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COMPARATIVE ASSESSMENT OF THE SUSTAINABILITY OF THE URBAN DEVELOPMENT IN THE SELECTED CITIES OF CENTRAL AND EASTERN EUROPE

Предложен набор из 26 критериев, сгруппированных по экономическим, демографическим, экологическим, экосистемным, социальным, культурным и др. признакам, для оценки тенденций к устойчивому развитию городов. Тестирование критериев производилось в 1998-2000 гг. на основе изучения статистических данных по социально-экономическому развитию, демографии и состоянию окружающей природной среды 10 городов Центральной и Восточной Европы – Харьков, Киев, Львов (Украина), Варшава, Познань, Гданьск (Польша), Прага, Ческе Будейовице, Брно (Чешская Республика), Братислава (Словацкая Республика). Наибольшие значения комплексного индекса устойчивого развития (возможный максимум = +78, возможный минимум = -78) были получены для Праги и Ческе Будейовице (т.е. развитие этих городов из исследованного ряда на современном этапе в наибольшей степени является устойчивым), в то время как минимальные - для Харькова и Львова (развитие которых на данном этапе проходит в «противоположном направлении»). Между показателями по критериям экономической и демографической, экономической и экологической, экологической и биологической групп установлена достоверная положительная парная корреляция.

This article summarizes outcomes of the project, which was carried out in 1998-2000 and aimed to examine the landscape patterns and process concerning the land use and ecological diversity patterns through the field and archival studies in order to find relevant indexes of sustainability of urban development [4]. The city of Kharkiv has been chosen as a model by reasons of its location, history, the role as a regional central city, being the biggest national industrial, transportation and educational center, and landscape diversity [1-3]. Additionally, comparative studies of experience achieved in landscape ecology, land use planning throughout the region of Central and Eastern Europe were carried out in 9 selected cities of the same or similar functions in Ukraine (Kyiv, Lviv), Poland (Gdansk, Poznan, Warsaw), Slovak Republic (Bratislava), and Czech Republic (Prague, Brno, Česke Budêjovice) [5-11].

To assess a sustainability/non-sustainability of urban development in any city, a number of criteria has been introduced. Those criteria have been grouped into the following categories:

- economic;
- demographic;
- landscape and ecosystem;

- environmental;
- biological;
- cultural;
- political.

Within each category, there are several criteria, which have been tested during the carrying out the given project. The field and archival studies, as well as a search for official statistical data and other published sources [4-11] were undertaken to make possible assessment of various indexes on the final stage of the project.

Thus, the group of the *economic* criteria includes the following ones:

1) stable rate of growth of gross and net domestic product (ECO-1);
2) stable growth of average income per person at low dispersion among different social and occupational groups (ECO-2);
3) growth of the number of private households (ECO-3);
4) decrease of unemployment rate and its further maintenance at the lowest level (ECO-4).

Among the *demographic* criteria:

1) stable or zero net growth of population number (DEM-1);
2) increase of the life expectancy in the population (DEM-2);
3) decrease of infant mortality rate (DEM-3).

Among the *landscape criteria* the following ones were proposed:

1) percentage of natural land cover in an urban area is the same or increasing at the increase of urban area due to population and household growth, or it is stable at the same size of an urban area (LSC-1);
2) at the growth of average income and population number the percentage of agricultural lands is not increasing at the same size of an urban area, or it is decreasing at the growth of an urban area (LSC-2);
3) the percentage and diversity of wetlands are stable at the growth of an urban area (it means that some wetlands should be artificially created to maintain a hydrological balance and to treat the urban run-off) (LSC-3).

The group of the *environmental* criteria:

1) number of environmentally-caused disasters steadily decreases to the level of that or less than outside urban areas (ENV-1);
2) rates of environmental pollution and concentrations of pollutants in the air, soil, hydrogeological, and aquatic environments are steadily decreasing to the levels that do not damage ecosystem health (ENV-2).

The *biological* criteria:

1) at least there is no decrease of number of species in an urban area comparing to previous years, or there is an increase of their number (BIO-1);

2) at the same level of total abundance (population density) there is observed increase of the percentage of the species groups different than synanthropic and urbophilous (BIO-2);
3) fluctuation rates in the pest species is steadily decreasing (BIO-3);
4) adventive exotic species at least do not increase their range and abundance (BIO-4);
5) rare (endangered and threatened) species, once having appeared in an urban area, maintain their number (BIO-5).

The *cultural* criteria are presented with the following:
1) there are certain ethnic groups in a community, which maintain their identity through increase of the number of national schools, printed production, exhibition, cultural actions, at an absence of inter-ethnic and inter-confessional conflicts (CLT-1);
2) an existence of traditional arts and crafts (measured through the number of workshops, galleries, etc.) (CLT-2);
3) the public awareness of environmental conditions in the community is high at the situation of the economic growth (CLT-3);
4) increase of the number of people in major social groups familiarized with local plant, animal, fungi species (CLT-4).

Finally, the group of the *political* criteria includes the following ones:
1) an existing electoral system of forming municipal authorities (POL-1);
2) environmental issues in political agenda of elected representatives (POL-2);
3) regular informing the population on the environmental conditions in a local communities (POL-3);
4) any land use planning question is discussed with representatives of local non-governmental environmental groups (POL-4).

After examination of the published and archival sources, and comparing to the current situation, it has been possible to note that the natural or semi-natural land cover decreased while the city grew, and such trend is actual in present both in Kharkiv, and in Kyiv, for example. There were no attempts to restore the damaged or strongly transformed ecosystems like woodlands and grasslands in the urban areas and vicinities.

As for agricultural lands, their percentage in urban areas was steadily increasing due to decrease of people's income. This is a leading trend of contemporary land use in Ukrainian cities. The increase of agricultural land cover within urban areas is observed due to increase of the number of kitchen gardens instead of pasture or mowing grasslands; especially in the city's vicinities kitchen gardens has become the major type of land use. This does not refer to more sustainable land use due to extensive management of

these rather small patches through implementation of notable energy subsidies, large amounts of fertilizers and pesticides.

The more difficult is assessment of sustainability related to urban wetland increase. From one hand, this increase, observed during the last two decades, is a good sign. However, from other hand, this increase has been caused by human construction activities and losses from local water supply and sewage systems. This process, in its turn, caused worsening of people's living conditions and quality of ground water. Now it is understood that the problem should be managed. This requires additional field studies. Some of urban wetland areas should obviously be maintained as local air cooling systems, sinks of pollutants coming with run-off, and reserves of biological resources.

To address some *biological indicators* of sustainability, one may note, after analyzing current urban tree health, that average state of tree health is described as weaken to strongly weaken. About 1/6 of total area of green stands in the city of Kharkiv requires reconstruction. However, tree species richness is quite high (about 150 domestic and introduced species), while 4 the most numerous species account together more than 45% of total number of trees. It seems that in order to increase stability of urban ecosystem the evenness of species abundance in a total community should be higher. To test this hypothesis the data from other cities are needed together with the data on environmental pollution dynamics.

As for other types of plant communities, it is possible to note the increase of the percentage of ruderal communities in total vegetation cover of the Kharkiv area, because of increase of disturbed lands. This is a sign of lowering sustainability level, too.

As for *environmental indicators* of sustainability, the decrease of air pollution in the last decade is noted due to decrease or even decline of traditional industrial production in the city of Kharkiv. At the same time, in some localities within the city, air pollution has been increased, because of transport impact through increase of the number of automobiles in the city.

After examining the official statistical sources, it has been noted that demographic indexes of the Kharkiv urban area do not contribute to the bigger sustainability. Thus, in the last decade the negative net growth of urban population has been observed; however, it was caused by decrease of birth rate and increase of death rate, including infant mortality that is higher than in Kyiv, but lower than in Lviv or some traditionally industrial cities of Donetsk Coal Basin region of Ukraine. The life expectancy in urban population has been significantly decreased in males and less - in females; it is a characteristic trend for whole Ukraine.

While analyzing the data of literature and information search and having discussed various urban ecological issues with colleagues from Ukraine and the Central and East European countries, the resulting comparative assessment of the urban sustainability traits has been done. A value from –3 to +3 was allocated to each criterion depending on the direction of development ("-" means "out of sustainability", "+" – "towards sustainability") and its expression ("0" – "unfair, "1" – "slightly", "2" – "moderate", "3" – "strongly"). The results of assessments are shown in the table.

Comparative assessment of sustainability of the selected Central and East European cities (trends in 1991-1998)

Sustain ability indexes	Kharkiv	Kyiv	Lviv	Warsaw	Poznan	Gdansk	Prague	Czeske Budejovice	Brno	Bratislava
ECO-1	-3	-2	-3	2	1	-1	2	2	2	1
ECO-2	-3	-2	-3	2	2	1	3	2	2	1
ECO-3	2	3	3	3	3	2	3	3	3	3
ECO-4	-3	0	-3	0	-1	-2	-1	-1	-1	-2
DEM-1	-1	1	-2	1	1	1	1	1	1	1
DEM-2	-3	-1	-3	1	1	0	1	1	1	0
DEM-3	0	1	-1	2	2	1	2	2	2	1
LSC-1	-2	0	-1	-1	0	2	0	1	0	0
LSC-2	-1	0	-1	0	1	1	2	1	1	1
LSC-3	1	0	-1	0	-1	3	0	1	0	0
ENV-1	-1	-1	-1	1	1	0	0	1	0	0
ENV-2	1	1	1	1	1	2	1	2	1	1
BIO-1	1	1	1	1	0	1	1	2	0	2
BIO-2	1	1	0	1	1	0	0	0	0	0
BIO-3	1	1	1	1	1	0	0	1	0	0
BIO-4	-3	-2	-2	-1	-1	-1	0	0	-1	-1
BIO-5	0	1	0	1	1	2	0	1	0	1
CLT-1	1	2	-1	0	1	0	3	1	1	2
CLT-2	1	3	2	2	2	2	3	3	2	2
CLT-3	1	1	1	1	1	1	1	1	1	1
CLT-4	0	1	1	1	1	0	1	1	2	1
CLT-5	1	2	1	1	2	2	2	2	2	2
POL-1	2	2	2	3	3	3	3	3	3	3
POL-2	0	0	0	0	0	1	1	1	1	1
POL-3	-1	0	-1	0	0	1	2	2	2	2
POL-4	-2	-1	-1	1	2	1	2	3	2	2
Total value:	-10	12	-11	24	25	23	33	37	27	25
Total ECO:	-7	-1	-6	7	5	0	7	6	6	3
Total DEM:	-4	1	-6	4	4	2	4	4	4	2

Total LSC:	-2	0	-3	-1	0	6	2	3	1	1
Total ENV:	0	0	0	2	2	2	1	3	1	1
Total BIO:	0	2	0	3	2	2	1	4	-1	2
Total CLT:	4	9	4	5	7	5	10	8	8	8
Total POL:	-1	1	0	4	5	6	8	9	8	8

Such cities as Česke Budějovice and Prague were assessed as the most corresponding to the notion of sustainable development, with total index values 35 and 32, respectively, while Kharkiv and Lviv were assessed with the lowest values in the selection: -10 and –12, respectively, that means their contemporary development is going "out of sustainability". Kyiv, the Ukrainian capital, got totally 10 points, that indicates slight but fair trend towards more sustainability. Polish cities Warsaw, Poznan, and Gdansk, and the Slovakian capital, Bratislava, occupied intermediate positions between Kyiv and the Czech cities. Statistically significant strong correlation was found between the economic and demographic (the Pearson's correlation coefficient r=+0,947), economic and political (r=+0,832), economic and environmental (+0,694), environmental and biological (r=+0,713) groups of criteria.

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