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Measuring Sustainable Development Goals at a Local Level: A Case of a Metropolitan Area in Romania

Júlia A. Nagy [1], József Benedek [1,2,*] and Kinga Ivan [1]

[1] Faculty of Geography, Babeș-Bolyai University, Clinicilor Street, 5-7, 400006 Cluj-Napoca, Romania; julia.nagy@ubbonline.ubbcluj.ro (J.A.N.); kinga.ivan@ubbcluj.ro (K.I.)

[2] World and Regional Economics Department, University of Miskolc, 3515 Miskolc-Egyetemváros, Hungary

* Correspondence: jozsef.benedek@ubbcluj.ro

Received: 1 October 2018; Accepted: 28 October 2018; Published: 31 October 2018

Abstract: Metropolitan areas became the breeding ground for economic, political, and cultural concentration as well as for creativity and innovation. Therefore, sustainability within the urban dimension plays a crucial role in the overall success to attain the SDGs (Sustainable Development Goals) and their targets under the 2030 Agenda for Sustainable Development in 2015. Nevertheless, for cities, regions, or countries to monitor and measure their progress, there is a need for harmonized and reliable indicators. Consequently, the current study addresses sustainability on a local level by measuring the extent to which a Romanian metropolitan area achieves the SDGs agreed to in 2015 by the 193-member states of the United Nations. The paper analyses 16 out of the 17 SD (Sustainable Development) goals as the goal titled "Life below water" was not applicable. Relying on mainly quantitative data, we used the method of normalization and aggregation based on the arithmetic mean, which helped us to calculate the scores attained by each of the component localities of the metropolitan area within the SDGs and their overall SDG index. Next to this, the study combines the quantitative data analysis with a GIS (Geographic Information System) computer mapping technique. The results show that the municipality achieved the best results in the metropolitan area and a vertical development process from west to the east prevails. Measuring progress through a well-defined set of indicators and an optimization technique proved to be crucial in defining attainments' levels within the metropolitan area.

Keywords: SDG Index; metropolitan area; sustainable development; urban development

1. Introduction

Endeavors towards addressing, measuring, monitoring, or implementing procedures to achieve sustainable development has received great attention in the recent decades. Nevertheless, there always was and most probably will be room for improvement in tools and methods used to ensure development in a sustainable manner. Therefore, in 2015, an agreement was brought in the partnership of 193 countries of the United Nations [1] in developing a framework that would lead to the accomplishment of a large variety of goals in the fields of economic, social, and environmental sustainability by the year of 2030. A wide spectrum of common, broadly applicable and attainable tools was needed to measure the progress of these countries in attaining the goals on one hand and identifying gaps that need more attention on the other. Consequently, the SDG (Sustainable Development Goal) Index and Dashboards have been introduced that offer a synthetized analysis of each country's performance in achieving the 17 commonly agreed Sustainable Development Goals [2]. It is also important to consider the fact that these goals are not placed on a hierarchical ladder, hence, equal importance should be given to each. Nevertheless, solving global problems require contributions on local, regional, and national levels. Consequently, local governments play a crucial role in developing policies, guiding actions, and stimulating knowledge to contribute to the achievement of the projected sustainable development goals. In the meantime, specific and appropriate tools are needed to audit local conditions, identify problems, take appropriate actions, and measure progress in delivering results and, accordingly, meeting the SDGs.

However, to our knowledge there are still no studies designated for the measurement of SDGs on a local level (NUTS (Nomenclature of Territorial Units for Statistics) 5 in Europe) that are based on the methodology developed at a country level by the Sustainable Development Solutions Network (SDSN). Our analysis aims to fill this research gap. More specifically, taking the case of the Cluj Metropolitan Area (CMA), we calculate the SDG Index and Dashboards based on the SDSN methodology. Therefore, the main objective of this study is to develop a methodology based on the formal measurement of SDGs, applied on a local scale, defined in Europe as the NUTS 5 level. As pointed out before, to accomplish this objective, first we calculated the score for each of the SD Goals (except the 14th goal entitled 'life below water' because our spatial setting is continental). Next to this, Dashboards (Appendix A, Figure A1) have been created to summarize the achievement of each component locality within each of the SD goals. Following the calculation of the individual SDG scores, we aggregated the results and determined the overall SDG Index for each of the CMA's locality and, finally, of the entire metropolitan area.

2. Literature Review

The context of global sustainable development required the framing of shared goals and adoption of common actions. Consequently, with the launch of the Millenium Development Goals (MDGs), a new stage of global cooperation on addressing sustainability related issues emerged [2]. Further, in response to their ending agenda in 2015, a new phase of political compromise on addressing sustainability related challenges ascended when the 193 member states of the United Nations agreed on common efforts to accomplish progress in addressing social, economic, and environmental encounters in their countries [2]. With the 17 SDGs comprising 169 targets, the stakeholders expressed their ambition to act collaboratively to achieve by 2030 the agenda for sustainable development [3]. Therefore, the analysis and evaluation of baselines for the Sustainable Development Goals and Index became a focal theme to several scientific studies [2,4,5].

Several initiatives address the evaluation of sustainability at local [6–9], regional [7], or national [1,2,5] levels. For example, Tanguay [8] developed a selection method for Sustainable development indicators (SDI) on an urban level called SuBSelec, which is based on a total of 188 indicators retrieved from 17 related studies. The aim behind the approach was to extensively address the elements of sustainable development and to reduce the number of urban sustainable development indicators to an optimal number.

Next to this, Mascarenhas [7] established a set of 20 local scale indicators for the Algave region in Portugal, which aim to facilitate the interaction between the local and regional scales on the monitoring process of sustainable development. The work taken up by Kawakubo et al. [6] defined a new version of the so-called CASBEE-City (Comprehensive Assessment System for Built Environment Efficiency) instrument, developed to evaluate and monitor sustainability levels achieved by communes and cities around the world within the framework of SDG indicators and greenhouse gas emissions. The instrument was applied to 79 urban areas from 39 countries. The results reflect on the higher achievement levels of well-developed urban areas in relation to quality of life and lower achievements in terms of environmental load, whereas the least developed urban areas experience opposite outcomes under these two subjects. In a more definite perspective, Tomalty [9], for example, developed an overall community sustainability index. The study involves 27 municipalities with over 30,000 inhabitants from Ontario, Canada and the calculation of the overall index is based on 33 indicators covering the subjects of smart growth, livability, and economic vitality. To generate a composite index for each of the above-mentioned subjects, the normalization of the collected data was performed. Recent papers demonstrate the use of the min-max method as well as the arithmetic mean calculation.

For example, Nhemachena [5] evaluated the sustainability associated to the field of agriculture for 13 sates of Southern Africa, where eight indicators within the field of agriculture were normalized based on the min-max method and an agriculture-related SDG composite index was calculated based on aggregation through the arithmetic mean. Next to this, both, the min-max and arithmetic mean methods were applied by Sachs et al. [1] and Schmidt-Traub et al. [2] in the calculation of the SDG index used in the sustainability appraisal of 149 countries. The study of Guijarro [10] comes with a new weighting model in the calculation of the SDG index. Although being similar to the previous studies, the model is based on the min-max normalization method. The results show that in terms of sustainable development, from the EU's 28 countries, the best performers are Austria and Luxemburg whereas the worst performers prove to be Greece and Romania.

Nevertheless, the question of measuring SDGs on the local level has only been addressed in few studies by using different methodological approaches. Sustainable development, for example, in a Romanian context, has been addressed by Sirbu et al. [11] using nine indicators whereas Stănciulescu and Bulin [12] applied 10 indicators in a timeframe of five years when comparing Romania's and Bulgaria's progress with the EU's average achievements. Next to these, other recent studies on Romania that analyze sustainable development are approaching this topic from the view of the renewable energy sector [13–16], and the perspectives of sustainable transport [17,18] or regional well-being [19].

Even though, from an international perspective, sustainability at the local level has been addressed by various scholars [6–9], our research remains one of the few studies that assesses progress in attaining the SDG goals on the metropolitan scale. Therefore, the applied methodology retains its relevancy not only in a Romanian context, but also applied in other international studies. Enhancing performance at the local level contributes to the attainment of achievements on higher administrative levels. Therefore, the integrated and place-based approaches became a focal point of the Europe 2020 Strategy and, consequently, addressing the urban dimension became an essential effort for the current European planning system [20]. The current paper considers the progress of several local authorities in a Romanian metropolitan setting within the context of the SDGs and builds a metropolitan SDG Index, which is also represented on a map. The selected study area for our analysis is the Cluj Metropolitan Area (Figure 1), which is located in the North-West development region of Romania and the heart of the historic region of Transylvania. It is situated on a surface of 1537.54 km^2 with a population of 425,592 inhabitants [21]. It is one of the largest metropolitan areas in Romania. From a territorial administrative perspective, it is composed of the municipality of Cluj-Napoca and its adjacent 17 communes divided on two distinct functional 'rings' (Figure 1) according to the intensity of their labour relations with the metropolitan core of Cluj-Napoca [22]. The municipality has a population of 323,484 inhabitants [21] and is situated on a surface of 1795 km^2, being one of the most important drivers of economic growth and cultural centers in Romania [23,24]

The metropolitan area was founded in 2008 as a response to the top-down initiative of the Romanian Government and manifestation of the growth pole concept. The main reason behind this turn was the process of Romania's adherence to the European Union that increased the role of decentralization, with the aim to achieve balanced territorial development [23]. Nevertheless, in several cases, the decentralized structures prove to be inefficient [25] and the strong socio-spatial differentiation between the composing localities of the metropolitan areas might jeopardize the territorial cohesion, balanced progress [26], and, subsequently, metropolitan-wide sustainable development. In the case of the Cluj Metropolitan area, from both economic and demographic perspectives, the new twist triggered a drive that started from the urban core towards the hinterland and led to a so called urban-rural diffusion [27]. The functional transformations experienced within communities and the necessity to create improved connection between the urban core and rural settlements placed these development processes in a new spatial dimension. Moreover, the urgent need to interlink the human resources living in rural areas and the workplaces offered in the urban core promoted intensified harmonization between commuting and accessibility [22], and placed urban development challenges in a new spatial and functional dimension. Consequently, there is a need to ensure that metropolitan governments increase their capacity in applying practices that increase their competitiveness [28], review their progress [2], and drive the inclusive development of their component localities. As part of the integrated planning process, the first integrated plan elaborated for the metropolitan area of Cluj was the Integrated Urban Development Plan (IUDP), effective for the period of 2009–2015. Nevertheless, its shortcoming was the fact that in certain initiatives, the development concentrated in the municipality, hence, by some means, development returns failed to trickle down to the adjacent communes. The second effort on the integration axes from a planning perspective was the adoption of the Integrated Urban Development Strategy (IUDS), valid for the period of 2014–2020–2030, and the Integrated Mobility Plan (IMP), which provide a framework for strategic planning and enforce trans-boundary development. Nonetheless, the fragmented governance approaches [26], rapid and uncontrolled urban-hinterland transformations, [27] as well as financial support based on arbitrary decisions [29], threaten the effectiveness and fulfilment of integrated plans. The increased migration of the population in the communes directly adjacent to the municipality (the first ring communes) led to a fairly earlier development spread in these areas and slower development in the metropolitan fringe [29]. Nevertheless, the outmigration from the center to the outskirts must be considered a natural phenomenon, which requires customized initiatives and adaptive planning [30]. Consequently, there is a need for better consideration of the spatial characteristics, continuous measurement of progress, identification of intervention areas, and customized actions to achieve sustainable results.

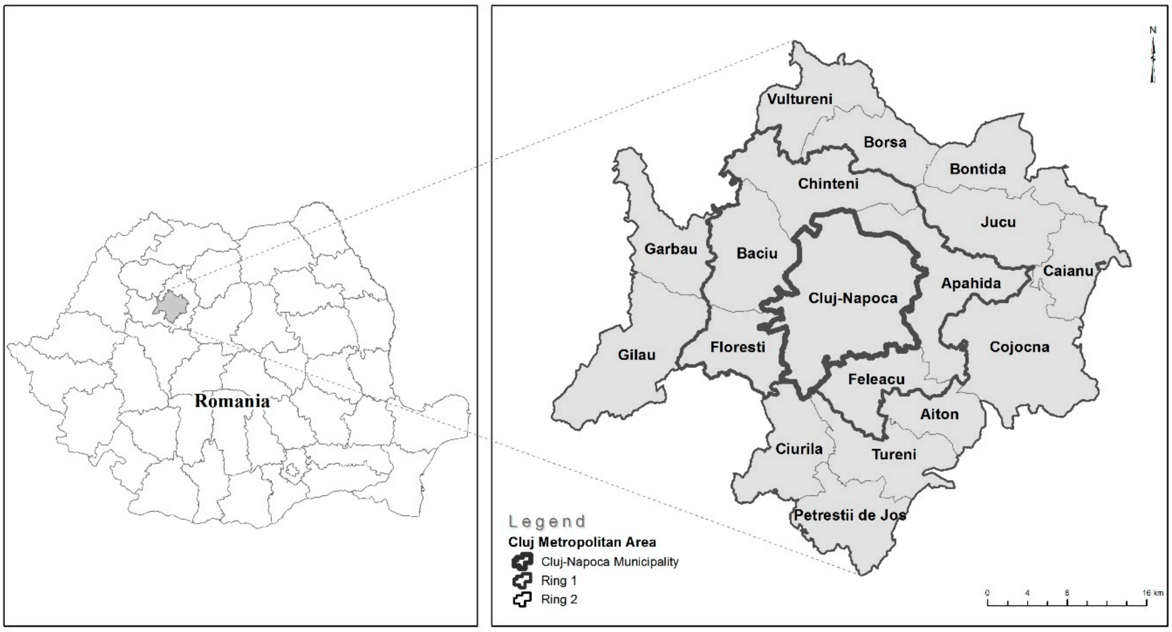

Figure 1. Location of the study area.

3. Materials and Methods

3.1. Data Selection

In the phase of data collection, we identified quantitative indicators that were identical or closely similar in their description to those used in Ref. [2], yet, were applicable on a local scale. Next to this, they had to be statistically reliable, the latest available, official, and accessible for all the analyzed local authorities. Nevertheless, we acknowledge the fact that in the case of several SDG indicators, data availability on the local level was an issue, especially under the SDG 9, SDG 10, SDG 12, and SDG 13, where datasets within these goals are only available on higher administrative levels or do not exist at all. Also, in the case of composite indexes, the Local Human Development Index (LHDI) is the only exception that offers statistics in its perspective. Consequently, we mainly relied on a data source obtained from the National Institute of Statistics (NIS) [21]. To calculate the SDG Index, depending on the data availability, we used a range of indicators for 16 out of 17 SDGs. Because our case area does not relate to resources, such as oceans or seas, it was not conceivable for our research to pursue the analysis of the 16th SDG titled "Life below water". In cases where the NIS did not provide data, we considered data attainable from other official sources, such as the World Bank in Romania, General Inspectorate of Romanian Police, Traffic Department (GIRPTD), Census data [31], Open Street Map Dataset [32], Corine Land Cover [33], Romanian Ministry of Environment [34], Romanian National Environmental Protection Agency [35], Cluj County Police Inspectorate [36], the Integrated Strategy of Cluj Metropolitan Area (ISCMA) [37], or, in the case of Local Human Development Index (LHDI), based on the calculations of Dumitru S. [38]. As no official data is available on the number of seats held by women in local councils, we gathered this information from the Local Authorities' website or, when this was not available, we contacted the local mayor's office by phone. For all indicators included in the calculation of the SDG Index, data was available for each of the 18 analyzed localities of the CMA. Consequently, a total of 36 indicators and one composite indicator, the LHDI, were included in the creation of the SDG Index and Dashboards. The indicators used in our analysis are summarized in Table 1.

3.2. Method for Constructing and Visualizing the SDG Index

After gathering the raw data, the process to determine the SDG Index involved three phases: First, normalization of data to allow comparability and accumulation across them; second, aggregation of the indicators within each of the SD goals followed by the aggregation of the indicators across the SD goals; and, finally, the third step involved the process of visualizing the SDG Index of each individual locality on one single map representing the entire Cluj Metropolitan Area.

3.2.1. Normalization

Since our analysis was performed on a local level in an area composed by localities with similar characteristics and no utmost performances, we did not complete statistical tests as described in the methodology of Schmidt-Traub et al. [2]. To make the data comparable across the indicators, we had to bring them to a prevalent, non-dimensional unit for which we used the normalization method. As indicated by Nardo et al. [39], ranking, standardization, benchmarking, or rescaling are some of the methods used for this purpose. Nevertheless, similar to other analyses that dealt with calculation of SDG Indexes [1,2,5,10], Better Life Index [40], and Smart Growth Index [9], we used the min-max normalization method.

Therefore, the first phase involved the normalization of each variable on a scale from 0 to 10, where 0 indicated the worst performance and 10 the highest performance. First, to remove the effect of extreme values, we established the lower and upper bounds for the worst and best values and then we used the min-max method [40] to create the range of (0–10). It is important to note that for some indicators, the high value score represents good performance (such as employment to population ratio), marked with $\hat{x}$, and for others, bad performance (traffic deaths rate), marked with $\check{x}$. Therefore, the formulas are inversely applied depending on these attributes and, consequently, it is also ensured that higher values represent better performance.

$$\hat{x} = \left(\frac{x - min(x)}{max(x) - min(x)} \right) \times 10 \tag{1}$$

$$\check{x} = \left(\frac{max(x) - x}{max(x) - min(x)} \right) \times 10 \tag{2}$$

where x is the value of raw data; $min(x)$ and $max(x)$ determine the lower and upper bounds for worst and best performance, respectively, whereas $\hat{x}/\check{x}$ is the normalized value after the rescaling process.

Through normalization, the data became easily comparable across all the indicators and facilitated the next phase, the aggregation.

Table 1. Summary of indicators used to construct the SDG (Sustainable Development Goal) Index and Dashboards.

SDG	Indicator	CMA Avg. Score	Latest Available Year	Source
1	LAU revenues per capita (RON/person)	0.63	2012	[41]
2	Crop production t/ha	4.92	2003	[21,31]
3	Infant mortality rate (per 1000 people)	8.29	2016	[21,31]
	Physician density (per 1000 people)	1.24	2015	[21,31]
	Serious traffic accidents rate (per 1000 people)	6.21	2016	GIRPTD
	Traffic deaths rate (per 1000 people)	8.49	2016	GIRPTD
4	Net primary school enrolment rate (%)	5.42	2016	[21]
	Population aged 25 and above with tertiary educ (%)	2.00	2011	[21]
	Population 25 and above with upper-, post-secondary, non-tertiary educ (%)	3.90	2011	[21]
5	Female average years of schooling of population aged 25 and above (%)	3.38	2011	[21]
	Female labor force participation rate (%)	5.79	2011	[21]
	Proportion of seats held by women in local councils (%)	4.27	2017	[31]
6	Access to sanitation/bath (% of dwellings)	3.93	2011	[21]
7	Access to electricity (% of total dwellings)	8.23	2011	[21]
	Access to central heating (% of dwellings)	3.00	2011	[21]
8	Employment to population ratio (%)	2.12	2016	[21]
	Unemployment rate (%)	7.88	2016	[21]
	Automated teller machines (per 1000 people)	2.58	2017	[32]
	Youth not in employment, education or training (NEET) %	5.41	2011	[21]
9	Access to rail station (0–1)	3.89	2017	[37]
	Access to road (0–3)	3.78	2017	[37]
	School teachers (per 30 pupils)	3.89	2016	[21]
	Road density (km/km^2)	2.14	2017	[32]
	Natural gas network density (km/km^2)	1.59	2015	[21]
	Water network density (km/km^2)	1.56	2015	[21]
	Proportion of the population using internet (%)	2.69	2011	[31]
10	Local Human Development Index	4.19	2011	[38]
11	Living floor (m2 per person)	3.63	2016	[21]
	Access to water (% of dwellings)	4.60	2011	[21]
12	Access to wastewater network/septic tank (% of dwellings)	4.28	2012	[21]
13	Green areas (%)	3.79	2012	[33]
14	Not applicable	n/a	n/a	n/a
15	Change in forest area (%)	2.16	2006–2012	[33]
	Natura 2000 sites (%)	2.13	2015	[35]
	Terrestrial sites of biodiversity that are protected (%)	2.45	2017	[34]
16	Crime coefficient (Index)	9.28	2017	[36]
	LAU EU funds revenues (RON/capita)	0.92	2012	[41]
17	Public expenses on culture (RON/capita)	2.86	2012	[41]
	Public expenses on health (RON/capita)	4.51	2012	[41]

Source: Adapted from Schmidt-Traub et al. [2].

3.2.2. Aggregation and Calculation of the CMA's SDG Index

Some methods for aggregating composite indices are, for example, the Leontief production function, geometric mean, and arithmetic mean. Several scholars have used the arithmetic mean aggregation method to calculate the SDG Index [1,2,5], Human Development Index [42], African Green Growth Index [43], Global Innovation Index [44], or others, like Hogan et al. [4], for example, used the geometric mean to construct the index of essential health service at the level of the WHO member states. For the calculation of the SDG Indexes, we used the arithmetic mean method as it is easily applicable and explicable. Like Schmidt-Traub et al. [2], to avoid situations where flexibility is given to the local authorities of the CMA to differentiate their preferences in addressing various SD goals based on their weight, and to thrust them with assigning equal importance to all the SDGs, we chose to apply fixed and equal weights to each of the SD goals instead of using flexible weights. We considered this approach more appropriate as it demands equal attention of the LA's (Local Authorities') on all goals and creates a clear picture of their distance to achieve the optimum level within the specific goals. Consequently, the aggregation phase involved two steps: First, we aggregated the normalized values of the indicators separately within each of SDGs; and second, we aggregated the variables across the goals. When aggregating the indicators under the separate SD goals, next to the calculation of the arithmetic mean and as pointed before, we assigned the same weight for each indicator. When it came to the calculation of a locality's SDG Index, based on the same methodological approach used by [2], yet reflected on a local level, the following equation was applied:

$$I_i\ (N_i,\ N_{ij},\ I_{ijk}) = \sum\nolimits_{j=1}^{N_i} \frac{1}{N_i} \sum\nolimits_{k=1}^{N_{ij}} \frac{1}{N_{ij}}\ I_{ijk} \quad (3)$$

where I_i is the index score for locality i of the Cluj Metropolitan Area, N_i is the number of SDGs for which the locality has data (in our case, this was 16 for each of the member localities), N_{ij} is the number of indicators for SDG j for which the locality i has data, and I_{ijk} is the score of indicator k under SDG j for the locality, i.

Correspondingly, to calculate the SDG Index for the entire metropolitan area, we also used the arithmetic average of the component locality's SDG Indexes.

As the SDGs form a united role in a compact agenda, achieving progress towards the targets defined under each individual SDG is crucial. Likewise, when we consider the metropolitan scale, a change of one locality's progress influences the progress of the entire CMA. To visualize the progress levels of each local authority in the overall SDG Index of the Cluj Metropolitan Area, in the last phase, we created a map illustrating the performance levels of the CMA's localities within the SDG Index.

3.2.3. Mapping the SDG Index of Localities within the CMA

For mapping the geographic data, we used the ArcGIS software and the classification of the localities according to their SDG Index achievement on the CMA's map, which was based on the Jenks Natural Brakes optimization method [45]. The classification algorithm was introduced in 1977 in the cartographic analysis process by G.F. Jenks as a statistically optimal data classification [4], yet is based on a classification process developed by Fisher [46] that aims at assuring "maximum homogeneity" by minimizing variance between classes and maximizing variance across them. Other widely used alternative classification methods would have been the Equal Interval and Equal Count, however, we applied the Natural Brakes as the classification produced with this tool is highly accurate. Next to this, it examines a large variety of solutions and yields the optimal version, it eliminates extreme scores in the case of non-linear distribution, and from a visual perspective, it produces straightforward maps by minimizing the variation within each color by grouping scores close to each other under the same shade [47]. We divided our dataset on four classes and illustrated numerically in the legend the minimum and maximum scores of each class. The map illustrates the spatial distribution of each of the CMA's analyzed locality SDG Index based on the four-level classification.

3.3. Method for Constructing and Visualizing the SDG Dashboards

Following Sachs et al. [1], we built the SDG Dashboards of the localities from the CMA by using the same data we got after the rescaling and aggregation. Consequently, the scores gathered by each locality under each SD Goal were grouped and placed on a "traffic light" table. We took the scores yielded by the calculation of the overall score for each SDG under each locality of the CMA, and outcomes were assigned to a color band. This was followed by conveying a color band for the SDG Index obtained by each of the CMA's localities. To set the thresholds for the color bands, we applied the Jenks Natural Brakes classification described in the previous subchapter. As the classification was made on a division of our dataset on four classes, the traffic-light table is also built on four colors, representing each locality's progress under each of the 16 SDGs and their overall SDG Index achievement. The green band represents the closest achievement towards the optimum outcome and is limited by the upper bound, signifying the maximum value that can be attained for each variable. This is followed by the yellow and orange bands that reflect an increased distance from the maximum outcome, and, lastly, the red band, signifying the greatest distance from the SDG achievement bounded from below with the minimum value that was attained.

3.4. Data Limitations

Despite constant endeavors to enhance methodological robustness, several limitations arise. Shortages of or missing data for lower administrative territorial levels toughen the precision of the analysis. The analysis extensively relies on the census data, which is a useful tool for long term evaluation. Even though we used the most recent available indicators, census data only gives the possibility for 10 to 10 years' comparison, which does not give precise and up to date reflections about the definite situation of the analyzed territory. Next to this, the substitution of missing indicators affects the outcomes attained within the complex indexes and increases uncertainty, which eventually manifest in the end achievements. Further, the use of equal weights can also influence the overall accomplishments, a fact that calls for remedies in this perspective. Therefore, supplementation of the analysis with evidence from stakeholder perception surveys and behavioral findings could bring a closer reach to a more realistic picture of the actual position of the localities within the SDGs.

4. Results and Discussion

As pointed before, in our analysis, we assess the spatial expression of the 16 SDGs. To synthetize all the 36 indicators and one index into a scalable compound measure of the overall achievement of each locality and, subsequently, the CMA, we calculated and mapped the overall SDG Index for each locality respective of the CMA, as presented in Figure 2 below.

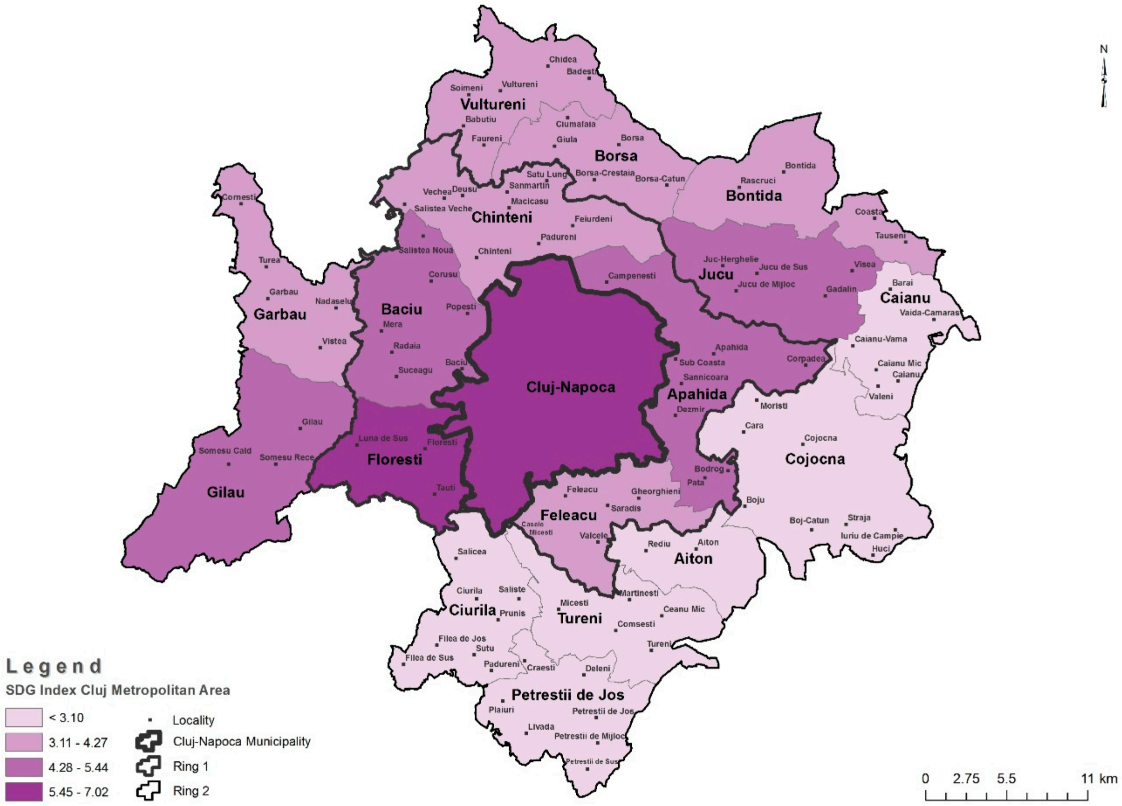

Figure 2. The map of the SDG Index in the Cluj Metropolitan Area.

Furthermore, the SDG Index facilitated the ranking of localities against their overall achievements and made them comparable with each other. The Dashboards (illustrated in Appendix A), on the other hand, provide a clear and comprehensive picture about the differences in each locality's performance within the individual SDGs and help identify imbalances in their development path by comparing their performance across the individual sustainable development goals. Next to this, they also serve to assist in identifying the implementation priorities in each of the CMA's localities. As shown in Figure 2, based on the SDG Index, the municipality of Cluj-Napoca ranked first from the Cluj Metropolitan Area having covered 7.02% of the distance towards the maximum result of 10.00 across the SDGs. Next to the municipality, the first ring locality of Florești is the only one that also managed to make it to the first level category (indicated by the green band in Appendix A) with about a 10% lower score than Cluj-Napoca. The second level category (indicated by yellow in Appendix A) is composed by two of the first ring localities, Baciu and Apahida, respectively, and two of the second ring localities, Gilău and Jucu. Consequently, the remaining two localities of the first ring communes of Feleacu and Chinteni only manage to integrate in the third level category (indicated with the orange band in Appendix A), yet, the latter one reaches results slightly lower than the second ring commune of Bonțida. Next to this, the first ring locality of Chinteni falls 5% behind the metropolitan average of 4.04. The remaining localities from the third level category achieving results within the orange band are the second ring communes of Borșa, Gârbău, and Vultureni, falling with about 10% below the metropolitan average score. Meanwhile, six out of the 18 analysed localities remain in the red band. This fourth level category is led by Tureni followed by Petreștii de Jos, Ciurila, Căianu, Aiton, and the last in ranking, Cojocna. The localities of the red band are at least 6.90% of the distance away from the maximum score (10.00) and 7.82% at the most. Consequently, a clear divergence can be observed in the accomplishment levels and feasibility of localities mainly considered to be part of the functional urban area (including, in our case, the communes of Florești, Baciu, Apahida, Gilău, and Jucu) and the remaining communes of the metropolitan area with lower provision of utility and transport services. Therefore, in line with the Integrated Urban Development Strategy (2014–2020–2030) [37], the administrative capacity should be expanded and strengthened at a metropolitan scale to ensure progress in achieving a more coherent development and, consequently, better progress of the CMA in delivering the SDG goals. Furthermore, a deliberate amalgamation of legislative and incentive frameworks should be enforced to stimulate the preservation and management of the ecosystem and transition to more inclusive policies and initiatives.

As illustrated in Appendix A, the SDG Dashboards show that even if the municipality manages to achieve good performance in most of the areas, it still faces great challenges in terms of peace and justice and difficulties under the goal of zero hunger and environmental protection. Similar areas present challenges to Florești as well (the only commune entering the green band interval) as it enters the red band category in terms of environmental protection and partnerships with reduced progress in promoting inclusive societies. Consequently, besides their close results, the two best performing localities of the metropolitan area face fewer, but similar, and imperative challenges in addressing environmental protection, and promoting peaceful and inclusive societies as well as strengthening their involvement in encouraging partnership development, to achieve the goals of sustainable growth. Overall, the outcomes highlight the need for paying greater attention to the management and integration of green areas, but also improving communication and cooperation between the public and private sectors. Next to this, the local plans and strategies should ensure that increased attention is given to initiatives addressing issues related to management and conservation of green infrastructure and incentive structures are developed for inclusive and cooperative actions.

Similarity in progress can be seen also within the second category level communes (Baciu, Apahida, Gilău, and Jucu), and even if their 'green zones' are slightly more or similar to the previous two, their achievements are mostly situated in the yellow or orange band. They tend to face similar challenges as the municipality and Florești in terms of reducing environmental degradation, but face greater encounters in ensuring healthy well-being, ending poverty, and promoting inclusive societies. Next to this, under the 17th goal of strengthened partnership, the second ring commune, Jucu, is the only commune that achieves progress by integrating itself in the green band, and the second ring commune of Gilău has the same results in terms of climate change. The consolidation of the green-blue network remains a priority action at the metropolitan level as expressed by the IUDS (2014–2010–2030) [37]. Nevertheless, the challenge is stronger for the communes that experienced increased urbanization patterns and faced substantial load of real estate developments (Florești, Baciu, Apahida), and lower for those having a more rural nature. Ending poverty, however, remains a persistent claim for a higher share of localities, and should receive greater policy attention and mobilization of resources to build resilience and reduce vulnerability of those in need.

The third category level localities show substantial differences in their performance within the SD goals. The second ring communes of Borșa, Gârbău, and Vultureni have the most of the 'red zones', and, at the same time, are the worst performers of their category level. The most important challenge of these third level category localities is ending poverty in all its forms. Next to this, the ninth SD goal is also a theme that reflects on the lack of innovation, poor infrastructure, and deficient industrialization in these communes and calls for remedies. Some localities, notably, Chinteni, Borșa, and Vultureni, perform quite well under the goal of climate change, yet, Bonțida and Gârbău necessitate more attention under this theme. Further, mostly Vultureni, but, at a certain level, the remaining second ring localities of this category (Bonțida, Borșa, and Gârbău), require the increase of resilient and inclusive practices. Consequently, a critique might be directed towards the Integrated Urban Development Strategy in following the guidelines developed under its integrative nature. The results show that, even if the IUDS as well as the IMP contain an important focus on the provision of metropolitan-wide public transport, there is still a persistent need for more efforts in the planning practice for greater integration of service delivery, on the one hand, and improvement of food provision, on the other.

The fourth level category, similar to the previous category, presents the greatest challenges under the first goal of ending poverty, where all of the component localities achieve scores within the red band. A worse performance is shown under the goals of quality education and lifelong learning, access to water and sanitation facilities, and lack of economic growth. Therefore, substantial progress is awaited to be done by these localities in ensuring access to basic infrastructure, increasing investments in education, actions in attracting innovation, increasing social inclusion, and creating employment opportunities. As reflected by the dashboards, deficiencies are also present in terms of gender equality as well as environmental protection. Even if the communes of Aiton and Ciurila have the highest number of red band challenges, the furthest away from the highest score of the metropolitan area is Cojocna, as it has no yellow nor green band achievements under the SD goals. Therefore, even though the existent integrated strategies do cover objectives that address current and essential goals, the challenges identified through the study indicate the need for greater policy harmonization, more targeted interventions, and more emphasis on the disclosure of the progress already achieved to attain more efficient advancement in following the SDGs.

To examine the existence and the extent of a relationship between the two indexes that we had available, we correlated the SDG Index with the LHDI, the composite measure of three major themes of health, education, and income. As shown in Figure 3, there is strong evidence from the scatter diagram that a strong, positive relationship ($r = 0.92$) exists between the two variables, which leads us to think that those localities that make significant investments in health and education are more likely to perform better on the SDG Index as well. Further, as indicated by the formula, approximately 85% of the variation in the SDG Index can be attributed to the variation in expenditures on health, education, and the income outcomes.

The results highlight the deliberate consequences generated by the inexistence of express policies involving the SDGs defined under the Agenda 2030 on local and regional levels of the Romanian policy-making process. Therefore, it is beyond the scope of this study to assess the institutional profiles for the implementation of local policies aimed at the achievement of the SDGs established by the UN. As previously mentioned, the main local policy documents relevant for the SDGs are the IUDS 2009–2015, continued by the Sustainable Urban Mobility Plan 2016–2020, both developed as part of local public administration efforts to attract EU funds under the Regional Operational Programme.

This implicitly reinforces the premise that the local public administration remains the main local institutional actor involved indirectly in the achievement of UN SDGs. Under such circumstances, we assume that a horizontal approach comes into play, where an organization-centric approach prevails over the vertical, or product-centric, approach. At the national level, the Romanian National Strategy of

Sustainable Development was adopted in the current year, in line with the UN SDGs, but, currently, it is still unclear how the government will proceed with its implementation. However, poor coordination, as a characteristic of the Romanian planning system, brings along a strong top-down approach and a weak involvement of local actors in the establishment of development priorities.

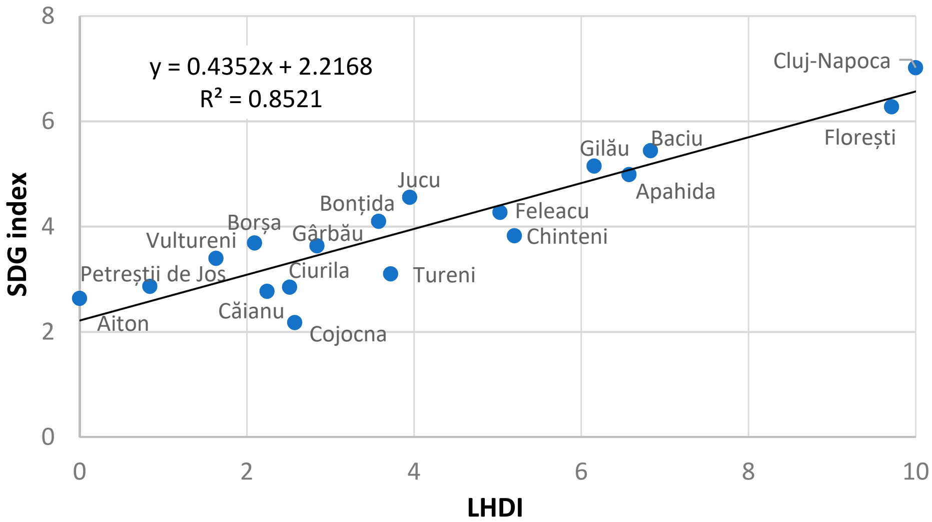

Figure 3. The correlation between the SDG Index and LHDI (Local Human Development Index).

5. Conclusions

The paper established a baseline investigation of the SDGs in a metropolitan setting. The methods involved a normalization, aggregation, and mapping process. Through this methodological framework, the component localities of the metropolitan area were ranked depending on their progress to achieve the SDGs. Even though the analysis faced limitations, especially in terms of gathering statistical data, the paper gives a starting point to assess the SDGs on the local level. The main shortcomings consisted of the fact that the analysis is based on data available strictly on the local level, and, due to this limitation, the number of indicators used within the examination of each separate SDG goal varies depending on their availability. However, we are confident that despite of the above-mentioned limitation, significant parts of our methodology, such as data normalization, aggregation, and, especially, the visualization techniques, can be widely applied in other spatial contexts as well.

The findings show that that urban core—the municipality of Cluj-Napoca—stands the closest to the maximum score of 10.00 by covering 7.02% of this distance. This score is slightly lower than the national achievement of 7.41 [1], yet, supports the results of several studies mentioned in the literature review [23,26,27,29], which found that on the metropolitan level, the urban core is the most developed and, according to our analysis, has the highest progress level in achieving sustainable development. The municipality is followed by three communes from the first ring (Florești, Baciu, Apahida) and two localities of the second ring (Gilău and Jucu), showing that there is a vertical (west-east) progress visible in the CMA in terms of achieving the SD goals. Consequently, sustainable development progress is visible not only in the first ring communes, but also managed to reach out to the second ring communes as well. Nevertheless, localities on the western part of the municipality perform better in the SDGs, an outcome that can strongly correlate with the better development level of these communes that corresponds with higher accessibility to road infrastructure as their territory has access to the motorway and to a European road. Even more, this pattern is also visible on the eastern side of the municipality where the only technological park is located outside the municipality's administrative boundary. Consequently, according to the findings, in concordance with the vertical territorial development, a pattern of sustainable progress can be seen on the west-east axis of the metropolitan area. Even yet, the best performing localities face greater challenges in terms of environmental protection, security, and inclusive approaches. On the opposite side, the worst performing localities have better progress within these areas. However, the fact that under the 'no poverty' SDG, only 12 communes integrate in the red band raises major concerns. Next to this, as out of the 18 analyzed localities, two localities manage to integrate in the green band and six in the red band, the metropolitan average score of 4.04 demands firm and extensive efforts to achieve the 2030 Sustainable Development Agenda. The spatial-functional inequalities and economic vulnerability between the first and second ring communes of the municipality present concerns and claims greater attention from their governments in reviewing progress on the SDGs. Our main findings are relevant for similar institutional contexts characterized by low coordination in the setting of spatial policy goals among national and local level actors. As such, it can serve as a benchmarking tool for metropolitan areas where economic priorities are prevailing over social or environmental aspects. As this is the first study in Romania that measures SDG's on the local level, it is essential for similar studies to be performed not only on local, but also regional and national levels as well. Consequently, we also appointed future efforts towards extending our analysis on a greater scale and overcoming data limitations with the inclusion of a larger set of indicators to permit a wider and more precise application of the methodology set out in this paper.

Author Contributions: All authors contributed equally to the compliation of this article and to the preparation of the final manuscript.

Funding: This research was funded by an EAHERDIF grant to the Center for the Study of Democracy at the Babeș-Bolyai University (PN-III-P4-ID-PCE-2016-0729).

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

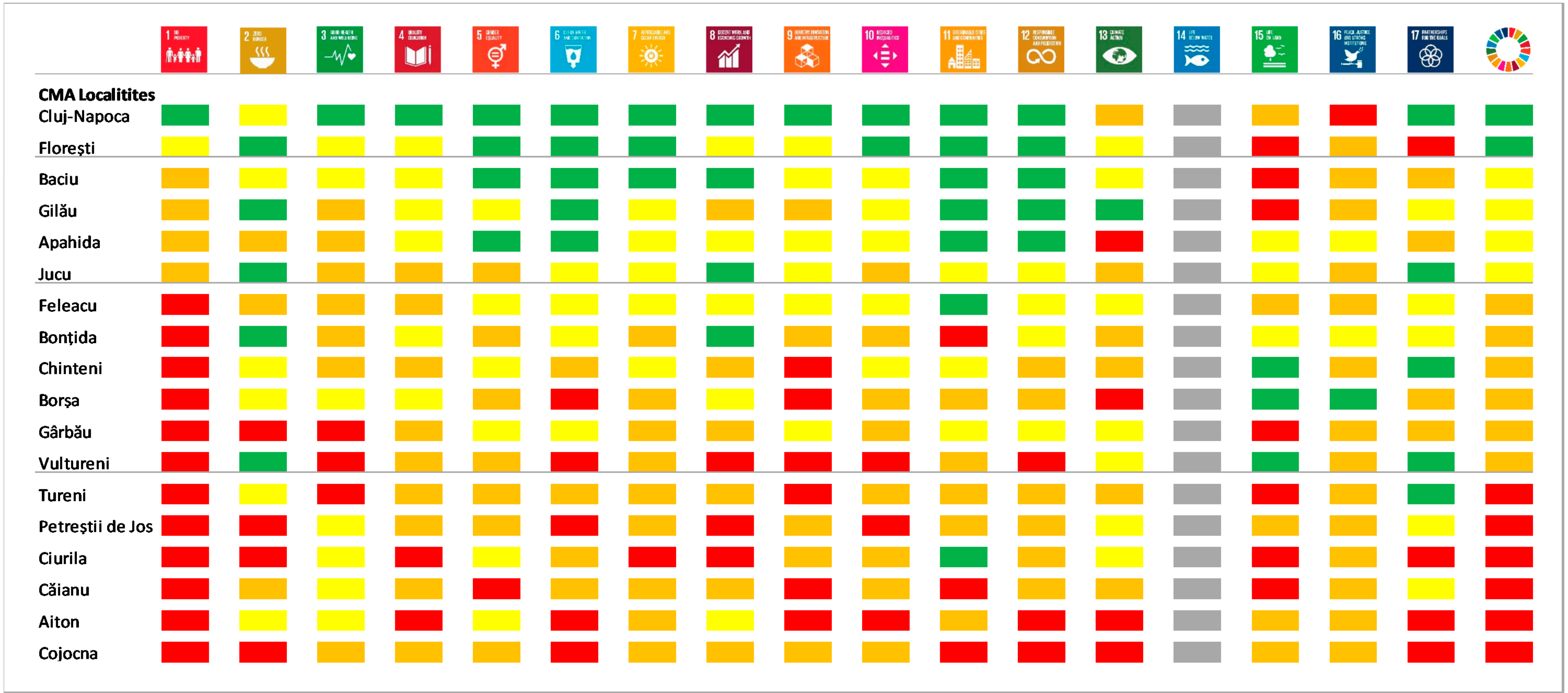

Figure A1. SDG Dashboards and SDG Index of CMA (Cluj Metropolitan Area).

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