RevistaEconomică
Journal of economic-financial theory and practice

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

SPATIAL MONITORING RESULTS VISUALISATION FOR SUSTAINABLE CONSUMPTION ACTIVITIES

Maria KEHAYOVA-STOYCHEVA[1], Julian VASILEV[2]

[1]University of Economics Varna, Bulgaria, 0000-0002-8637-6433
[2]University of Economics Varna, Bulgaria, 0000-0002-6146-746X

Abstract: *The purpose of this paper is to present a methodology for visualizing spatial data on the results of monitoring sustainable household activities. The research covers the creation of a methodology for using a GIS-based approach in the visualization of spatial data on indicators on sustainable consumption. Current research activities on sustainable urban consumption and the methods for presenting aggregated results reveal the novelties in this paper. Testing the proposed methodology for using a GIS-based approach in the visualization of spatial data on indicators of sustainable consumption results in the adaptation of the new technology in other countries, cities, teams focused on the analysis and visualization of spatial data on certain indexes. Moreover, the proposed approach opens two dimensions: (1) the possibility of visualization of cross-sectional spatial data on sustainable consumption and (2) the possibility of visualization of time series spatial data on sustainable consumption. The results of the study showed that other researchers and municipality specialists on sustainable urban consumption may use the proposed methodology for presenting (visualizing) spatial data. They may be cross-sectional or time-series spatial data. This visualization is an opening point for the decision-making process in finding solutions to some problems with ecology, recycling and taking specific measures to promote and stimulate sustainable consumption. Moreover, measures for preventing bad practices in contrast with sustainable consumption may be taken. The suggested method introduces the potential to visualize cross-sectional spatial data related to sustainable consumption and the opportunity to visualize time series spatial data on sustainable consumer activities. The study findings indicate that other researchers and consumption sustainability experts can employ this proposed approach to present spatial data effectively.*

Keywords: *cross-sectional spatial data, time-series spatial data, GIS-based visualization, sustainable consumer activities, Varna households*

JEL classification: *C02, C81, C88, Q56*

1. Introduction

The management of each process can be realized in several ways, either based on intuition, based on the principle of "trial and error", or based on data. The best way is to lead to good results or to achieve pre-set goals. Business practice shows that processes that develop in a rapidly changing environment are complicated to manage only by intuition or by "trial and error". In such cases, data-driven solutions are most effective. No one disputes the fact that we live in times marked by abrupt changes – significant technological developments, globalization, military conflicts, climate change, changes in lifestyles, and in solutions to meet needs (Rahma, Qulub, Wahyu Prasetyo, Rizqi, & Sodiq, 2024). This necessitates the search for effective solutions based on a large amount of data.

Since its introduction in 2015, the UN Sustainable Development Goals have focused on the need to create and maintain a good information environment that will become the basis for effective process management ("THE 17 GOALS | Sustainable Development," n.d.). For each of the 17 Sustainable Development Goals, there are references that their achievement can only be ensured based on complete and accessible information. For example, under Goal 12, which refers to the achievement of sustainable

[1] *kehajova_m@ue-varna.bg * - corresponding author*
[2] *vasilev@ue-varna.bg*

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

production and consumption, some sub-goals relate to the achievement by 2030 of providing adequate information to everyone about sustainable development, as well as about lifestyles that are in harmony with the natural environment; developing and implementing tools to monitor the impact of tourism on sustainable development. Goal 17 also contains important references relating to the construction and maintenance of sustainability data and information. Sub-target 17.8 focuses entirely on measuring progress in sustainability performance ("THE 17 GOALS | Sustainable Development," n.d.). According to UN data, only 45% of the data on indicators for achieving sustainability goals are complete. It is also difficult to find clear information boards that outline problems or differences in results achieved (United Nations - Department of Economic and Social Affairs, n.d.). In this sense, any effort and scientific inquiry that refers to improving the ability to monitor sustainability-related results is relevant and necessary. This is the reason why there are numerous studies in this direction.

In terms of improving the monitoring of sustainable consumption, it can also be said that there are many diverse points of view. The review of the specialized literature shows several main topics and solutions that have been worked on in recent years.

- There are numerous studies focused on measuring sustainable consumption by offering systems of indicators. Part of the research is aimed at measuring sustainable consumption at the level of large systems – state, and city (Lorek & Spangenberg, 2001) (Environment Policy Committee, 1999) (Caeiro, Ramos, & Huisingh, 2012). Part concerns the provision of indicator systems for measuring sustainable consumption at the household level (Haron, Paim, & Yahaya, 2005) (Kabadayi, Koksal, Dursun, & Tuger4, 2016) (Zalega, 2020) (Quoquab, Mohammad, & Sukari, 2019) (Michalos, Creech, Christina, & Kahkle, 2009) (Peattie, 2010) (Beke, Lendvai, Kovács, & Lisányi, 2022) (Durón-Ramos, 2013).
- Some research has focused on the development of tools to measure sustainability and sustainable consumption in the form of calculators (Edelson, 2019) (Bartolj, Murovec, & Slabe-Erker, 2018) (West, Owen, Axelsson, & West, 2016). The authors of this article also propose a calculator for measuring sustainable household consumption (Kehayova-Stoycheva & Vasilev, 2023).
- Single studies summarize the capabilities of Georgard Information Systems for sustainable urban planning and management (van Maarseveen, Martinez, & Flacke, 2019).

What is presented in this article concerns the improvement of the visualization of data on sustainable consumption of households. Often, when studying sustainable consumption, data for different settlements are used. Traditional visualization methods use comparative tables and graphs that allow for an analytical presentation of differences in household sustainable consumption. Geographic information systems make it possible to visually track the differences in the sustainable consumption of households between different settlements. Here is a clear example. From surveys among 2117 households from the cities of Sofia, Varna, and Svishtov, we have data on actions for sustainable consumption, which relate to home maintenance, nutrition, mobility in the settlement, and disposal of products. 68 variables were generated and grouped with different numbers in different groups of actions (23 variables for actions related to home maintenance, 18 for actions related to nutrition, 9 for mobility, and 18 for actions related to product releases). Key indicators observed to assess the state of sustainable consumption are 5 indices – Index of Sustainable Actions Related to Housing (IH); Sustainable Food Action Index (IF); Index of Sustainable Actions Related to Mobility in Settlements (IM); Index of Sustainable Actions related to Product Disposal (IPD) and Index of Sustainable Consumption of Households (SCI). The data were collected through a personal interview in two waves – in April 2021 and in December 2022. The values of the indices range between 0 and 1 and show the extent to which the household has made progress in sustainable consumption as a whole, as well as in the individual areas observed. The closer the values are to 1, the better the household's behavior towards sustainable consumption actions. The indices are calculated for each household. Based on the individual indices, the average values of the indices are calculated separately for all households by city, which allows for regional comparisons.

RevistaEconomică
Journal of economic-financial theory and practice
Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

2. Methods

2.1 Formal description of the methods

Spatial data exist in all spheres of economics. Spatial data may have tabular visualization but using a GIS-based approach, the visualization is better. Two types of spatial data exist: (1) cross-sectional (or momentary data at a certain point) spatial data and (2) time-series spatial data. The geographic dimension may be "town".

Let's have this sample dataset.

Table 1: Sample dataset

Town	Cross-sectional spatial data for 3 indicators (Ind1, Ind2, Ind 3)	Time-series spatial data for indicator Ind4 for 3 time periods (e.g. months)
Varna	4; 2; 2	3; 5; 7
Svishtov	7; 6; 6	4; 9; 8
Sofiq	3; 9; 5	2; 1; 6

Source: Own elaboration

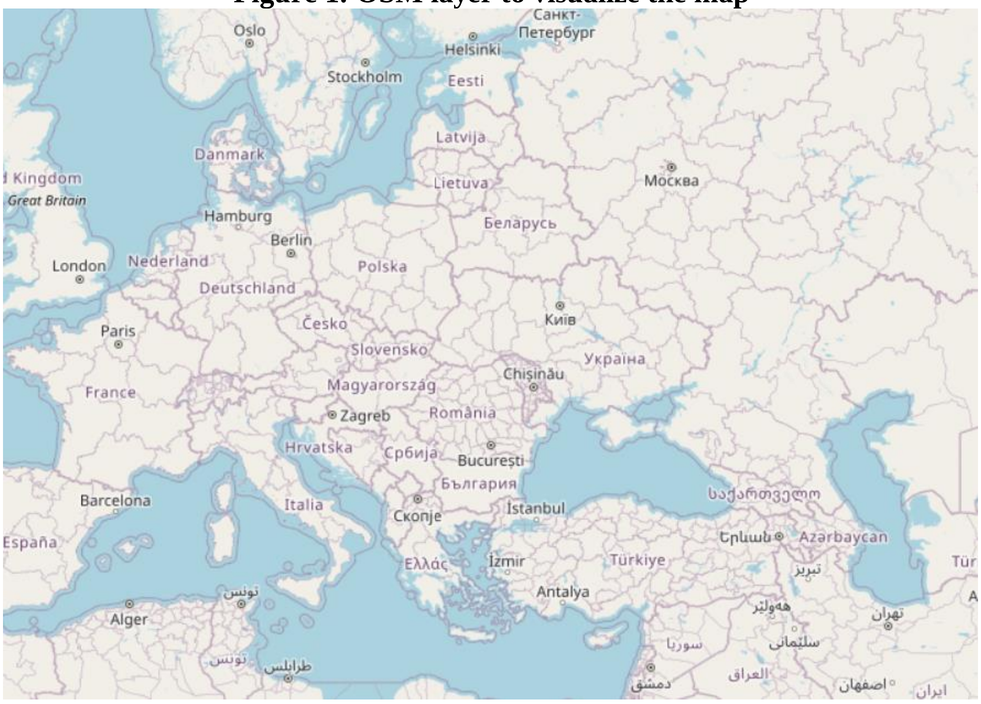
An open-source software is used QGIS to visualize spatial data.

The process starts with "New project" in QGIS. The project is named and saved. The created file is "2024 Sibiu.qgz".

An OSM layer is added to visualize the map.

The icon QuickMapServices is used to add an OSM layer. This layer is zoomed in. The OSM layer is the map that is used as a background.

Figure 1: OSM layer to visualize the map

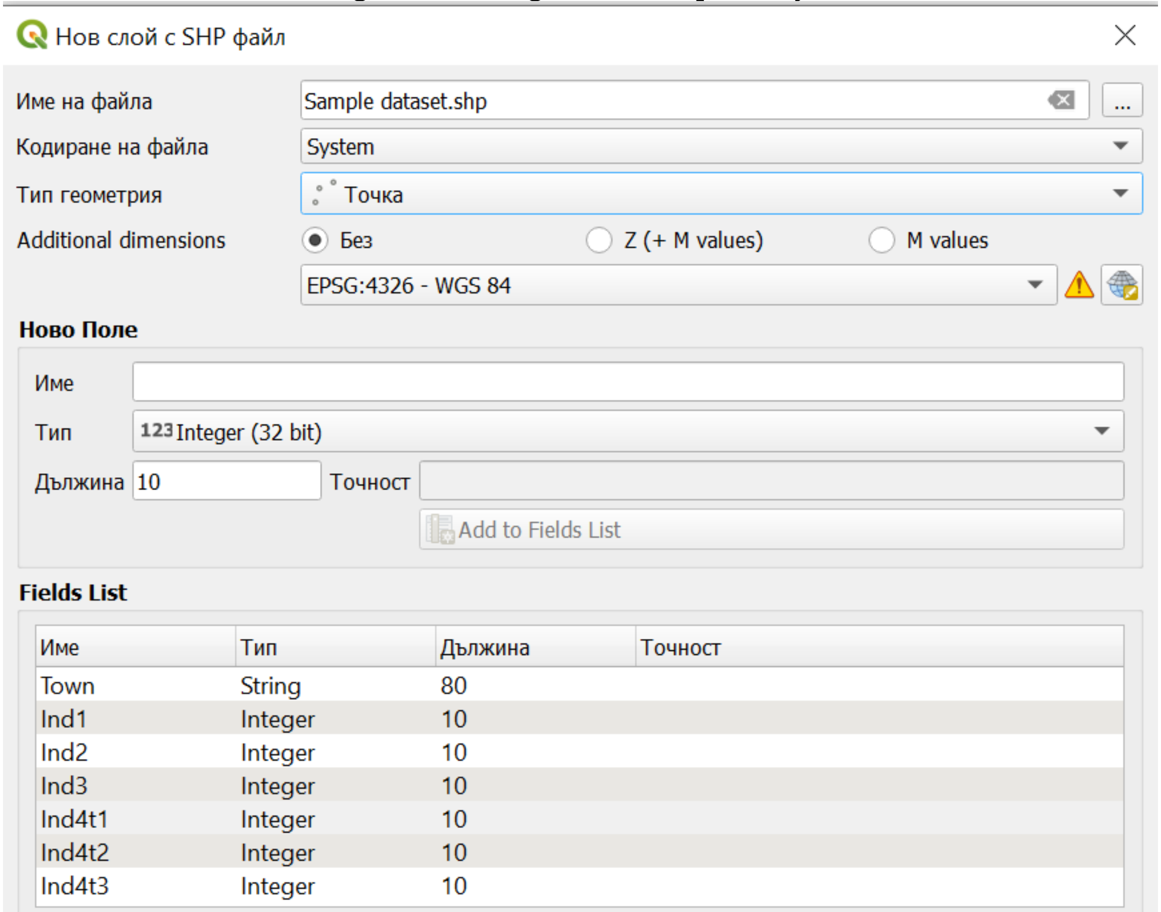


Source: Own elaboration

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

A new Shape file vector layer "Sample dataset" is created (Layer/Create layer/ New Shapefile layer).

Figure 2: Adding the new shapefile layer



Source: Own elaboration

The name of the file, storing the layer is given ("Sample dataset.shp"). The type of geometry is "point". The filed list describes the attributes table connected to the vector layer.

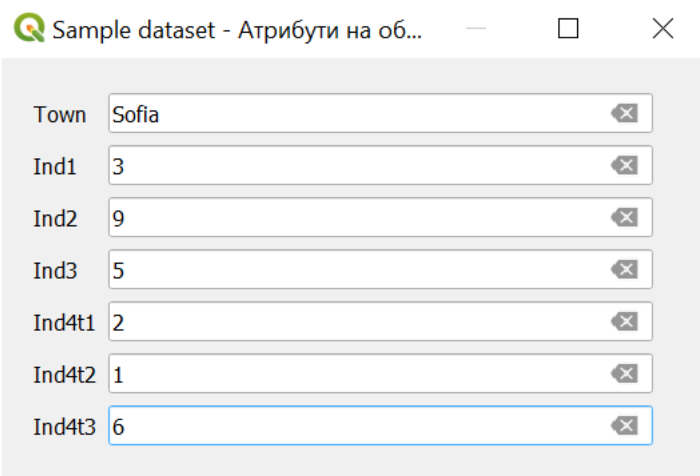
The Toggle editing button is used to start marking the points (towns) on the map.

The Add Point Feature button is used to add towns and enter spatial data for each town (point on the map).

Spatial data for each town is added.

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

Figure 3: Adding data for each town/point of the vector layer (shape file layer)



Source: Own elaboration

The Toggle editing button is used for stopping the process of adding towns/point on the map. The changes are saved.

2.2 Description of the real spatial dataset with data for sustainable consumption

Having the results from the real surveys in Varna, Svishtov and Sofia, the following data are calculated.

Table 2: Real dataset with aggregated data for sustainable consumption

Type of data	Index/Town	Varna	Svishtov	Sofia
Cross-sectional data (for the whole period)	Average Index Housing	0.524	0.430	0.421
	Average Index Food	0.501	0.429	0.408
	Average Index Mobility	0.296	0.248	0.279
	Average Index Product Disposal	0.183	0.169	0.180
	Average Sustainable Consumption Index	0.397	0.336	0.334
Time-series data	Average Sustainable Consumption Index 2021	0.399	0.325	0.321
	Average Sustainable Consumption Index 2022	0.396	0.347	0.348

Source: Own elaboration

3. Results

3.1 Formal presentation of results

The dataset (linked to the vector layer) is visualized using the “Open attribute table” in the context menu of the vector layer “Sample dataset”.

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

Figure 4: Adding data for each town/point of the vector layer (shape file layer)

Sample dataset — Features Total: ...

	Town	Ind1	Ind2	Ind3	Ind4t1	Ind4t2	Ind4t3
1	Sofia	3	9	5	2	1	6
2	Varna	4	2	2	3	5	7
3	Svishtov	7	6	6	4	9	8

Source: Own elaboration

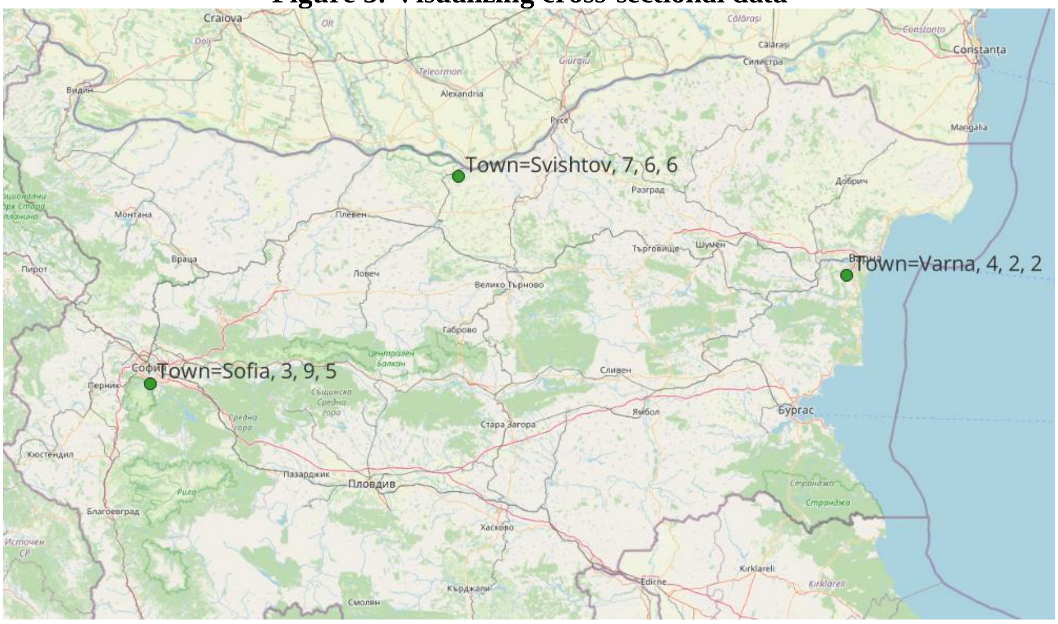
To visualize the cross-sectional data of indicators Ind1, Ind2 and Ind3 the Layer Properties windows is opened (from the context menu of the vector layer "Sample dataset").

The abc Control feature labelling is chosen.

The value is filled with "'Town='||Town||', '||Ind1 || ', ' || Ind2 || ', ' || Ind3".

The font size, the font colour may be changed. The colour of dots also may be changed. Now it is green.

Figure 5: Visualizing cross-sectional data



Source: Own elaboration

Time series data for two periods of measurement may be given.

The abc Control feature labelling is chosen.

The value is filled with:
"'Town='||Town||'; Ind4, period 1='||Ind4t1 || '; Ind4, period 2=' || Ind4t2".

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

Figure 6: Visualizing time-series data

Source: Own elaboration

Text wrapping is chosen. The symbol for text wrapping is set to “;”.

3.2. Presentation of results using real spatial data for sustainable consumption

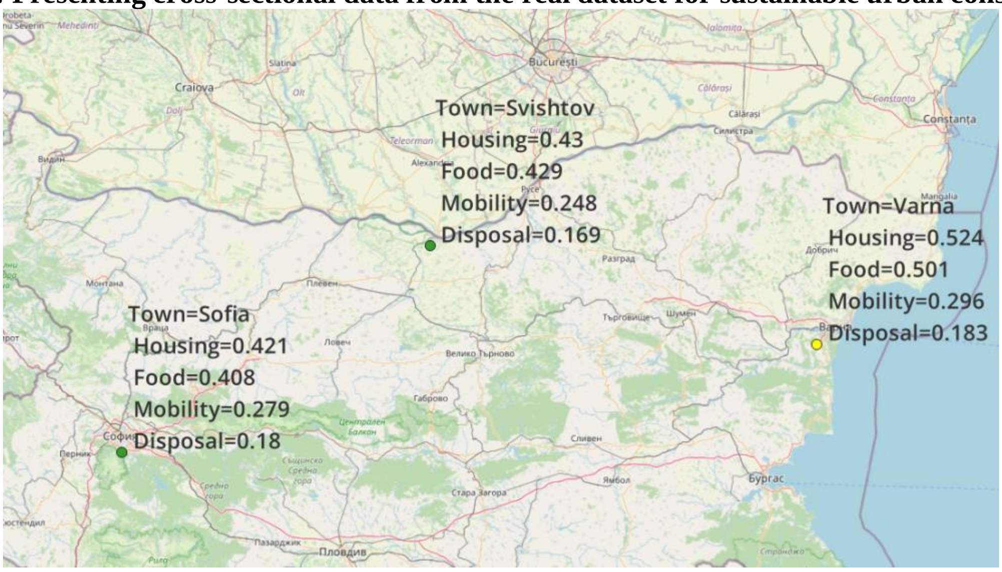
The first primer with real data presents cross-sectional spatial data for the dimensions of the sustainable consumption (figure 7).

The  Control feature labelling is chosen.

The value is filled with:

'Town='||Town||'; Housing='||Housing || '; Food=' || Food|| '; Mobility=' || Mobility|| '; Disposal=' || Disposal

Figure 7: Presenting cross-sectional data from the real dataset for sustainable urban consumption



Source: Own elaboration

RevistaEconomică
Journal of economic-financial theory and practice
Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

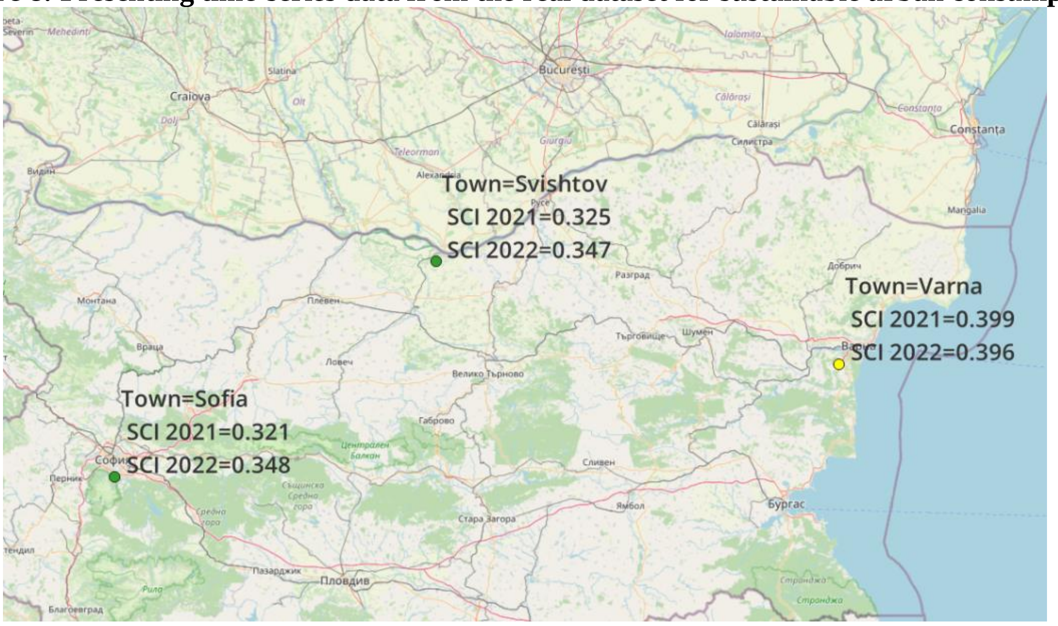
The second primer with real data presents time-series spatial data for the dimensions of the sustainable consumption (figure 8).

The  Control feature labelling is chosen.

The value is filled with:

'Town='||Town||'; SCI 2021='||SCI2021||'; SCI 2022='||SCI2022

Figure 8: Presenting time-series data from the real dataset for sustainable urban consumption



Source: Own elaboration

SCI – Sustainable Consumption Index

4. Results

The application of spatial visualization allows for a very quick orientation of the state of sustainable consumption in the three monitored cities. When the indicators are selected, they are visualized in the order of their arrangement and make it possible, if the indicators are related, to observe internal structures for each city separately. In our case, the value of the average aggregate index for sustainable consumption is placed in fifth place. It is visualized that in all three cities, the level of sustainable consumption of households is not high, the contrary. The ASCR (Average Sustainable Consumption Index) values for households in individual cities range between 0.334 and 0.397, which means that this is a low to average level of sustainable consumption. Comparatively, the average SCR value is the highest for households in the city of Sofia. Varna. In all three cities, it is clear that the lowest are the average values of the index of sustainable actions related to product releases, followed by the averages of the mobility indices. In general, households in the city of Sofia. Varna has the best performance in terms of the monitored activities. When selecting observed key indicators, it is good to keep in mind that it is best to visualize no more than 2-5 indicators at the same time. When selecting a larger number of indicators, visualization complicates interpretation rather than facilitates it.

5. Conclusions

Using spatial data visualization for sustainable consumption is convenient, easy, and useful. This allows for rapid awareness of differences in observed key indicators, both in terms of snapshot data at a specific point and also in terms of dynamics of key indicators over time in a specific geographical point. Spatial visualization can be used successfully to easily understand survey results and promote them to a wider audience. On the other hand, for inclusion in analytical reports that can be used to make management decisions.

Acknowledgments
This research is financed by project NPI-70/2023 "Sustainable consumer activities of Varna's households – possible reasons".

References:

- Bartolj, T., Murovec, N., & Slabe-Erker, R. (2018). Development of a Household Sustainable Consumption Index and Its Application to EU-28. *Sustainable Development*, 26(1), 34–50. https://doi.org/10.1002/sd.1689
- Beke, J., Lendvai, M. B., Kovács, I., & Lisányi, J. B. (2022). Sustainable Consumption Scales: Measuring Young Customers' Sustainable Food Consumption Behaviour. *BNEJSS Balkan and Near Eastern Journal of Social Sciences* Balkan ve Yakın Doğu Sosyal Bilimler Dergisi Kovács et Al, 2021(03), 7. Retrieved from https://www.researchgate.net/publication/357749349
- Caeiro, S., Ramos, T. B., & Huisingh, D. (2012). Procedures and criteria to develop and evaluate household sustainable consumption indicators. *Journal of Cleaner Production*, 27, 72–91. https://doi.org/10.1016/j.jclepro.2011.12.026
- Durón-Ramos, M. F. (2013). Assessing Sustainable Behavior and its Correlates: A Measure of Pro-Ecological, Frugal, Altruistic and Equitable Actions. *Sustainability*, 5, 711–723. https://doi.org/10.3390/su5020711
- Edelson, S. (2019). Meet the Sustainability Calculator That Tallies Benefits of Resale. Women's Wear Daily, p. 23. Retrieved from https://wvu.idm.oclc.org/login?url=https://www.proquest.com/trade-journals/meet-
- ENVIRONMENT POLICY COMMITEE. (1999). TOWARDS MORE SUSTAINABLE HOUSEHOLD CONSUMPTION PATTERNS INDICATORS TO MEASURE PROGRESS 82545. Paris.
- Haron, S. A., Paim, L., & Yahaya, N. (2005). Towards sustainable consumption: an examination of environmental knowledge among Malaysians. *International Journal of Consumer Studies*, 29(5), 426–436. https://doi.org/10.1111/j.1470-6431.2005.00460.x
- Kabadayi, E. T., Koksal, C. G., Dursun, I., & Tuger4, A. T. (2016). Pro-Environmental Consumption: Is It Really All About the Environment. Pressacademia, 3(2), 114–114. https://doi.org/10.17261/pressacademia.2016219940
- Kehayova-Stoycheva, M., & Vasilev, J. (2023). Developing a Household Sustainable Consumption Index Calculator – Marketing and IT Dimensions. *TEM Journal*, 12(4), 2101–2111. https://doi.org/10.18421/TEM124-21
- Lorek, S., & Spangenberg, J. H. (2001). Indicators for environmentally sustainable household consumption. *International Journal of Sustainable Development*, 4(1), 101. https://doi.org/10.1504/IJSD.2001.001549
- Michalos, A., Creech, H., Christina, M., & Kahkle, M. H. (2009). Measuring Knowledge , Attitudes and Behaviours towards Sustainable Development : Two Exploratory Studies. International Institute of Sustainable Development, 1(January), 37.
- Peattie, K. (2010). Green Consumption: Behavior and Norms. Annual Review of Environment and Resources, 35(1), 195–228. https://doi.org/10.1146/annurev-environ-032609-094328
- Quoquab, F., Mohammad, J., & Sukari, N. N. (2019). A multiple-item scale for measuring "sustainable consumption behaviour" construct: Development and psychometric evaluation. *Asia Pacific Journal of Marketing and Logistics*, 31(4), 791–816. https://doi.org/10.1108/APJML-02-2018-0047

Vol. 76, issue 3 Year 2024
DOI: 10.56043/reveco-2024-0028

- Rahma, A. Z., Qulub, A. N., Wahyu Prasetyo, W., Rizqi, N. A., & Sodiq, A. (2024). Contemporary Business Environment and Contemporary Techniques. *Journal Of Global Research Publications*, 1(1), 18–25. https://doi.org/10.59435/jgrp.v1i1.2024.4
- THE 17 GOALS | Sustainable Development. (n.d.). Retrieved July 27, 2021, from https://sdgs.un.org/goals
- United Nations - Department of Economic and Social Affairs. (n.d.). UN 2.0 and the Sustainable Development GoalsNo Title. Retrieved from Related SDGS - Science website: https://www.un.org/sites/un2.un.org/files/un-2.0-and-sdgs-en.pdf
- van Maarseveen, M., Martinez, J., & Flacke, J. (2019). GIS in Sustainable Urban Planning and Management. In *GIS in Sustainable Urban Planning and Management*. https://doi.org/10.1201/9781315146638-1
- West, S. E., Owen, A., Axelsson, K., & West, C. D. (2016). Evaluating the Use of a Carbon Footprint Calculator: Communicating Impacts of Consumption at Household Level and Exploring Mitigation Options. *Journal of Industrial Ecology*, 20(3), 396–409. https://doi.org/10.1111/jiec.12372
- Zalega, T. (2020). Sustainable Consumption in Consumer Behaviour of Young Polish Singles. Acta Scientiarum Polonorum. *Oeconomia*, 19(1), 89–100. https://doi.org/10.22630/ASPE.2020.19.1.10.