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URBAN SUSTAINABILITY ASSESSMENT OF ROMANIAN CITIES

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Abstract: Urban sustainability focuses on the more efficient management of the resources in cities and their regions. It is a challenge to develop a framework that it easy to replicate and can be used by any city in the world. In this paper, we aimed to develop a methodological approach for assessing urban sustainability of Romanian cities. We designed an index (Urban Sustainable Development Index) based on aggregating data from 15 indicators structured on the 3 sustainability domains, with equal weights per each domain. General results present medium and low USDI scores which indicate that cities are almost unsustainable. Very few cities have high USDI scores, making them almost sustainable cities due to the environmental or social contribution. Cities used as case studies have problems related mainly to green areas, waste management, crimes, health care infrastructure and low GDP. The assessment framework used for determining urban sustainability helped us identify some problematic domains. The proposed methodological approach can be replicated by cities worldwide, being recommended especially for cities with difficult access to data. The analysis uses representative information for urban sustainability that can be easily replicated and used for monitoring by stakeholder and decision makers at local level.

Key words*:* urban sustainability, indicators, assessment framework, cities, Romania

1. INTRODUCTION

Urban sustainability integrates all the city resources available inside its administrative limits and beyond. It is considered as an equilibrium between the economic, environmental and social pillars of sustainability at urban scale (Dizdaroglu, 2015; European Commission, 2018). In the context of current development trends as dynamic urbanization and transformation of cities, people are using more resources and consumption patterns are changing (Fiksel, 2007; Moore, 2015) affecting us all. The effects are visible especially at urban level, these being the most densely populated areas on Earth and have a major impact in our society (Phillis et al., 2017; Akande et al., 2019; Sharifi, 2020). Urban planning, transportation, education, health care, housing, pollution, waste and green areas are several challenges that impact in different ways and with various intensities our lives (Fayman et al., 2011; Frantzeskaki *et al.*, 2017; Almeida, 2019). In response to these challenges, the United Nations have developed the 17 Sustainable Development Goals (United Nations, 2016b, 2017b, 2017a). Goal 11 – *Make cities and human settlements inclusive, safe, resilient and sustainable* (United Nations, 2019) is promoting a holistic and inclusive vision, integrating urban planning, transparency, and monitoring (United Nations, 2012; Pânzaru, et al., 2020) for achieving urban sustainability. Urban sustainability represents an optimum management of the resources available inside and in the proximity of a city which doesn't exceed the environmental support capacity.

Assessing urban sustainability involves a large array of variables and methods (Singh et al., 2012). Studies which aimed to assess urban sustainability usually focused on methods involving indicators (Shen et al., 2011; Dawodu, et al., 2017), indexes (Mega & Pedersen, 2012; Bondarchika et al., 2016; Jato-Espino et al., 2018), statistical analysis (Munier, 2011), cluster analysis (Akande et al., 2019), Delphi method (Mapar *et al.*, 2017), multicriterial assessment (Shmelev & Shmeleva, 2019; Bennich, et al., 2020), and rating systems (Vega, 2012; Kaur &

Garg, 2019). Usually, those techniques are aggregated in an efficient assessment framework, but it cannot be used for all kinds of purposes or scales, because there is no universal solution or framework (Kaur & Garg, 2019; Steiniger et al., 2020).

Zarghami & Fatourehchi (2020) used multicriterial analysis by developing a framework and aggregating the information in a mathematic expression for quantifying cities sustainability and ranking them by score. Munier (2011) applied statistical methods (entropy concept) for selecting indicators from the OECD framework, using a top-down approach, and considering policies, goals, indicators and their weights when he conceptualized the local assessment framework. There are many programs and frameworks regarding the assessment of urban sustainability such as: Global City Indicators (Global Cities Institute, 2017), ISO 37120 (ISO, 2018), Sustainable City Index (Arcadis, 2015), Mercent Quality of Living (Mercent, 2019), International Urban Sustainability Indicators (European Commission, 2018), which assessed the urban sustainability through a top-down approach that took into consideration national or international standards (Singh et al., 2012; Tran, 2016).

Likewise, there are several examples of indexes used for urban sustainability assessment such as: Environmental Performance Index (EPI) (Wendling et al., 2020), Living Planet Index (LPI), Ecological Footprint Index (EFI), City Development Index (CDI), Human Development Index (HDI), Environmental Sustainability Index (ESI), Environmental Vulnerability Index (EVI), Well-Being Index (WI), Genuine Savings Index (GSI) (Böhringer & Jochem, 2007), developed using different approaches and methodologies, but needing large amount of data and being very hard to reproduce.

Considering the possibilities and techniques for assessing urban sustainability, researchers often aggregated information by weights (Feleki, Vlachokostas and Moussiopoulos, 2018) and rating systems to rank cities according to their sustainability scores (Phillis, et al., 2017; Sun, et al., 2020). Because cities and countries are different in terms of environmental, economic and social characteristics, in this study we aimed to propose a framework that acknowledges this diversity by adding positive and negative threshold values for each sustainability dimension which will reflect more accurately the perspective of urban sustainability. The gap this research is aiming to fill is represented by the fact that there are not many studies that offer easy-to-replicate methods in assessing urban sustainability. The existing ones are very complex and require a lot of data and time to build an image on the degree of sustainability. Most of the frameworks are difficult to replicate and do not use data easy to access for every city. The present study allows the evaluation of urban sustainability with a small number of indicators, for which data can be easily obtained, but at the same time they have a high quality and address the sustainable development goals.

Our study was developed starting with the objective for developing tools for urban sustainability assessment in Romania. After 15 years since the adherence to the European Union, Romania is still adjusting to European policies and regulations. Even if European policies promote a transparent approach and openness regarding public data and informing their citizens about different subjects of public interest such as: decisional processes, health care services, education, basic utilities, air pollution, waste management etc., in Romania it is still a challenge to provide detailed data in many fields. There is a need for integrating urban sustainability assessment at local and national level. The subject was approach only in a study using SDG indicators on rural and urban areas of Romania (Benedek et al., 2021). We address this matter in a pragmatic perspective proposing an easy-to-use approach for public authorities and aiming to develop a methodology for assessing urban sustainability of Romanian cities.

2. MATERIALS AND METHODS

2.1. Study area

Romania has 320 cities and an average density of 5.8 cities per 100 km^2 (Popescu-Criveanu et al., 2014). For this study we selected 42 cities as case studies for testing our methodological approach (Figure 1). Based on urban population, the selected cities are represented by 3 major categories: (a) big cities with population over 250 000 inhabitants (N=8), (b) medium cities with population between 100 000 and 250 000 inhabitants (N=17) and (c) small cities with population less than 100 000 inhabitants (N=17). The population of these cities is concentrated in residential areas, mostly represented by collective buildings. Using the number of households, the cities are grouped in cities with less than 50 000 (N=24), between 50 000 and 100 000 (N=10) and over 100 000 (N=8) (INS, 2020).

From the social perspective, Romanian cities are focused mostly on social wellbeing, rather than social inclusion. From an economic point of view, Romania has underdeveloped regions (including urban areas) with low income and marginalized communities that have a poor access to basic facilities, education and

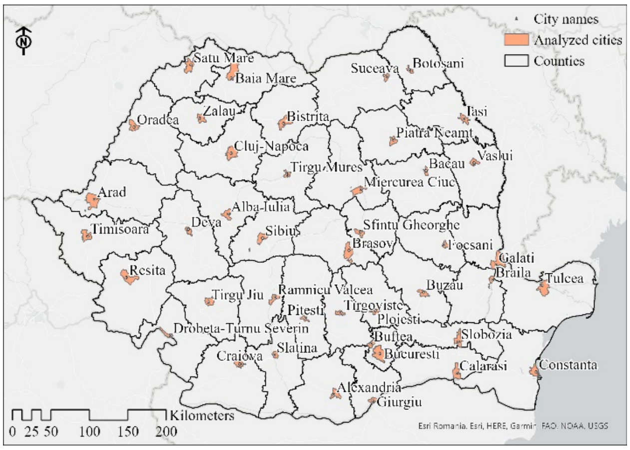

Figure 1. Location of the analyzed cities

health care services (Swinkels et al., 2013). After 1990, Romanian cities adapted their functional profile to survive the changes. Most cities now focus on tertiary activities and very few of them retain only industrial and agricultural activities (Popescu-Criveanu et al., 2014). From the natural environment point of view, the analyzed cities are part of the 4 major relief units present in Romania, namely: (1) plains (N=16); (2) hills (N=6); (3) plateaus (N=14) and (4) mountains (N=6). Most of the large analyzed cities are in plain and plateau areas, having the possibility of extending their urban areas easier than those situated in mountain or hill areas. Also, the natural conditions of the cities are influencing their social behavior and their economic approaches. Part of the cities are well known for environmental problems (air pollution, mineral exploitation, deforestation etc.) which drag with them social and economic problems.

2.2. Methodology

For the present study we developed a methodological approach in 5 steps: (i) designing the assessment framework based on the scientific literature, (ii) establishing criteria for choosing the indicators, (iii) selecting indicators, collecting and standardizing data, (iv) weighting indicators and (v) aggregating data to obtain the Urban Sustainability Development Index (USDI) (Figure 2). First, we did a preliminary screening of the literature in order to design the assessment framework of urban sustainability. The framework was structured mirroring the 3 domains of sustainability - social, economic and environment (Feleki, et al., 2018; Azzouz & Jack, 2020), containing 15 indicators (Table 1), 5 for each domain. The indicators were selected using the following criteria: (a) *data availability*, data must be available for all Romanian cities (Saad, et al., 2019), (b) *relevance*, it must be related to urban sustainability (Hák, et al., 2016) and to contribute to SDG targets (Londoño Pineda & Gabriel Cruz Cerón, 2019), (c) *measurable*, it should be easy to measure and to have a measurement unit (Saad, et al., 2019), (d) *comprehensive*, it must be easy to understand and to present a description (Hák, et al., 2016) and (e) *comparability*, it must be comparable between cities (Ramos, et al., 2004; Rossberga *et al.*, 2017; Cichy & Rass, 2019).

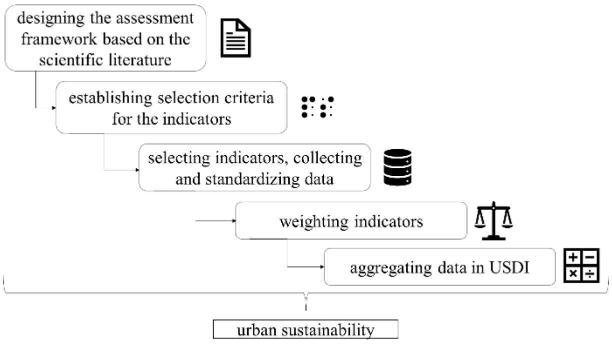

Figure 2. Workflow of the research

In 2020 data needed for calculating the indicators was collected in a tabular format using as sources: National Institute of Statistics (Romanian abbreviation INS) (INS, 2020), Permanent Electoral Authority (Romanian abbreviation AEP) (AEP, 2020), National Air Quality Monitoring Network (Romanian abbreviation RNMCA) (RNMCA, 2019), World Bank (Swinkels et al., 2013), Copernicus products (European Union, 2018) and urban waste strategies. Data was standardized using the formulas provided by Iojă et al., (2014), considering the positive or negative influence of the indicator on urban sustainability (Tian & Sun, 2018; Wang, et al., 2020), presented in equation 1 and 2, where Ind_n – *normalized indicator*, max – *maximum value of the indicator*, min – *minimum value of the indicator*, y – *indicator value*. Equation 1 is applicable when the highest value of the indicator has a negative influence on urban sustainability and Equation 2 is applicable when the highest value of the indicator has a positive influence on urban sustainability.

$$Ind_n = \frac{1-100}{max-min} \times y + \frac{100 \times max - 1 \times min}{max-min} \quad (1)$$

$$Ind_n = \frac{100-1}{max-min} \times y + \frac{1 \times max - 100 \times min}{max-min} \quad (2)$$

For data aggregation we used a weight linear combination (Illahi & Mir, 2020) with an adjustment based on the principle proposed by Panda, et al., (2016) using benefit and cost as threshold. We considered as negative threshold the decreasing trend of *GDP growth rate reported to the national average* for the economic domain and the decreasing trend of

Table 1: Indicators used in the assessment

No.	Pillar	Indicator code	Indicator name	Data sources	Description	Year	Weight	Influence	References
1	environment	GA_%	Green areas (%)	INS	Green urban areas expressed in percentage from total urban area for each city	2019	0.0995	↑	(Munier, 2011; Arcadis, 2015; Tran, 2016; Feleki, et al., 2018; ISO, 2018; Lehner et al., 2018; Merino-Saum et al., 2020; Steiniger et al., 2020; Wei et al., 2020)
2	environment	IS_%	Impervious surface (%)	Copernicus	Percent of impervious surfaces from urban areas	2018	0.0296	↓	(Tran, 2016; Fang et al., 2021)
3	environment	PM10_no	Particulate Matter 10 µm (number of times the daily limits were exceeded)	RNMCA	Number of times the maximum allowed daily limits by legislation were exceeded	2019	0.1403	↓	(Munier, 2011; IESE Business School, 2016; Tran, 2016; Akande et al., 2019; Steiniger et al., 2020)
4	environment	WDI_%	Water distribution infrastructure (%)	INS	Percent of the total street's length covered by water distribution infrastructure	2019	0.0227	↑	(Arcadis, 2015; Panda, et al., 2016; ISO, 2018; Merino-Saum et al., 2020; Wei et al., 2020)
5	environment	UW_kg_cap	Urban waste (kg per capita)	Waste strategies	Quantity of urban waste produced expressed in kilograms per capita	2019	0.0395	↓	(Arcadis, 2015; Feleki, et al., 2018; ISO, 2018; Lehner et al., 2018; Kaviti Musango et al., 2020; Merino-Saum et al., 2020)
6	social	MC_%	Marginalized communities (%)	World Bank	Percent of marginalized communities	2020	0.0550	↓	(Munier, 2011; Feleki, et al., 2018; ISO, 2018; Lehner et al., 2018)
7	social	C_1000_inhab	Crimes (per 1000 inhabitants)	INS	Number of persons in prisons and detention centers reported to 1000 inhabitants per year	2019	0.0282	↓	(Munier, 2011; Arcadis, 2015; IESE Business School, 2016; Panda, et al., 2016; Feleki, et al., 2018; ISO, 2018; Merino-Saum et al., 2020)
8	social	EPP_%	Elections public participation (%)	AEP	Percent of public participation at local elections	2020	0.0118	↑	(Akande et al., 2019; Merino-Saum et al., 2020; Steiniger et al., 2020)
9	social	HED_1000_inhab	High school education degree (per 1000 inhabitants)	INS	Number of high school graduates reported to 1000 inhabitants per year	2018	0.1386	↑	(Munier, 2011; IESE Business School, 2016; ISO, 2018; Kaviti Musango et al., 2020)
10	social	HB_1000_inhab	Hospital beds (per 1000 inhabitants)	INS	Number of beds in public hospitals reported to 1000 inhabitants per year	2019	0.1005	↑	(Munier, 2006)
11	economic	T_1000_inhab	Tourists (per 1000 inhabitants)	INS	Number of tourists reported to 1000 inhabitants per year	2019	0.0599	↑	(Arcadis, 2015; IESE Business School, 2016; Fang et al., 2021)
12	economic	PT_1000_inhab	Public transportation (per 1000 inhabitants)	INS	Number of public transportation vehicles (all categories, trams, buses, minibuses) reported to 1000 inhabitants	2019	0.1427	↑	(IESE Business School, 2016; Feleki, et al., 2018; Lehner et al., 2018)
13	economic	BP_1000_inhab	Building permits (per 1000 inhabitants)	INS	Number of building permits reported to 1000 inhabitants	2019	0.0157	↑	(Munier, 2011; Wei et al., 2020)
14	economic	MS_%	Modernized streets (%)	INS	Percent of streets modernized reported to streets length	2019	0.0197	↑	(Wei et al., 2020)
15	economic	GDP_mil_lei_cap	Gross domestic product (millions of lei per capita)	INS	Gross domestic product expressed in millions of Lei per capita	2019	0.0962	↑	(Munier, 2011; Bondarchik et al., 2016; Akande et al., 2019; Wang, Shi & Wan, 2020; Superti et al., 2021)

population dynamics for the social domain. The increasing trend of *GDP growth rate reported to the national average* for the economic domain and the increasing trend of *population dynamics* for the social domain were considered as positive thresholds.

For the environmental domain the absence of *historical pollution* and ecological problems (2015-2019) was considered as positive threshold, while their presence (2015-2019) was associated with the negative threshold. The values used as threshold for each domain are presented in Table 2. For example, if the population increased by 120 residents, it meant that the trend was upward, so the threshold was positive and associated with a value of 2.

Table 2 Threshold positive and negative values

Historical pollution *(Hp)*		**Population dynamics *(Pd)***		**GDP growth rate *(GDPgr)***	
presence	*value*	*no. of residents*	*value*	*rate value*	*value*
yes	-5	over 5000	5	over 10	5
		over 100	2	over 5	2
		-100 to 100	0	-5 to 5	0
		under -100	-2	under -5	-2
		under -5000	-5	under -10	-5

The Urban Sustainable Development Index (USDI) was calculated using Equation 3. The environment index (EnI), social index (SoI) and economic index (EcI), which assess the urban sustainability for each of the three domains, with thresholds and without thresholds are presented in Equations 4-9, where *USDI* - Urban Sustainable Development Index, Ind_n – normalized indicator, W_{ind} – indicators weights, *Hp* – threshold value for historical pollution, *Pd* - threshold value for population dynamics, *GDPgr* – threshold value for GDP growth rate, *Enl* – environment index with threshold, $Ind_{n\ en}$ - normalized environment indicator, $W_{ind\ en}$ – environment indicators weights, *Sol* – social index with threshold, $Ind_{n\ so}$ - normalized social indicator, $W_{ind\ so}$ – social indicators weights, *EcI* – economic index with threshold, $Ind_{n\ ec}$ – normalized economic indicator, $W_{ind\ ec}$ – economic indicators weight, *Enl'* - environment index without threshold, *Sol'* – social index without threshold, *EcI'* – economic index without threshold.

The values of the USDI were grouped in 6 intervals corresponding to sustainability classes (Graymore, et al., 2010; Boyko et al., 2012) (Table 3). Also, we tested the spatial autocorrelation of the results using Global Moran. For data collection, management and analysis, we used Microsoft Office Excel (Microsoft Corporation, 2019) and ArcGIS Pro 2.9 (Esri Inc., 2022).

Table 3. USDI values classification

No.	**Sustainability classes**	**Intervals**
1	very unsustainable	≤20
2	unsustainable	20.01-35.00
3	almost unsustainable	35.01-50.00
4	almost sustainable	50.01-65.00
5	sustainable	66.01-80.00
6	very sustainable	>80

3. RESULTS

3.1. Environment indicators

Using the methodological approach described in section 2, we obtained an overview of each domain of sustainability. The contribution of environment indicators to urban sustainability was small for green areas, impervious surfaces, water distribution infrastructure and urban waste, while particulate matter had high contribution for most of the cities (Figure 3a). We observed that the preliminary results, without threshold, indicate that some cities such as Bucharest were sustainable, even if the city undergoes a European infringement procedure for air quality. The environment index without using the threshold for historical pollution had a mean of 17.31 [7.41-27.34; ±4.05] compared to the environment index with threshold for historical pollution with a

$$USDI = \sum_1^n Ind_n \times W_{ind} + Hp + Pd + GDPgr \qquad (3)$$

$$EnI = \sum_1^n Ind_{n\ en} \times W_{ind\ en} + Hp \qquad (4)$$

$$SoI = \sum_1^n Ind_{n\ so} \times W_{ind\ so} + Pd \qquad (5)$$

$$EcI = \sum_1^n Ind_{n\ ec} \times W_{ind\ ec} + GDPgr \qquad (6)$$

$$EnI' = \sum_1^n Ind_{n\ en} \times W_{ind\ en} \qquad (7)$$

$$SoI' = \sum_1^n Ind_{n\ so} \times W_{ind\ so} \qquad (8)$$

$$EcI' = \sum_1^n Ind_{n\ ec} \times W_{ind\ ec} \qquad (9)$$

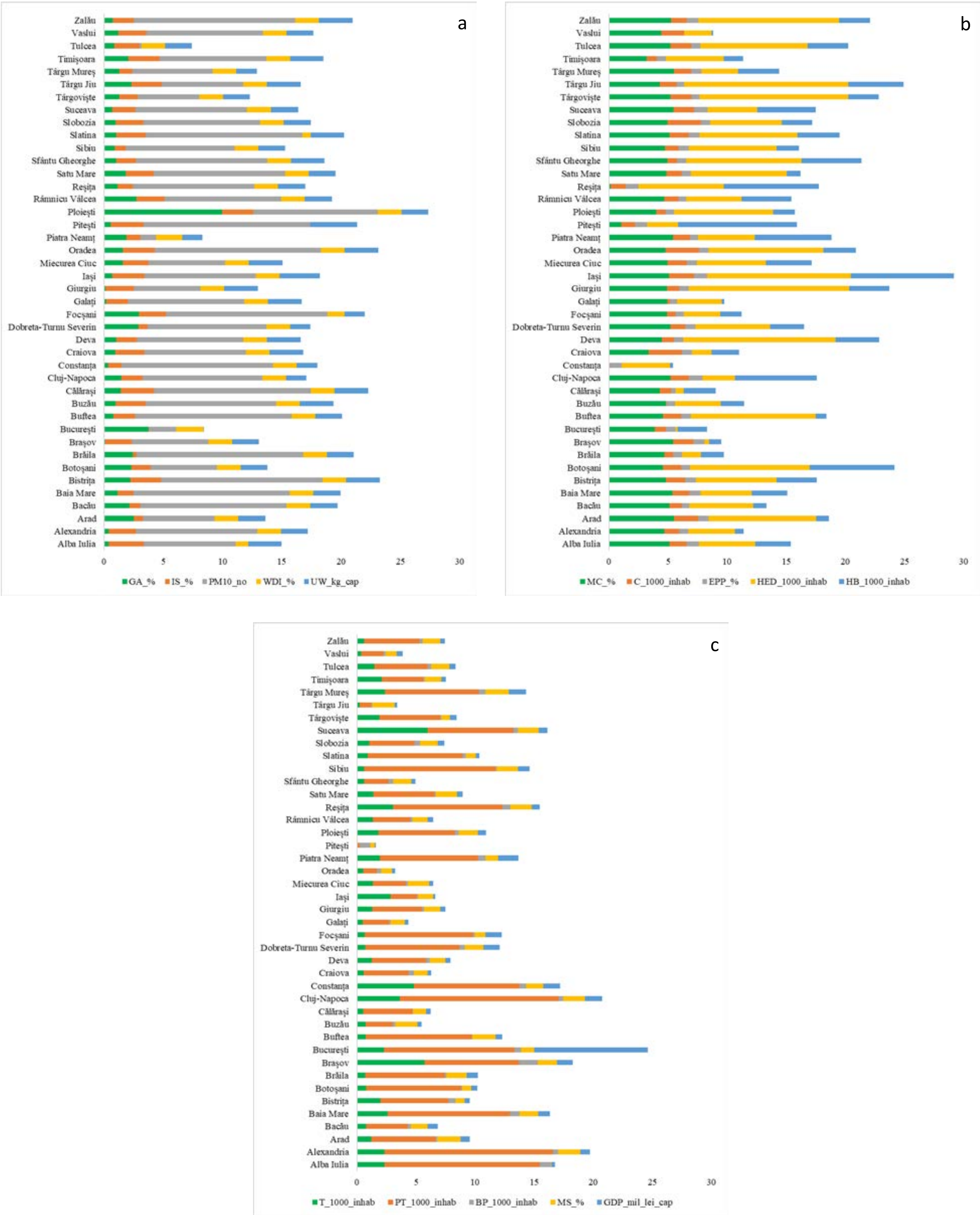

Figure 3. a. Contribution of environment indicators to urban sustainability, where GA_% - Green areas (%), IS_% - Impervious surfaces (%), PM10_no - Particulate Matter 10 μm (number of times the daily limits were exceeded), WDI_% - Water distribution infrastructure (%), UW_kg_cap - Urban waste (kg per capita); b. Contribution of social indicators to urban sustainability, where MC_% - Marginalized communities (%), C_1000_inhab - Crimes (per 1000 inhabitants), EPP_% - Elections public participation (%), HED_1000_inhab - High school education degree (per 1000 inhabitants), HB_1000_inhab - Hospital beds (per 1000 inhabitants); c. Contribution of economic indicators to urban sustainability, where T_1000_inhab - Tourist (per 1000 inhabitants), PT_1000_inhab - Public transportation (per 1000 inhabitants), BP_1000_inhab - Building permits (per 1000 inhabitants), MS_% - Modernized streets (%), GDP_mil_lei_cap - Gross domestic product (millions of lei per capita)

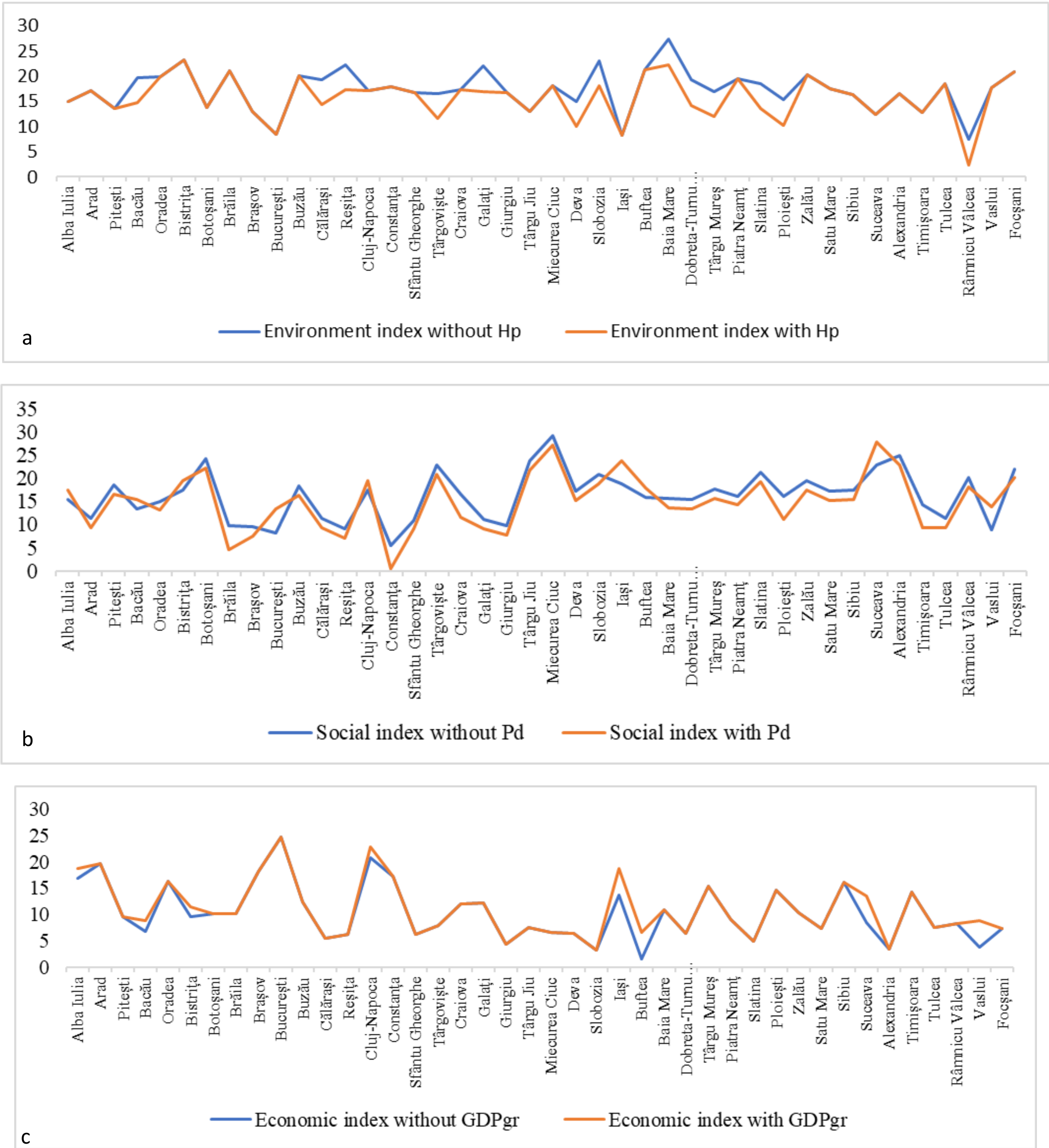

Figure 4. a. Environment index values with and without considering historical pollution; b. Social index values with and without considering population dynamics; c. Economic index values with and without considering GDP growth rate

mean of 15.77 [2.41-23.24; ±4.19] showing differences on 31% of the analyzed cities. Using historical pollution as threshold for environmental domain, gave us an overview of the environmental conditions of the cities, that diminished the environment index values where appropriate (Figure 4a). The maximum value the environment index could reach was 33.16. The higher the obtained value, more sustainable was the city.

3.2. Social indicators

The contribution of social indicators to urban sustainability was small for crimes, public participation in elections and hospital beds indicators, while marginalized communities' indicator maintained a medium contribution. Most of the cities had high contribution for high school education degree indicator (Figure 3 b). The social index without using the threshold for population dynamics had a mean of 16.26 [5.42-29.14; ±5.20] compared to the social index with the threshold for population dynamics with a mean of 15.05 [0.42-27.82; ±5.87] showing differences on all of the analyzed cities. Population dynamics as threshold for the social domain helped to improve the social approach considering that an increase of population is an indicator for the attractiveness of living in cities. There were 21% cities with a positive correction, with an increase in population, and 79% with a negative correction, with a decrease in population (Figure 4b). The maximum value the social index could reach was 33.41.

3.3. Economic indicators

The contribution of economic indicators to urban sustainability for Romanian cities was small for building permits, modernized streets, GDP indicators, and moderate for tourists and public transportation indicators (Figure 3c). The economic index without using the threshold for GDP growth rate had a mean of 10.34 (1.60-24.61; ±5.23] compared to the economic index with the threshold for GDP growth rate with a mean of 11.00 [3.21-24.61; ±7.43] showing differences on 19% of the analyzed cities. GDP growth rate shows the economic development of cities. The threshold had registered only positive values, which implied an increase in the values of the indicator from 2 to 5 points, for 3 cities and respectively for 5 cities (Figure 4c). The maximum value the economic index could reach was 33.42.

3.4. Urban sustainability

The results indicated a limited level of sustainability of Romanian cities. The almost sustainable cities (N=6) are concentrated in the center of the country, known as Transylvania region and in the north-eastern part of the country, known as Moldavia region. The almost unsustainable cities (N=29) and unsustainable cities (N=7) are spread around the country forming clusters (Figure 5). The almost sustainable cities are spatially grouped as the spatial autocorrelation test (Global Moran) confirmed a positive autocorrelation among urban sustainability (0.25). The contribution of indicators to urban sustainability was significant for social dimension, the smallest contribution was from the economic indicators, even if the GDP growth rate was positive for all the analyzed cities. The environment indicators influenced the urban sustainability only for the cities known for their historical pollution and in this specific case we had 13 cities.

4. DISCUSSIONS

At general level, we obtained an overview of urban sustainability of Romanian cities including the 3 domains of sustainability and using thresholds for

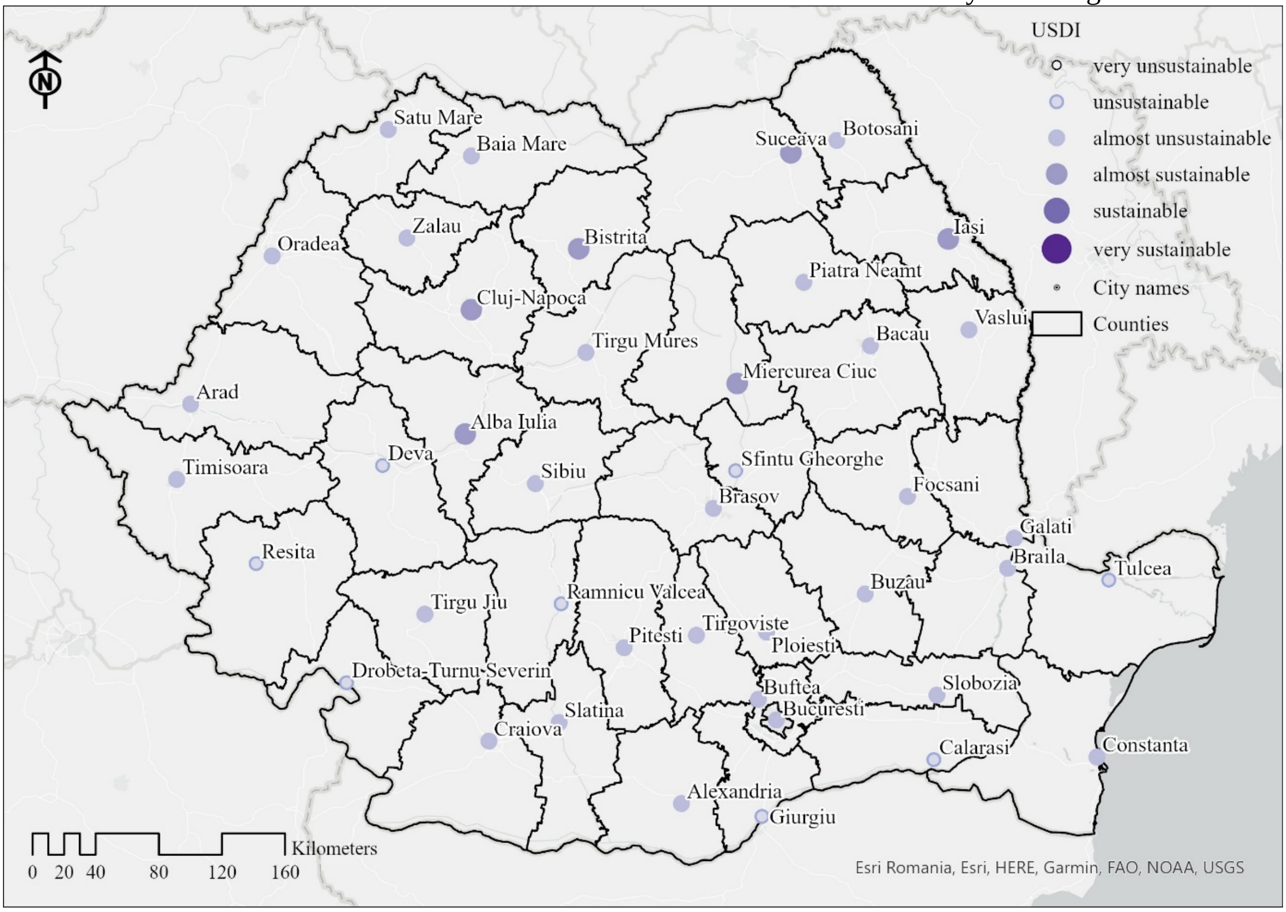

Figure 5. USDI spatial distribution of Romanian cities

each domain. The interactions of the 3 domains of sustainability sustain a smart and sustainable city (Feleki, et al., 2018) which is practically the main objective of SDG 11 and the direction proposed by United Nations for urban planning (United for Smart Sustainable Cities, 2017). In our specific case, 66% of cities are almost unsustainable according to USDI results, with a positive spatial autocorrelation that indicates clustering areas.

The general results indicate that Romanian cities have to improve their work in achieving sustainability and aligning with Agenda 2030 targets (United Nations, 2015). The indicators used in the assessment framework contribute to SDG 11 and are complementary with other SDGs (Table 4), which makes them relevant not only for urban sustainability (Merino-Saum et al., 2020; Rama et al., 2021), but for sustainability at global scale - United Nation targets (United Nations, 2016b, 2017b, 2017a) and national scale - National Strategy for Romania’s Sustainable Development (Departamentul pentru dezvoltare durabilă, 2018). Even so, the small values obtained by cities suggest the lack of implication of the authorities in managing their resources and population needs. The lowest scores of USDI indicate that the cities have issues in all 3 domains: environment, social and economic.

At environmental level, the problems highlighted by the values of the index indicate deficiencies for green areas, impervious surfaces, water distribution infrastructure and urban waste. Green spaces are insufficient in relation to the surface and the population of the cities (Badiu et al., 2016; Vasilescu, et al., 2022). Impervious surfaces are growing due to urban expansion (Suditu, 2009), which does not entail the development of water distribution infrastructure or the proper management of urban waste or green spaces (Gavrilidis et al., 2020). All these, in conjunction with the current consumption patterns of society, make them have an important negative impact on the environment (Fang et al., 2021) and hinder achieving human well-being and urban sustainability (Ramaswami et al., 2016; Niţă & Ioja, 2020).

Social index focused on safety, public participation, health, education and inequality (Benites & Simões, 2021; Mitincu et al., 2021) that are considered key elements for social inclusion and equity promoted by United Nations (United Nations, 2016a). The results in this direction indicate that Romanian cities are struggling with crimes, mostly scams, organized groups of thieves and pickpockets, drug-related crimes etc. (OSAC, 2020) to which are added the problems of marginalized communities, lacking a stable income, poor housing and illiteracy (Swinkels et al., 2013). Public health facilities are concentrated mostly in urban areas and are not equally distributed at national level creating spatial clusters (Dumitrache et al., 2016) and limiting access to this category of services. Same issue is present for educational institutions as well, especially for higher education.

Table 4. Indicators contribution to SDGs

No.	Pillar	Indicator code	SDG relation*
1	environment	GA_%	3, 11, 13, 15
2	environment	IS_%	11, 13
3	environment	PM10_no	3, 11, 13
4	environment	WDI_%	6, 9, 11, 12, 14, 15
5	environment	UW_kg_cap	11, 12, 15
6	social	MC_%	1, 2, 3, 8, 10, 11
7	social	C_1000_inhab	3, 10, 11, 16
8	social	EPP_%	11, 16
9	social	HED_1000_inhab	4, 8, 9, 10, 11
10	social	HB_1000_inhab	3, 5, 9, 11
11	economic	T_1000_inhab	1, 2, 3, 9, 10, 11
12	economic	PT_1000_inhab	3, 9, 10, 11
13	economic	BP_1000_inhab	9, 11, 12, 16
14	economic	MS_%	3, 8, 9, 10, 11, 16
15	economic	GDP_mil_lei_cap	1, 8, 11

*SDG1 - End poverty in all its forms everywhere (2), SDG2 - End hunger, achieve food security and improved nutrition and promote sustainable agriculture (2), SDG3 - Ensure healthy lives and promote well-being for all at all ages (8), SDG4 - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (1), SDG5 - Achieve gender equality and empower all women and girls (1), SDG6 - Ensure availability and sustainable management of water and sanitation for all (1), SDG7 - Ensure access to affordable, reliable, sustainable and modern energy for all (1), SDG8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (4), SDG9 - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (8), SDG10 - Reduce inequality within and among countries (5), SDG11 - Make cities and human settlements inclusive, safe, resilient and sustainable (13), SDG12 - Ensure sustainable consumption and production patterns (3), SDG13 - Take urgent action to combat climate change and its impacts or (1), SDG14 - Conserve and sustainably use the oceans, seas and marine resources for sustainable development (1), SDG15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (3), SDG16 - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (2)

From the economic index perspective, Romanian cities have good public transportation, but very low GDP per capita values. The allocation of financial resources in the territory is unbalanced. Local public authorities are trying to attract funds through European programs that will allow them to implement projects necessary for local communities. In Romania there are few cities that accessed European funds and developed their infrastructure (Lucian, 2014).

Our methodological approach was developed in order to assess urban sustainability for Romanian cities in a pragmatic way and easy to use and replicate, without collecting other kind of data at city level than that offered by administrative sources (Leach et al., 2017). The framework structure following the 3 domains of sustainability creates equilibrium among them and their equal weights provide the possibility to also assess the domains separately, without influencing the USDI results. The number of indicators is considered moderate and there were taken into consideration the researchers recommendations for relevance, redundancy (Mapar et al., 2017; Illahi & Mir, 2020) and especially regarding data availability at city level (Firoiu et al., 2019). The thresholds were established in order to project positive and negative impacts from the environment, social and economic dynamics and adjust the domain indexes. The values were selected considering the minimum and maximum values obtained for each dimension. It may be a limitation if the values for population dynamics and GDP growth rate are much more scattered compared with our test data.

5. CONCLUSIONS

The study provides methodological approach for assessing urban sustainability considering the 3 domains of sustainability aggregated in the USDI. The novelty of our assessment framework consists in the thresholds used for each domain and the possibility to understand better those domains. The selected indicators are relevant for cities, with available data for performing the analysis, useful for authorities and suitable for monitoring sustainability over time. Our study represents a practical operationalization through indicators for assessing urban sustainable development for Romanian cities. Further analysis and assessment can be undertaken using the methodological approach proposed for the other cities in Romania. As the impact on daily activities, perhaps from the administrative perspective this work will represent a warning signal that in Romania cities do not have data concentrated at urban scale and for researchers is hard to perform analysis using frameworks from other countries and must adapt and narrow the information. From the environmental perspective there is still a problem to acquire data. Fortunately, the current administration can prove we are wrong and there is a good way to collaborate and guide for decision-making.

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