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reviews of sustainability and resilience of the built environment for education, research and design

Saja Kosanović, Alenka Fikfak, Nevena Novaković and Tillmann Klein [eds.]

This thematic book series is a result of the Erasmus+ project, *Creating the Network of Knowledge Labs for Sustainable and Resilient Environments (KLABS)*. The books are dedicated to establishing a comprehensive educational platform within the second cycle of higher education across the Western Balkan region. The series comprises five volumes in the English language:

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FOR SUSTAINABLE & RESILIENT ENVIRONMENTS

Creating the Network of Knowledge Labs for Sustainable and Resilient Environments – KLABS

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Integrated Urban Planning
Directions, Resources and Territories

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Saja Kosanović, Alenka Fikfak, Nevena Novaković and Tillmann Klein

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integrated urban planning directions, resources and territories

Enrico Anguillari and Branka Dimitrijević [eds.]

Preface

Saja Kosanović, Alenka Fikfak, Nevena Novaković and Tillmann Klein

The continuous evolution of the notion of a sustainable and resilient built environment demands repeated examination. For this reason, the state-of-the-art thematic series *Reviews of Sustainability and Resilience of the Built Environment for Education, Research and Design* contributes to the comprehensive understanding of the two approaches and their interrelations in the built environment by retrospectively investigating their development, addressing current issues, and speculating on possible futures. The series represents one of the results of the Erasmus+ project, Creating the Network of Knowledge Labs for Sustainable and Resilient Environments – KLABS, dedicated to establishing a comprehensive educational platform within the second cycle of higher education across the Western Balkan Region.

The sustainable and resilient built environment is a multi-layered and multi-disciplinary construct. To successfully tackle the intricacy of the points in question, the series of books comprises five thematic volumes that initially approach sustainability and resilience from the socio-spatial perspective, subsequently address sustainable and resilient urban planning and urban design, and then focus on individual buildings and a range of approaches, methods, and tools for sustainable and resilient design, placing particular emphasis on energy issues. By addressing different levels of the built environment and different aspects of sustainability and resilience in a systemic way, 83 academics from 12 different countries gave 54 contributions in the form of narrative or best evidence articles with the main objectives of informing the development of specialised knowledge, building critical awareness of interdisciplinary and transdisciplinary knowledge issues, and connecting university education with the domain of scientific research. The broad aim is to develop the collection of reviews of sustainability and resilience of the built environment that are useful for students, educators, professionals, and researchers, all of whom are dealing with these two important subjects internationally.

We express our gratitude to all authors, editors, reviewers, and members of the publication board for investing significant efforts in the development of the book series in the framework of the Erasmus+ project, KLABS.

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Innovative Approaches to Waste Reduction, Reuse and Recycling within an Integrated Urban Planning Concept

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ABSTRACT **Municipal solid waste is generated through the activities of every economic sector. In the 20th century, the usual methods of waste management were landfilling and incineration. European theory and practice in the past 20 years has recognised new concepts and approaches in Municipal Solid Waste Management (MSWM). Based on EU directives and national laws, many European countries have already established a Zero Waste concept, with the aim of shifting the current MSWM practices towards sustainable natural cycles, whereby almost all discarded materials become resources for others to use. The Zero Waste concept involves re-use, recycling, and waste reduction and its ultimate goal is the nullification of all waste produced in a specific area.**

Unfortunately, not all European countries have managed to achieve this goal yet. Most of them have reached the milestone of 40-60% waste recycling (according to the statistics of European Environmental Agency, while others are still in the initial stages).

This chapter will describe the step-by-step implementation of innovative approaches to waste reduction, reuse, and recycling, using the case study of the municipality of New Belgrade in Serbia. The Serbian context is of particular interest, since almost none of the EU policies on waste reduction have been implemented. Therefore, the chapter will provide a model-approach to efficient MSWM in accordance with recent EU practices, directives, and laws. The model described is of interest to other municipalities that have not yet developed a strategy for sustainable waste management.

KEYWORDS Municipal Solid Waste Management (MSWM), MSW mode, urban planning, recycling, Serbian cities

1 Introduction

Over the past 30 years, due to accelerated population growth and, with it, an increasing amount of waste, there has been a growing need for larger waste disposal areas, or for defining alternative methods for solid waste disposal and treatment (reuse, recycling, reduction of waste, and incineration). The problem of inadequate municipal solid waste management (MSWM) solutions creates various adverse effects that are manifested within ecological (increase in pollution), economic (use of quality agricultural, buildable, or forest land for landfills), technological (irrational and uneconomical management of solid waste), and social frameworks (increase in the degree of dissatisfaction among the stakeholders) (Dorvil, 2007). As a result of all of these problems, social awareness of the negative impacts of inadequate solid waste management is also rising. Those impacts are cumulative and have long-term negative effects on citizens, which may also be empirically determined in all settlements. An increasing number of theoretical studies in the domain of environmental planning (Al-Khatib et al., 2007; McDougall, White, Franke, & Hindle, 2003) are directed towards finding adequate MSWM systems and waste planning methods, which are primarily used in big urban centres. More recent methodologies in spatial and urban planning propose a new approach to researching the problem of MSWM (in the domain of defining the location and means of its elimination) in urban areas (Khajuria, Matsui, & Machimura, 2011; Motlagh & Sayadi, 2015; Rada, Ragazzi & Fedrizzi, 2013; Worrell & Vesilind, 2012). Recent research in the field of waste management (Al-Khatib, Arafat, Daoud & Shwahneh, 2009; Al-Khatib, Kontogianni, Abu Nabaa, lshami & Al-Sari', 2015; Diaz, 2009; Rybaczewska-Blazejowska, 2014) shows that the inclusion of the social aspects of this problem is necessary, through an appreciation of the affinities, behaviours, and interests of the local population as a high-ranking criterion in the selection of a method and location for eliminating waste.

On the other hand, in recent years, the Zero Waste concept has become common among the EU member countries as the newest paradigm in MSWM, because it sets a clear direction for reducing waste to the highest possible degree, and encourages a philosophical shift towards considering the elimination of waste as one of the ultimate human goals. The Zero Waste concept is based on reducing, reusing, and recycling, or converting the resources to a level of 90% or more by the year 2025 (set by UN), and disposing of only inert residual waste (Zaman & Lehmann, 2011).

Unfortunately, this goal has not yet been achieved by many European countries, having in mind that the percentage of recycled waste is 40 -70% (Eurostat, n.d.).

Countries such as Serbia, Bulgaria, Romania (i.e. predominantly Western Balkan countries) are at the very beginning of MSWM. Their concept of the waste management is based on technologically weaker ways of managing waste (e.g. landfilling, incineration), or sometimes more environmentally friendly - such as composting (Hristovski,

Olson, Hild, Peterson & Burge, 2007; Hadjijeva-Zaharieva, Dimitrova & Buyle-Bodin, 2003).

Serbian cities emerge as being particularly important for this research theme because they have implemented almost none of the waste reduction concepts. The only waste management system applied and considered in Waste Management Strategy of the Republic of Serbia from 2010 to 2019 (Government of Serbia, 2010) is the disposal of waste at unsanitary disposal sites. Within the research (Nenkovic, 2007; Nenkovic-Riznic, 2011) on the possibility of introducing a system of waste management in Serbian cities, a model approach was set up for managing waste based on the current theory, practice, and legislation that is implemented in the European Union. This model, as part a of a wider interdisciplinary study (Nenković-Riznić, 2011; Nenković-Riznić, Marić & Pucar, 2016), can also serve as strategic guidance for the implementation of the concept of advanced waste management in other Western Balkan countries, as well as in countries with similar ecological problems. This model could help in developing sustainable solutions for waste management in existing or newly planned urban areas.

2 Theoretical, Technical and Legislative Overviews of MSW Management in Europe

2.1 Theoretical Overview

Although waste disposal is only one of the waste management methods that is used less frequently in recent European and world practice, it is still the only method of eliminating waste in the urban areas of developing countries (Bleck & Wettberg, 2012; Guerrero, Maas, & Hogland, 2013; Marshall & Farahbakhsh, 2013; Nenković-Riznić, 2011; Troschinetz & Mihelcic, 2009). Recent research in the area of waste management (Al-Khatib et al., 2015; Guerrero et al., 2013; Diaz, 2009) shows that the methods of eliminating waste are changing structurally, from the most used one up until now – landfilling – all the way to processing (recycling) and re-use, in accordance with the basic principles of sustainable development.

The method of MSWM does not depend solely on the type of settlement, but rather it is conditioned by the number of inhabitants, their age and employment, the amount of waste generated, and its composition, as well as the social circumstances, local economic conditions, and, to a great extent, the geographical characteristics of an area (Al-Khatib et al., 2007; Dorvil, 2007; Henry, Yongsheng, & Jun, 2006; Tchobanoglous, Theisen, & Vigil, 1993; Tchobalnoglous & Kreith, 2002). In this regard, the justification for selecting a particular method of waste treatment must take into account all of the above parameters. All of the recent theoretical assumptions emphasise the benefits of recycling over landfilling, and can be identified in a number of practical examples,

both in developing and in European countries (Al-Khatib et al., 2007; Bleck & Wettberg, 2012; Guerrero et al., 2013; Khajuria et al., 2011).

It is not rational to even consider developing a recycling system in a particular area if, above all, there is no interest in it by the local population, and if there is not a large enough quantity of waste to be treated (Tchobanoglous, et al. 1993). Evidence for this hypothesis should be sought primarily in economic and social planning, which state that irrational planning that does not include the affinities and behaviour patterns of the local population could lead to the realisation of projects that may even be economically viable at a given time, but are simultaneously environmentally and socially unacceptable (De la Barra, 1995).

On the other hand, this problem is directly connected to the theory of decision making through verification and selection of the best, i.e. the most adequate methods/strategies for the MSWM, in accordance with the *in situ* conditions and criteria (by means of multicriteria analysis). In addition to the economic, geographical, and ecological parameters, this should also include social criteria: the affinities, habits, and behaviour patterns of the local residents.

Bearing in mind the multidisciplinary nature of this problem, there is a necessity for theoretical verification through various scientific and theoretical disciplines. The use of one-sided research that does not include inter- and multidisciplinary knowledge would result in the formation of a deterministic position, the results of which would not be relevant enough in terms of selecting an adequate method/strategy for eliminating municipal waste in urban areas of developing countries. Having a planning approach to the problem, which includes a range of theoretical and empirical facts from different disciplines, could establish a unique method for defining a strategic approach for managing municipal waste in the cities of developing countries. All of these discussions, founded on contemporary planning, sociological, psychological, economic, environmental, and technological approaches, as well as on decision-making theories (Matthias, Guipponi & Ostendorf, 2007), represent a basis for the research, verification, and development of a model for sustainable waste management in urban areas.

2.2 Sustainable Waste Management

Waste minimisation and the prevention of waste

Research on waste management on a global level (Pongratz, 2002), indicates that the reduction of waste 'at source' is the most desirable of all the options. According to Riemer and Kristoffersen (1999), the minimisation of waste consists of three elements: preventing and/or reducing the generation of waste at source; improving the quality of the waste generated, such as reducing the hazard; and encouraging reuse, recycling, and recovery.

Waste minimisation is carried out through increasing the efficiency of production; reducing the amount of packaging material for end-products; buying 'environmentally friendly' products (that claim reduced, minimal, or no harm upon ecosystems or the environment); composting organic waste at source (e.g. in gardens); reusing different products whenever possible and so on (Nenković, 2007).

Re-use

The re-use of waste is one of the sustainable ways of managing waste. It is not only environmentally friendly, but also economically and socially beneficial. According to Pongratz (2002, p. 32) there are two methods of waste re-use: "One is the re-use of an artefact for the same purpose, for a second time or more, in the same form and with the same material properties (where material constantly remains in the same form for several uses). The second one is the re-use of an artefact for another, different purpose to the original one, in the same form and with the same properties of the material as at the first use".

Recycling

Recycling was defined as "reprocessing in a production process of the waste materials for the original purpose, or for other purposes, including organic recycling but excluding energy recovery" (European Parliament and Council, 1994, article 3 para. 7). The purpose of recycling is to conserve resources and reduce the negative impact on the environment by reducing large volumes of waste disposed of at landfills. In this regard, it should be noted that although recycling is now an environmentally justified treatment of municipal waste, its sustainable management does require the expenditure of additional energy. It is a closed circular system, antagonistic to the linear flow system which is practised by many underdeveloped, and a few developed, countries in the management of municipal waste (Nenković-Riznić, 2011; Troschinetz & Mihelcic, 2009).

Composting

Organic waste, such as food leftovers and garden waste, is reduced and recycled by means of composting (McDougall et al., 2003). Composting is the process by which organic waste is converted into fertiliser or humus by encouraging the biological process of decomposition under controlled conditions. Regardless of whether the composting takes place in gardens within households or in large plants, it has many advantages: it reduces the amount of waste in sanitary landfills; it enriches the soil, reduces erosion, helps protect biodiversity, enables healthier plant growth, and reduces the use of artificial fertilisers and pesticides.

Zero Waste concept

According to the definition by the Zero Waste International Alliance (ZWIA, 2009, para. 2), "Zero waste is a goal that is ethical, economical, efficient, and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use".

Although difficult to achieve, this system of waste management has been partially implemented in some northern European countries (Belgium, Sweden, Norway), where it has been applied more or less successfully for a number of years.

There are a number of theoretical discrepancies that accompany this concept concerning whether Zero Waste applies to Zero Waste generation or Zero Waste disposal. This concept requires a fundamental change in the existing legislation, strategic commitment at the level of European countries, and changes in the awareness of population in relation to waste management. Some countries, like Scotland, have already established a Zero Waste national plan with the aim of decreasing waste by up to 70% until 2025 (Scottish Government, 2010). Although the Zero Waste concept is one of the major European objectives in the field of environmental planning, this concept will only be realised in a systemic way in the years to come.

2.3 European Legislation in the Field of Waste Management – An Overview

In order to determine the appropriate methods for treating waste it is necessary to have an overview of the legislation in this field as it is implemented in European Union countries, which directly correlates with the existing political framework. Since, globally, waste management is regulated by similar legislative frameworks, more attention will be given here to the European law in this area. The issue of planning for the management of municipal waste and how to eliminate it is treated in the EU by two types of legislative frameworks: the legal framework that discusses the principles and methods of waste treatment, as well as the mechanisms, rights, and responsibilities of investors in the processes of managing municipal waste; and the legal framework concerning spatial and urban planning, municipal activities, local government, and regional development. Besides these basic legal frameworks, it is necessary to take into consideration the general planning framework in solving this problem, since it directly affects aspects of the physical structure of the problem and represents the development support for developing a methodology of waste management (Nenković-Riznić, 2011). The basic EU legislative framework that ensures a legal foundation for the treatment of municipal waste includes three categories:

- the EU directives on waste and hazardous waste: Directive 2008/89/EC and Directive 91/689/EEC with Regulation (EC) No 166/2006;
- the EU directives on waste treatment processes: Directive 1999/31/EC on the landfill of waste, and
- the EU directives on specific waste streams: Directive 86/278/EEC on the use of secondary fertilisers in agriculture and European Parliament and Council Directive 94/62/EC on packaging and packaging waste
- the EU directive on the assessment of the effects of particular plans and programmes on the environment (Directive 2001/42/EC).

3 Methodology for Developing a Model for Sustainable MSW Management

The Zero Waste concept is still far from realistic application. Taking into account the fact that, in the European Union, the average quantity of recycled waste, according to the statistics from the European Environment Agency (EEA, 2013), is around 39%, which is a significant improvement compared to the last decade of the 20th century. The countries with the largest average quantity of recycled waste (in relation to the total volume deposited) are Austria 63%; Germany 62%; Belgium 58%; Switzerland and Netherlands 51%. On the other hand, the lowest percentage of recycled material in SEE countries is recorded in Croatia, Romania, and Bulgaria (members of the EU), and Bosnia and Herzegovina, Montenegro, Serbia, and Former Yugoslav Republic of Macedonia (outside the EU). All of the above countries have a percentage of recycled waste below 1%.

These data speak predominantly about the degree of application of the existing strategic and legal frameworks in the Western Balkan countries, as well as the degree of development of environmental awareness among all parties interested in the process of waste management (the population, state and local governments, businesses, NGOs, etc.).

Given the fact that in Western Balkan countries all of the EU directives (or their derivatives in non-EU countries, through individual laws that are harmonised with legislation from the EU directives) are in effect, the question remains: how it is possible to ensure their implementation and thereby increase the level of recycling? Although there is a clearly defined set of previously mentioned directives that oblige EU member and non-member countries to apply the principles of environmentally sound management of waste, in practice, in the Western Balkan countries, this system is mostly limited to the disposal and incineration of waste without prior processing and/or the utilisation of any energy produced (Hadjeva-Zaharieva et al., 2003; Hristovski et al., 2007; Vaccari, DiBella, Vitali & Collivignarell., 2013; Vego, Kučar-Dragičević & Koprivanac, 2008).

The reason for this is usually the inadequately defined responsibilities of the state and local government for the implementation of a system of rational waste management, as well as the absence of economic and ecological incentives which would raise the interest of citizens in recycling procedures.

Consequently, in the Western Balkan countries, it is necessary to develop a strategy for an integrated and sustainable waste management system that could systemically solve the problem of irrational landfilling and allow the consistent implementation of existing laws (harmonised with EU directives).

3.1 Existing and Newly Adapted Methodologies for the Implementation of Integrated MSW Management

Recent theoreticians and researchers state that municipal waste management must take society into account, i.e. the community of citizens, and that institutions at a local, as well as national level, must implement strategies for achieving the goal of reducing waste, with the full participation of citizens (Al-Khatib et al., 2009; Cecere, Mancinelli & Mazzanti, 2014; McDougall et al., 2003; O`Connell, 2011; Rybaczewska-Blazejowska, 2014; Tchobanoglous et al., 1993).

In order to achieve the above objectives, Nenkovic (2007, p. 399) has proposed a methodology that "includes the development of databases on citizens' preferences on the basis of which it is possible to determine: the most suitable and environmentally sound methods of waste disposal, the target groups, the affinities of citizens, the capacity of waste treatment plants, and similar". These data on preferences should also be supplemented with questions which can be of importance for the active involvement of the population in these processes (age group, gender structure, and others, since different groups react differently in the waste management process and generate different types of waste) (Nenković, 2007). Establishing a database of preferences, habits etc. is the main task of local authorities, the coordinators of strategies at the national and local level in order to achieve a coherent system of waste management. This practice must directly correlate with the practice of urban planning, which will, in the initial planning phases, directly facilitate adequate consideration of the existing land use and incorporation of MSW management plants in a particular space.

Once the database on preferences and habits of the local citizens is formed, it is possible to develop a local strategy for waste management with the aim to reduce waste in specific areas (re-use, recycling, waste to energy, etc.) according to the affinities of the local population (Tchobanoglous et al., 1993). Waste management planning represents the next stage in developing a model for waste management. Tchobanoglous et al. (1993) and, later, Williams (2014) claim that waste management planning is the process by which the needs of the population and the community in terms of MSWM are quantified and evaluated (basic needs on waste treatment, their habits etc.), and then the process of evaluating the alternatives for waste management treatment is carried out by the planners and the optimal options are defined. The MSMW planning involves collecting information on citizen's habits, needs, potential location for MSW, evaluating it, presenting the data obtained, evaluating potential alternative solutions, and proposing the optimal one for best MSW practice.

Waste management plans are carried out by applying the selected waste management solutions to meet the needs of specific locations. Participation of experts from various fields, investors, residents, and relevant institutions in the preparation, development, implementation, and monitoring of waste management plans are crucial for their

successful delivery. Together they can influence the development of the final waste management plan.

Consideration of MSWM in urban planning is one of the main pillars of an efficient and fully functional city and is of major importance. Some examples of best practice in this field around Europe are the following: Hammarby Sjostad in Stockholm, a former brownfield site, which is now a sustainable community with reduced environmental impact (Ignatieva, 2014); Vathorst near Amersfoort, an eco-town that demonstrates the benefits of proactive approach and public participation in planning (PRP, URBED and Design for Homes, 2008); Hafencity Hamburg, a former brownfield area, now a sustainable community; Kronsberg near Hanover, a legacy of EXPO 2000, an eco-city that has achieved big savings in energy consumption, soil conservation, and waste reduction (PRP et al., 2008).

Since urban planning directly enters the decision-making process and the allocation of financial resources for projects, it has a strategic and political significance. Urban planning seeks to identify the potential and possibilities of different areas and proposes the way in which they can be used.

The needs of the citizens, in relation to specific MSWM treatments, are represented by their response to questions concerning the costs of waste disposal. These actions will be provided in terms of waste processing by the investor or a local utility company, and environmental protection. An eventual increase in the above needs may depend on the social standard of the residents, institutions, and commercial activities in the urban areas etc. (Garnetta, Cooperb, Longhursta, Judea, & Tyrrela, 2017).

Some European countries have developed frameworks and approaches for public participation, e.g. Germany, Italy, and United Kingdom, through the involvement of citizens in the planning process via websites, e-governance etc. (EIPP, 2009; Evans & Reid, 2013).

Besides the citizens involvement, decisions of local governance and the political activity of NGOs are the key moments in the cycle of decision-making regarding the choice of waste management methods. Planners consider alternative waste management solutions and present them to the local authorities and communities. Ideally, they jointly arrive at the optimal solution for a given area. In this regard, it is of great importance to enable participation of local residents through different public participation activities - education, questionnaires, surveys etc. to avoid NIMBY (not in my backyard) syndrome (Mazzanti & Zoboli, 2008). Such activities assist in avoiding potential negative outcomes of the waste management plan implementation.

All stakeholders should be identified and consulted in the decision-making process, and should be enabled to contribute to the development of waste management strategies and local waste management initiatives (Nenković, 2007).

3.2 Examples of the Development of Strategies for Waste Recycling

Back in 1992, the United States Environmental Protection Agency (EPA, 1992,) defined the stages of implementing a recycling programme/ strategy in countries where landfilling was the only waste management solution. This strategy could be hugely important in the Western Balkan countries, where almost none of the new technologies in waste management have been adopted. This strategy has been successfully implemented in USA and in all EU countries.

In USA, a basic recycling strategy has been integrated in several programmes, e.g. MDS (multifamily dwellings recycling) and was successfully implemented in California, Florida, New Jersey, Minnesota, Washington, New York, Michigan etc. (EPA, 1999). Europe has a shorter tradition in recycling - according to Jacobsen and Kristoffersen (2002), the most successful case studies on waste recycling and minimisation practices in Europe have been developed in Austria (minimisation of the landfilling of biodegradable municipal waste through recycling), Denmark (recycling), Germany (minimisation of packaging waste through recycling), Sweden and Netherlands (through recycling programmes for organic household waste) and UK (through a waste minimisation programme).

A waste recycling project for a specific area requires prior preparation and a detailed action plan that is implemented in several phases (EPA, 1992). These are:

- planning the method for and the location of waste collection;
- educating the population to enable active participation in solving the problem of irrational municipal waste disposal in residential areas (Williams, 2014);
- estimating local quantities of residential waste;
- setting realistic objectives regarding which materials from the total amount of waste will be recycled;
- evaluating the programme; and
- implementing the programme.

4 Implementation of a Waste Management Model in Serbia

Serbia was chosen as a pilot project for the testing of a model to introduce a waste management system in the Western Balkan countries, primarily because it does not have an adequate system for managing waste. In addition, all stakeholders in Serbia are relatively poorly acquainted with the comparative advantages of different waste management options. Bearing that in mind, from 2007 until the present, ongoing research has been conducted on the territory of Serbia (Nenković, 2007; Nenković-Riznić & Josimović, 2012).

Although the Serbian legislative system is fully harmonised with European directives (law on waste management, strategy on waste management in Serbia 2010-2019, set of rules on package and packaging waste, landfill locations, recycling etc.), almost none of the strategic policies and legal requirements have been implemented. In addition, there is no such information on citizens' awareness of environmental protection, thus the need arose to survey the population on these questions.

In this ongoing research (Nenković, 2007; Nenković-Riznić, 2011), the attitudes of New Belgrade residents were identified, as a representative residential municipality, not only of Serbia, but of the Western Balkans, regarding the location of a future recycling plant in their immediate vicinity. New Belgrade, with 200 skyscrapers and 600 residential building blocks, is the largest urban municipality in the Balkans, and has an average percentage share of certain types of waste in the territory of the Western Balkans (Nenković, 2007). During a single day the citizens of New Belgrade create around 169.66 tons of waste: (organic 38%; glass 25%; paper 7%; plastic 4%; and others; according to the statistics of PUC City sanitation of Belgrade, 2007-2017). These data directly indicate an estimation of the dimensions of buildings for processing waste, as well as the production line inside the building in the introduction of a recycling programme. The total amount of waste generated in this Belgrade municipality is deposited in the unsanitary municipal landfill.

The initial survey of the local residents, which was the part of the bigger research project conducted by the author (Nenković, 2007), was carried out at 3 specific points in New Belgrade on a sample of about 400 residents. Its purpose, as a form of research, was to determine the attitudes of citizens on the potential location of waste treatment facilities in New Belgrade, with the aim of defining the most appropriate ways of eliminating waste. The form of the survey was determined on the basis of previous research in this field (Manchester, Nova Gorica, Sydney Nova Scotia, London, and others) (Williams, 2003; Greater Manchester MWMS Final Draft, 2003). The survey was preceded by a short introductory training, which included an explanation of the needs and benefits of primary waste selection and the necessity of locating plants in their immediate vicinity via a targeted *in-situ* campaign.

The survey (Nenković, 2007; Nenković-Riznić, 2011) was designed as a closed multiple choice questionnaire. In addition to general questions, on the age of the respondents, their familiarity with ways of processing waste, and the amount of household waste generated, the survey contained a set of questions that determined the respondents' level of knowledge about specific problems that can occur as a result of choosing different methods of evacuating waste. The survey results showed that there is a direct relationship between the degree of participation in the survey and the age of the respondents (younger people are more concerned with waste management), that the average amount of waste generated is directly proportional to the economic status of the respondents (people with higher income generate more

waste), and that in New Belgrade (as was also evident in other Serbian cities) almost 100% of municipal waste is not sorted by type. The survey results also revealed that more education by the media and members of the local government is necessary to increase the awareness of the population and initiate their involvement in the implementation of waste management programmes. In addition, the results have shown that citizens are generally not familiar with the systems of subsidising or punitive policy. Finally, and most importantly, the survey results showed that the citizens believe that the location of recycling facilities within residential areas, with rigorous measures to protect the environment, and the participation of representatives from the local residents and local interest groups in decision making, is the most adequate method of managing waste. These conclusions can only be conditional, given the fact that the research was conducted on a relatively small sample of 300 surveyed citizens (Nenković, 2007; Nenković-Riznić, 2011). After carrying out the survey, the preparation and implementation of regional and local waste management plans is necessary, through which the locations of plants for the evacuation of waste would be more accurately defined. On the basis of the given data from the survey, the local administration, together with planners, can define the general objectives (according to point 'd' in EPA, 1992) of the procedures for defining the system of waste management, which make up part of the local strategies and plans for managing waste. These strategic documents would serve as general guidelines for preparing lower order urban plans (general regulation plan, detailed regulation plan, urban design projects, preliminary design projects, building permit design etc.), which would, in addition to the urban conditions for constructing plants for the evacuation of waste, also define the network of locations for the primary selection and collection of waste.

This research has been carried out for ten years with the occasional updating of data with the aim of defining new strategies in waste management in New Belgrade. However, keeping in mind that the data do not change annually, the 2007 survey can serve as a basis for setting the model and conducting the local waste management plan.

The main benefits of involving the citizens in the decision-making process on waste management are that their contribution ensures the success of the proposed projects. This gives legitimacy to the decisions made by the governance bodies or agencies and gains the trust of the local population, which demonstrates the initial hypothesis on the importance of involving all stakeholders in the process of deciding on the placement of facilities in a residential area.

5 Conclusions

Calling on international theoretical considerations and experience in countries that have the same or similar level of development as Serbia, a unique strategy for the implementation of new methods of eliminating waste in an urban setting was established. The strategy has not yet been adopted by the local authorities, but it was proposed to the city council in 2014.

Since it is virtually impossible to define a theoretical model for waste management that would correspond to the requirements and conditions of each city in SEE (or even parts of a city), in addition to the above-mentioned phases of implementation (EPA, 1992), it is necessary to determine the factors that may be either the *spiritus movens* or limiting factors that are peculiar to their particular environment.

Taking into account that no local strategy is universal, but that each city is an individual unit with different internal structures (infra and supra), demographic and social characteristics, and ultimately local customs, it is essential to find criteria for defining the method and location for managing waste. With this method it should be possible to set up a bespoke strategy for the city under consideration. Only in this way can the consensus of all stakeholders be achieved within a residential area, without negative environmental, economic or social implications.

The study case of New Belgrade suggests that a proposed waste management solution (which represents an alternative to the traditional treatment of municipal waste in an urban area -depositing, incineration, and unhygienic treatment) can be achieved only through full public participation.

There are several basic recommendations for the successful inclusion of citizens, experts, investors and non-governmental organisations in decision making processes on MSW management in urban areas. One of these is the formation of a relevant legislative framework that would allow legally based methods of participation for all stakeholders at each stage of planning and decision making. This action is followed by defining all the rights and responsibilities of each individual participant in the process (through procedures at the local level, regardless of whether they are individuals or social groups). After this stage, a scientifically based process of education should be established, which, in addition to defining the advantages and disadvantages of implementing a particular project, would include general concepts in the field of waste management. And finally, the last stage of public participation is the facilitation of easier access to planning documentation in the later stages of planning, as well as the provision of the opportunity for consultation before initiating the formal procedure for issuing the urban planning documentation necessary for construction, as well as in the processes that precede this procedure. Local and national Serbian planning policies could be easily adapted to the innovative approaches to waste reduction, reuse, and recycling, since the relevant Serbian legislation and strategies are fully harmonised with European

directives. The main goal of this process should be the achievement of the full implementation of existing strategic guidelines and rules, governed by policymakers at the national and local levels.

All of the above recommendations can be applied in other less complex urban situations and forms that could result in initial social disapproval in the absence of consistent attitudes among members of different interest groups.

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Spatial Dimension of Flood Risk

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ABSTRACT **In order to more successfully prevent the occurrence of floods and to mitigate their negative impact and numerous consequences, the Flood Risk Management (FRM) approach has been adopted in many European countries. Risk identification and assessment are the initial activities within the framework of FRM. This chapter analyses flood risk assessment from the supra-national to the individual buildings scale, describes different relevant assessment methods, and discusses the interconnectedness of flood risks at different spatial levels. Urban flood risk assessment is recognised in this chapter as being particularly complex, due to the variety of present factors, interrelations between physical and human components in the urban environment, and interrelations with other spatial levels in terms of floods. By analysing different scales of urban flood risks, it has been argued that further work in the development of risk assessment methodologies is especially necessary at the neighbourhood level, having regarded the significance of this spatial scale for successful flood management.**

KEYWORDS flood risk, assessment, mapping, spatial scale, urban areas