TOWARDS LOCALIZATION OF SUSTAINABLE DEVELOPMENT GOAL 11 IN THE CITY OF NIŠ, SERBIA: MANAGING MUNICIPAL SOLID WASTE FOR A RESILIENT AND SUSTAINABLE COMMUNITY

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ABSTRACT

The City of Niš is continuously investing efforts in advancing sustainable urban development while minimizing environmental impact. The first Voluntary Local Review (VLR) in the Republic of Serbia was undertaken by the City of Niš in 2023/2024, assessing the selected 26 indicators across 12 Sustainable Development Goals (SDGs). As a pioneering process in Serbia, the VLR of Niš has raised awareness about the SDGs and their advancement, and set good grounds for scaling up the local VLR nationwide.

This paper presents a part of VLR findings on Niš's performance on SDG 11 that concerns the Indicator 11.6.1. Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by cities. After delving into the legislation at the national level, the paper explores the current state in waste management in the City of Niš, analyses the data on the selected indicator, discusses the main challenges and local efforts, and proposes potential actions and projects to accelerate SDG progress in this area. The findings suggest that Niš faces challenges in waste management due to outdated landfill facilities that limit eco-friendly disposal options. However, the existing landfill rehabilitation project signifies a move toward sustainable practices, complemented by plans for a regional landfill, while efforts to tackle illegal landfills include establishing recycling yards and enhancing citizen awareness. Niš should prioritize sustainable waste management by developing a new landfill, rehabilitating the old one, improving waste separation and treating waste as a resource, with public campaigns promoting reduction, reuse and recycling. The findings of this study aim to enhance local waste management strategies, tracing the way towards a more resilient and sustainable community.

KEYWORDS _ *Municipal solid waste, Sustainable waste management, Landfill, Recycling*

INTRODUCTION

In an effort to reduce the adverse environmental impact of cities, the management of Municipal Solid Waste (MSW) is considered to be one of the crucial topics for advancing the Sustainable Development Goals (SDGs), which is set forth in the 2030 Agenda for Sustainable Development. According to the United Nations Department for Economic and Social Affairs (UNDESA), the MSW includes (UNDESA, 2016): waste generated from households, commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings), bulky waste (white goods, old furniture, mattresses), waste from selected municipal services (park and garden maintenance), and waste from street cleaning services (street sweepings, the content of litter containers, market cleansing waste). The overall approach to developing a waste management system implies three key steps (World Bank Group, 2020): (1) establishing waste collection services to protect public health, (2) improving waste treatment and disposal to provide environmental protection, and (3) implementing systems and incentives to enable the transition to sustainable resource management.

Since 2015, United Nations member states have been working closely with local and regional governments on actively localizing the 2030 Agenda, and implementing the SDGs outlined in this document. The 2030 Agenda encourages member states to perform regular and inclusive reviews of progress at the national and sub-national levels, and invites major groups and stakeholders, such as local authorities, to share reports on their contributions to the implementation of the Agenda (UN, 2015). Consequently, local and regional governments are increasingly engaging in sub-national reviews of SDG implementation, also called Voluntary Local Reviews (VLRs), thereby enhancing the overall progress of the SDGs (UN, no date).

During 2023 and 2024, the City of Niš, Serbia was actively developing its first VLR with the support of the United Nations Human Settlements Program (UN-Habitat), within the project *Voluntary Local Reviews: Evidence for Greener, Resilient and Sustainable Urban Recovery in Eastern European and Central Asian Countries in Transition*[1]. The VLR of the City of Niš was officially launched in October 2024, becoming the first document of its kind in the Republic of Serbia. As part of the voluntary local review process, the City of Niš identified specific SDGs, Targets and Indicators to assess, aiming to report on the progress made toward achieving the SDGs within its territory. Given the significance of MSW management for creating inclusive, safe, resilient and sustainable cities within the SDG 11, and the urge to improve environmental performance of cities prioritized in the Target 11.6., one of the selected indicators involved the Indicator 11.6.1. *Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by cities*.

This paper presents a part of VLR findings on Niš's performance on SDG 11 that concerns the Indicator 11.6.1., to demonstrate the progress the City of Niš has made toward building resilient and sustainable local communities. In line with the framing issue, the objectives of this study are: (1) to explore the legislative and strategic frameworks and local practices related to MSW treatment in the City of Niš, and (2) to identify actions and projects that would accelerate SDG progress of Niš in the field of waste management.

METHODS AND MATERIALS

The study uses empirical research and review of relevant literature and data sources. The methodological framework is conceptualized on the analysis of legislative and strategic documents at the national and local level, the description and analysis of comprehensive data on the selected indicator from various data sources, involving open data and publicly available documents, as well

[1] The VLR was developed as part of the UNDA Tranche 14 project, with partners in the implementation of the project involving: United Nations Human Settlements Program (UN-Habitat), United Nations Economic Commission for Europe (UNECE), United Nations Department for Economic and Social Affairs (UNDESA) and United Cities Local Governments (UCLG). The Voluntary Local Review of the City of Niš was prepared by the Local Consultant Milena Dinić Branković, with the support of the Local-Regional Coordinator Tanja Obradović, the National Coordinator Siniša Trkulja, and the newly established Monitoring Department of the City of Niš.

as semi-structured interviews with the delegates of the competent city authorities in stakeholder workshops organized during the VLR Niš co-creation process. The stakeholders provided valuable input on the course and state of waste management in Niš. Finally, the synthesis of study findings is used as a baseline for discussing the main challenges and local initiatives, as well as for developing action-oriented recommendations for sustainable MSW management in the City of Niš.

For calculating the indicator 11.6.1. for the City of Niš, this study uses UNDESA's methodology. This global methodological framework of indicators and statistical data was devised and adopted in 2017 as a follow-up and review mechanism for the implementation of the 2030 Agenda (UNDESA, no date). The *SDG indicator metadata* sheets are created for each indicator, as key to understanding and measuring progress on the SDGs. In the Definition part, the *SDG indicator metadata* for Indicator 11.6.1. quantifies the parameters that are essential for planning and implementing sustainable MSW (UNDESA. 2016.): (a) Total MSW generated in the city (tonnes/day), (b) Total MSW collected in the city (tonnes/day), (c) Proportion of population with access to basic MSW collection services in the city (%), (d) Total MSW managed in controlled facilities in the city (tonnes/day), and (e) MSW composition. Furthermore, the document highlights the conceptual differences between parts (b) and (c), which are important features to consider in the assessment. While part (b) refers to the volume of waste delivered to waste management facilities, part (c) focuses on the population receiving waste collection services. In some cities, waste collected from households is often dumped in nearby areas rather than being transported to disposal or recovery facilities. In such cases, households may have access to waste collection services, yet the collected waste contributes to environmental pollution. As a result, a city may report a high percentage of its population with basic waste collection access while the actual amount of MSW transported to proper waste management facilities remains low.

The scope of data analysis for the Indicator 11.6.1. is the administrative area of the City of Niš, as a local self-government (LSG) unit and the territory covered by the spatial plan. The choice of this particular scope of research is rooted in the fact that official data for cities in Censuses and other statistical sources in Serbia is often presented for the LSG territory (Dinić Branković, 2024). The research uses the latest available data, which predominantly refers to the year 2023, with some data available for 2024.

TREATMENT OF MSW AT THE NATIONAL LEVEL

Law on Waste Management of the Republic of Serbia

(Official Gazette of the Republic of Serbia, no. 36/2009, 88/2010, 14/2016, 95/2018 and 35/2023)

The waste management in the Republic of Serbia is regulated by the *Law on Waste Management*. The Law regulates: types and classification of waste; entities, responsibilities, and obligations in waste management; planning and organization of waste management; management of specific waste streams; conditions and procedures for issuing permits; trans boundary movement of waste; waste reporting and database; financing, supervision, and other issues of importance for waste management (Article 1).

The European integration process of the Republic of Serbia requires to ensure full compliance with EU legislation in the field of waste management and environmental protection, which the Serbian Law enables. Therefore, waste management in the territory of the Republic of Serbia is based on six principles prescribed by the Law (Article 6):

- *The principle of choosing the most optimal option for the environment* involves choosing the option that delivers the greatest benefit or the least harm to the environment as a whole, while considering acceptable costs and profitability, given the specific circumstances;
- *The principle of self-sufficiency* involves establishing an integrated and appropriate network of facilities for the recovery and disposal of mixed municipal waste, so as to enable the Republic of

Serbia to achieve the principle of self-sufficiency in waste disposal, as well as in waste recovery;

- *The principle of proximity and regional approach to waste management* stipulates that waste should be treated or disposed of as close as possible to its place of origin in order to avoid undesirable environmental consequences during the transport;
- *The principle of waste management hierarchy* outlines the priority order in waste management practices, which includes: prevention, preparation for reuse, recycling, other operations for recovery (such as energy recovery, etc.), and disposal as the last option in waste management;
- *The principle of responsibility* refers to the responsibility of producers and distributors of products that contribute to the increase in the quantity of waste;
- *The "polluter pays" principle* implies that the polluter must bear the full costs of the consequences of their activities.

The Law distinguishes the following types of waste: municipal waste (household waste); commercial waste, and industrial waste; which can be: inert, non-hazardous, and hazardous, depending on their characteristics that affect human health and the environment (Article 7). According to the Law, municipal waste is separately collected waste from households, including paper, cardboard, glass, metal, plastic, biodegradable waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, bulky waste, and mixed municipal waste and/or separately collected waste from other sources, if that waste is similar in nature and composition to household waste (Article 5, Paragraph 13).

For the purposes of waste management on the territory of the Republic of Serbia, the government adopts: the Waste Management Program; the Waste Sludge Management Program; the Regional Waste Management Plan, and the Waste Prevention Plan; while local self-government units adopt Local Waste Management Plans (LWMP) for their respective territories (Article 9).

Monitoring and reporting on waste management in the Republic of Serbia

The SDG Indicator 11.6.1. is partly being monitored at the national level, because only the data on total MSW generated is available. Monitoring is performed by the Serbian Environmental Protection Agency (SEPA) and calculated by the Statistical Office of the Republic of Serbia (SORS). A progressive increase in generated waste is evident in the last several years (from 2,710 thousand tonnes in 2017 to 3,180 thousand tonnes in 2022) (SORS, no date). The latest data show improvements in this sector, with a slight decrease of generated waste to 3,095 thousand tonnes in 2023.

Data on waste management in the Republic of Serbia is collected in accordance with the Law on Waste Management of the Republic of Serbia. All reporting entities are required to keep and maintain daily records of the quantities of waste generated, received, used, deposited, imported or exported, as well as to submit an annual report to the Agency (SEPA, no date). Reporting entities involve manufacturers of waste (except for households), entrepreneurs participating in the waste trade, manufacturers/importers of products that generate special waste streams, operators of the waste recycling facility, and landfill operators (SEPA, no date). Records of the number of submitted reports are being kept since 2013.

MSW COLLECTION AND MANAGEMENT IN THE CITY OF NIŠ

MSW in the strategic framework

The area of the City of Niš as a LSG unit is covered by the *Development Plan of the City of Niš 2021-2027* (DP), devised in 2021, and the *Spatial Plan of the City of Niš Administrative Area 2021* (SP), originally

developed in 2011, with modifications and additions adopted in 2022. Both documents deal with the issue of waste management and set the context for sustainable MSW management. The DP established the Priority goal 2.4. *Ensuring zero environmental pollution, preservation and restoration of ecosystems and biodiversity*, as well as the Measure 2.4.7. *Establishing a sustainable, inclusive and long-term waste management system*. The SP determined Priority planning solutions and projects, which, among others, involve: *Establishment of the "Regional Center No. 23 for waste management"*, *Improvement of waste collection and rehabilitation of existing dump sites*, and *Introducing activities of recycling*.

Niš had a *Local Waste Management Plan of the City of Niš* devised and adopted for the period from 2011 to 2021, but this document is now outdated. The overarching goal of the LWMP was to improve environmental protection, solid waste collection and disposal services, and improve hygiene and health conditions in the territory of Niš. The LWMP defined the basic orientation of waste management for the planning period based on the European Union strategic plans, established the hierarchy of possible waste management options, directed activities in the harmonization of legislation with EU legislation, identified responsibilities for waste, determined short- and long-term objectives for waste management, and defined the role and tasks of particular actors. Although the implementation of some waste management actions was indeed initiated, the overall objectives deploying advanced sustainable practices have not yet been achieved.

The overview and analysis of data on the Indicator 11.6.1.

MSW collection and management in Niš territory is performed by the Public Utility Company (PUC) Mediana. This company also collects recyclable waste, sorts it, and prepares it for transport. Mediana company has harmonized its waste management with the current national regulations. Waste characterization has been done, daily and annual waste management records are kept, and monitoring of landfill operations is performed. This data is regularly forwarded to SEPA.

The vast majority of LSG territory is covered by organized waste collection. The urban area of Niš is fully covered by organized waste collection (100%) (PUC Mediana employee, personal communication, November 24, 2023). Regarding rural areas, there have been permanent efforts on their inclusion in organized waste collection in the last few years, and on the removal and recultivation of illegal landfills in these areas. In 2022, 62 out of 69 rural settlements had access to waste collection service. In 2023, two additional villages were included in the organized municipal waste collection system, thereby leaving only five rural settlements without this service (Table 1) (PUC Mediana employee, personal communication, November 24, 2023). This represents 6,76% of the total number of settlements in City territory, and only 0.11% of the total population. The proportion of population with access to basic MSW collection services in the City of Niš is very high and amounts to 99.89%.

Table 1: Rural settlements without waste collection service. Source: Public Utility Company Mediana Niš, 2023.

	Rural Settlement					**City of Niš**
	Radikina Bara	Rautovo	Bancarevo	Kunovica	Cerje	
Population	47	8	39	22	150	249,501
Share	0.11%					100%

In the year 2022, total MSW collected in the city was 85,061 tonnes/year, or 201 tonnes/day (PUC Mediana employee, personal communication, November 24, 2023). Total MSW managed in controlled facilities in the city is approximately 3 tonnes/day, but this only refers to the waste that is brought from commercial facilities for destruction. The amount of generated and deposited waste in Niš has presented a constant increase in volume over the last years (Figure 1).

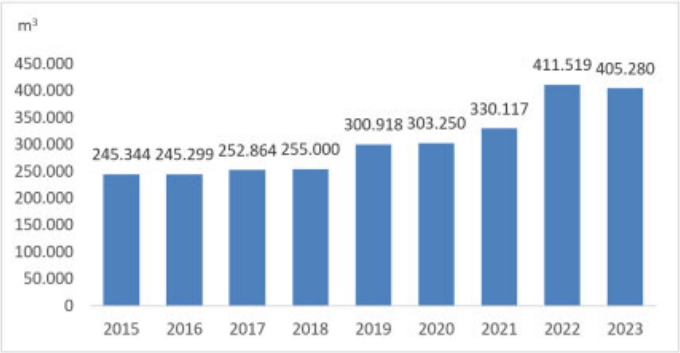

Figure 1: Total volume of deposited waste in m3 per year in the City of Niš. Source: Business plans of Public Utility Company Mediana Niš 2017-2025.

Collected municipal and other non-hazardous waste is transported to the local communal landfill "Bubanj", which is located on the edge of Niš administrative area, mostly in the territory of the municipality of Doljevac. The communal landfill was opened in 1968 and officially zoned for that use in 1971, with an exploitation period of 30 years. However, the exploitation of the landfill is constantly being prolonged by expanding certain fields, as a temporary solution in the absence of an adequate space for solid waste disposal. Until recently, Bubanj landfill operated as a plain garbage dump site, and it still presents the biggest environmental risk of the City of Niš (LWMP, 2021). The landfill is now in the process of rehabilitation, and the site is being used for the purpose of waste disposal until the new Regional Centre for Waste Management "Keleš" is developed.

Bubanj landfill is an unsanitary landfill because it does not meet the criteria of modern municipal waste management, nor does it ensure environmental protection. Its closure is planned after the end of the exploitation period, with the prerequisite for exploitation being to rehabilitate the landfill with minimal environmental protection measures and create conditions for recultivation of the existing area. The existing landfill consists of four segments (S1, S2, S3, S4), three of which are closed and partially recultivated (DP, 2021). The only active landfill segment is S4, which was rehabilitated in 2015 with the aim to provide enough capacity for additional two to three years. In S4 field, waste disposal is currently carried out by using the technology applied in the European Union. Construction of a new sanitary field S5 is also planned. Currently, the landfill is fenced, there are perimeter channels and retention basins. The base of the landfill is natural clay, which prevents the penetration of filtrate into deeper layers and into underground water. Measures of compaction and covering of waste with inert material are applied at the landfill. Landfill gases are channelled through biothorns[2] and released into the atmosphere. The landfill parameters are regularly monitored. There is no system for purifying leachate and waste water.

In the last decade, significant progress has been recorded in waste recycling practices in Niš. In 2016, individual households in the territory of two city municipalities, Medijana and Palilula, were provided with a "blue bin" for collecting packaging waste. Recycling islands for collecting plastics and glass have been installed throughout the city, involving 350 containers for collecting packaging glass and 250 nets for collecting PET packaging. All of these activities were carried out with the aim of developing positive habits of citizens and their active involvement in the waste management process, expansion of the system of separation of recyclable materials, and creation of new jobs in the recycling industry.

A Recycling Centre was built in 2014, in the industrial zone of the city, covering an area of about 5.5

2 Biothorns are gas wells used for the extraction of landfill gas.

ha. The Centre collects waste from three sectors - industry, commercial activities and households. Raw materials that are collected are recyclable materials: paper, cardboard, PET packaging, plastic film, Tetra Pak packaging, aluminium cans and glass. Recyclable waste that is collected from "blue bins" and containers for packaging waste is brought to the Recycling Centre for further sorting by waste fractions. Separated fractions are further baled and handed over to operators for recycling. Unprocessed waste is separated and taken to the landfill. The amount of packaging waste processed in 2022 amounts to 400 tonnes.

Apart from recycling of certain types of waste and waste disposal, other types of waste treatment are not performed in Niš.

DISCUSSION: MSW COLLECTION AND MANAGEMENT FROM THE SUSTAINABILITY PERSPECTIVE

Gaps and challenges

Despite the very high share of population and territory that is being serviced by organized waste collection in the City of Niš, the existing landfill does not enable environmentally friendly waste disposal. The amount of MSW collected and transported to controlled waste management facilities in Niš is therefore estimated as low, and this issue remains one of the biggest challenges that the City is facing nowadays. Achieving the required level of safety in MSW management and turning the current waste disposal process into a waste management process are urgently needed actions in the City of Niš.

From the perspective of stakeholders, the lack of financial resources and insufficient efforts of all actors are the main impediments to solving key problems in waste management. Also, successful integration of SDGs into waste management projects in Niš requires educational and promotional activities to enhance implementation, such as holding tribunes, round tables and panels for professionals, as well as better informing and engaging the citizens.

Local efforts and initiatives

The beginning of the project for rehabilitation, closure and recultivation of Bubanj landfill marked the starting of waste management practice that pollutes the environment less. The stakeholders highlighted that sustainable MSW is supported by enforceable planning documents at the local level that are aligned with the SDG 11. A regional landfill is planned at the border of the administrative area of the City of Niš, which will serve the municipalities of Niš, Gadžin Han, Svrljig, Ražanj, Doljevac, Aleksinac, Merošina and Sokobanja (SP, 2022). It will be formed in such a way to occupy mostly the already degraded space, with an extension that is adequately located in relation to natural and man-made conditions. The regional landfill will include two units: 1) Brownfield location (existing landfill after remediation), which is a functional and infrastructurally equipped site, and 2) Greenfield location (site "Keleš" in the territory of Doljevac municipality) zoned for a sanitary landfill of non-recyclable municipal waste. Regarding the development of regional landfill, the progress is slow. So far only a Decision has been adopted and signed by six LSG units.

In 2020, in the territory of the City of Niš, 42 illegal landfills were recorded, mostly in rural parts of city municipalities. Despite regular cleaning of these locations, the low level of environmental awareness among citizens causes illegal landfills to form again. Therefore, two Recycling Yards were opened in city municipalities Palilula and Medijana in 2022, and three more are planned in other city municipalities. These are sites where citizens can dispose of their waste that is not suited for household waste containers, such as bulky waste, green waste, hazardous household waste, waste from electrical and electronic equipment, batteries, etc. The goal of this initiative is to systematically

deal with the issue of illegal landfills. From the perspective of stakeholders, the best form of prevention from the creation of illegal landfills is to provide waste collection service for all settlements in rural areas, and to create Recycling Yards in urban areas.

A department of the company Mediana called Zelenilo composts biodegradable waste from parks for its own use. The humus obtained in this way is used for growing new seedlings in the Mediana nursery garden.

CONCLUSIONS

This paper explored the topic of sustainable MSW at the local level of the City of Niš, as one of the key issues for building resilient and sustainable local communities. In line with the first research objective, it can be stated that although the legislative and strategic frameworks support the sustainable MCW at both national level and in the City of Niš, the barriers that hinder the advancement of sustainable solutions are identified in local practice. Niš faces challenges in waste management due to outdated landfill facilities that limit eco-friendly disposal options, while financial constraints and insufficient efforts impede progress in the implementation of sustainable solutions. A shift towards sustainable waste practices was initiated with the existing landfill rehabilitation project, complemented by plans for a regional landfill, and further enhanced with efforts invested in tackling illegal landfills and raising citizen awareness.

Regarding the second research objective, activities of the City of Niš should prioritize planning and implementing sustainable practices in the management of MSW (Dinić Branković, 2024). A project of the utmost priority is the construction of a new landfill, along with continuation of the ongoing efforts in rehabilitation of the existing landfill site. Additionally, priority activities imply improving waste collection and its separation into key waste streams, coupled with a shift in paradigm to perceive waste as a resource. Developing a sustainable waste management system requires informed citizens actively engaged in the process, with awareness campaigns and educational initiatives focusing on the reduction of generated waste via prevention, reuse and recycling. In line with that, two additional key projects are highlighted: 1) the project focused on the primary sorting of all waste types, based on the analysis of current state and the assessment of collected raw materials, and 2) a project aimed at developing incentives to encourage individuals and local communities to actively separate and recycle their waste.

As a key process for advancing SDG implementation at the local level, the VLR of the City of Niš has highlighted the role of sustainable MSW management, raised awareness among local authorities and stakeholders on the topic, enhanced local strategies and evidence-based planning in this field, and set the context for sustainable practices that lead to a more resilient and sustainable community.

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