykus: 1) miestų plėtros planų „indėlį“ į planetos ekologinį balansą ir 2) miesto plėtros planų ekologinį poveikį lokaliniu mastu (poveikį vietos ekosistemų būklei).

2. Miesto „ekologinį pėdsaką“ ir jo kompensavimo galimybes vertinti regiono mastu, t. y. kartu su miestą aprūpinančiomis teritorijomis.

Raktažodžiai: ekologija, indeksas, miesto plėtra