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МОДЕЛ
ИНТЕГРИСАНОГ/ОДРЖИВОГ
УПРАВЉАЊА КОМУНАЛНИМ
ОТПАДОМ У РЕПУБЛИЦИ СРПСКОЈ -
КОМПАРАТИВНА АНАЛИЗА ИЗМЕЂУ
ДВИЈЕ РАЗЛИЧИТЕ ОПШТИНЕ

MODEL OF
INTERGRATED/SUSTAINABLE SOLID
WASTE MANAGEMENT IN
REPUBLIKA SRPSKA – COMPARATIVE
ANALYSES BETWEEN TWO
DIFFERENT MUNICIPALITIES

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MODEL OF INTEGRATED/SUSTAINABLE SOLID WASTE MANAGEMENT IN REPUBLIC OF SRPSKA – COMPARATIVE ANALYSIS BETWEEN TWO DIFFERENT MUNICIPALITIES

Abstract: Establishing an Integrated/Sustainable Solid Waste Management (ISWM) system that is accessible and financially supported represents a significant challenge for Republic of Srpska. Fragmentation of solid waste collection and disposal systems, technically unapproved landfills, absence of treatment technologies and insufficient number of recycling centers are some of identified problems. In order to identify the effectiveness in delivering SWM services and to emphasize the problems, the ISWM model was developed and tested on the case studies. This model illustrates a current practice in WM for two selected municipalities (Banja Luka and Šipovo).

Key Words: Waste management, solid waste, waste management planning in Republic of Srpska, ISWM Model.

МОДЕЛ ИНТЕГРИСАНОГ/ОДРЖИВОГ УПРАВЉАЊА КОМУНАЛНИМ ОТПАДОМ У РЕПУБЛИЦИ СРПСКОЈ - КОМПАРАТИВНА АНАЛИЗА ИЗМЕЂУ ДВИЈЕ РАЗЛИЧИТЕ ОПШТИНЕ

Резиме: Успостављање интегрисаног/одрживог управљања чврстим комуналним отпадом (ISWM) које је доступно и финансијски одрживо представља значајан изазов за Републику Српску. Фрагментација система прикупљања и депоновања отпада, неадекватне депоније које нису технички одобрене, непостојање технологија за третман отпада те недовољан број центара за рециклажу отпада само су неки од идентификованих проблема. Да би се идентификовала ефективност пружања услуга управљања чврстим отпадом и нагласили проблеми развијен је Модел за интергисано управљање комуналним чврстим отпадом, који је тестиран на два огледна примјера. Модел илуструје постојећу праксу управљања комуналним отпадом за два изабрана подручија (Град Бања Лука и општина Шипово).

Кључне ријечи: Управљање отпадом, чврсти оптад, планирање управљања оптадом у Републици Српској, ISWM Модел

1. INTRODUCTION:

Throughout the history of mankind, humans and human activities have generated waste materials which are often considered useless and undesirable. Waste has become one of the most significant problems of modern civilization. On the one hand, consumer society produces an enormous amount of waste and pollutes nature and, on the other hand, most people nowadays want to preserve their lifestyles, while also protecting the environment and public health. However, many of these waste materials, if they are managed properly, can be reused, recovered or recycled, and they can even become resources for industrial production or energy generation [1:950]. Significant concerns over the environmental impact of waste and the demand for a sustainable solution to the "waste" problem have created an entirely new industry: the waste management industry. However, the developing and transitional counties have significant problems in implementing the sustainable solid waste management. The challenges are mainly reflected in inappropriate management, insufficient and underdeveloped technology, an unfavorable economic situation and the lack of environmental awareness in the population, causing a tremendous environmental impact [2, 3, 4]. Therefore, introduction of efficient solid waste management and its affordability will be one of the key challenges of the 21st century for developing countries, and one of the key responsibilities of local city and municipal governments [5:257].

Republika Srpka (RS), an economically developing country, is faced with developing and implementing an effective, functional, adoptable and sustainable waste management system. Since the end of the civil war in mid 1990s, the Entity has been moving towards comprehensive political, economic and administrative restructuring. On this path, the economic transition process holds a significant place, especially the painfully changes in the structure of the economy, where the most productive parts of the economy, particularly industry, stopped working and attractive industry programs and technologies were lost. The country emerged from the war with a significantly destroyed communal infrastructure (e.g. electric energy, transport communications, water supply etc.), devastated industry and collapsed economy. The waste management sector in particular, was disadvantaged. The main problems are reflected in inappropriate municipal solid waste management, outdated technology, an unfavorable economic situation and the lack of awareness within the society. In recent years, local authorities have been making significant efforts to improve MSWM. Regulations and policies have been adopted and elaborated; waste management infrastructures are in the process of being developed and improved and commercialization of the sector has been encouraged. However, despite recent investments in the improved operation of regional landfill sites, the lack of suitable facilities, inadequate management structures, the lack of technical skills and poor law enforcement are the main obstacles to the further development of effective and efficient municipal waste management structures.

Furthermore, the level of waste management development within the country varies widely between municipalities. The process of municipal waste management in all municipalities is mainly characterized by the collection of waste from end users, transport to landfills and finally landfill disposal. Of the 63 municipalities in Republika Srpska, organized solid waste management takes place in 59 of them. Thus, for example, the collection of household waste in urban parts of the municipalities is generally satisfactory, despite the lack of technical infrastructure (e.g. inappropriate and inadequate collection vehicles, insufficient capacity of containers, etc.). On the other hand the most rural areas within the municipalities are not included in regular collection cycles, which results in a large number of illegal wild dumpsites,

frequently situated in areas where environmental and health impacts are potentially high [6]. According to several studies, the total coverage of the waste collection services varies from 60% [7] to 67. 6% and 48.18% [6].

2. THEORETICAL FRAMEWORK

Increasing waste generation rates and environmental issues caused by inappropriate waste disposal created the need for establishing affordable, effective and truly sustainable solid waste management policies [8]. However, the implementation of effective and sustainable solid waste management in developing and transitional countries is an especially challenging process. A review of the literature suggests that cities and regions worldwide are making improvements, however development is a relatively slow process because of a number of factors [5, 9, 10, 11, 12, 13, 6, 14]. Furthermore, solid waste management professionals have recognized that there is no single, simple solution to solid waste problems. Instead, an integrated approach is necessary, combining the elements of several techniques to deliver environmental, economic and social sustainability. This approach looks at the overall waste management system and develops ways of assessing overall environmental burdens and economic costs. According to [15:153], ISWM systems combine waste streams, waste collection and treatment and disposal methods, with the objective of achieving environmental benefits, economic optimization and societal acceptability. The concept of ISWM contradicts the traditional approach towards waste management by seeking stakeholder participation, covering waste prevention and resource recovery, including interactions with other systems and promoting the integration of different habitat scales (e.g. city, neighborhood, household). It also solves the limitation of strategies based on the Waste Hierarchy, where the system is developed on an exactly pre-defined path and has to be developed in the following order of preference: waste minimization, re-use, materials recycling, biological treatment, thermal treatment with energy recovery, thermal treatment without energy recovery, landfilling [15:153].

The first theoretical research based on practical experience in the field of Integrated and Sustainable Waste Management was conducted during the mid-1980s by WASTE, a Dutch non-governmental organization (NGO), and WASTE's South partner organizations, and further developed by the Collaborative Working Group on Solid Waste Management in Low- and Middle-Income Countries (CWG) in the mid-1990s. The result was the development of a framework/concept that has become a "norm" in waste management practices. The essential concept of integrated sustainable waste management has been developed out of experience to address certain common problems with municipal waste management in low- and middle-income countries, as well as in countries in transition. Therefore, based on the Life-Cycle approach, recognizes three dimensions in analyzing, developing or changing a waste management system: (1) Stakeholders, (2) Waste System Elements and (3) sustainability Aspects [16].

Through the last several years the concept of ISWM and its aspects has been further clarified and is gradually becoming the norm in discussion of solid waste management in developing countries [17, 18, 5, 19, 20, 21, 22, 23]. The ISWM systems combine waste streams, waste collection and treatment and disposal methods, with the objective of achieving environmental benefits, economic optimization and societal acceptability [5]. This approach is also a response to a growing global consensus that cities in developing and transitional countries need to take charge of the modernization process and to develop their own models for waste management

[15]. However, one of the main challenges derived from the analysis has been the usage of various methodologies for data gathering. Moreover, this problem is especially emphasized when the different cities from different countries are compared. In order to solve and minimize those limitations the ISWM benchmarking indicators set was developed [5, 11, 23]. This set allows benchmarking of a city's performance in waste management, allowing consistent comparison of performance between cities either in developing countries or in the developed world and monitoring changes and progress over time. Topic [23] research closely this thematic and develops a Model of Integrative/Sustainable Solid Waste Management.

A model (Figure 1) has been built around the analytical framework of UN-HABITAT benchmarking methodology [5, 11, 14], which is based on the concept of integrated and sustainable (solid) waste management, and around the phase model of [24, 25]. The analytical framework combine relatively standard, quantitative indicators for the three main physical components – collection, treatment/disposal and recycling – with a corresponding, qualitative, composite indicator for the "quality" of service provision for each physical component, as well as five further qualitative, composite indicators which assess performance for the three main aspects of governance, namely inclusivity of stakeholders, financial sustainability and sound institutions & proactive policies. On the other hand the KLAMPFL-PERNOLD et al. phase model [24: 183] allows an indicator-based classification of different countries or regions to determine the stage of waste management development. The classification of the development stage of waste management in a country or a region can be stated by using a few key parameters without large-scale, on-site surveys. The parameters are classified by using an economic, social, legal and ecological perspective. Depending on the waste management phase, certain waste management measures are appropriate and effective.

The ISWM from Topic [23] model is composed of three dimensions representing the sustainability process. In order to achieve sustainability, all dimensions in the model have to be in motion and connected to each other. The first green component represents the environmental dimension of sustainability and focuses on key drivers for the development of waste management, which include the three key physical components: (1) public health, which depends on a good waste collection service; (2) environmental protection achieved by controlled waste treatment and disposal; and (3) resource management ("3 R's" – reduce, reuse, recycle), which leads to a recycling society and recognizes waste management as a source of raw material. The second, blue element characterizes the institutional and social sustainability aspect.

Figure 1. Model of Sustainable Solid Waste Management [23]

To deliver a well-functioning system and to see contributions and benefits, full participation of all relevant stakeholders (both service users and service providers) have to be ensured. This aspect is considered from two perspectives: firstly, the active participation of the users of solid waste services, which describes how these stakeholders are included in the planning, policy formation and implementation processes. Secondly, the provider participation refers to the performance of the system, and the extent to which it serves all users equitably and according to their needs and preferences. The institutional/social component relies not only on effective stakeholder participation but also on the legal framework.

Moreover, it focuses on the implemented legislation and regulation, institutions and legal requirements on the national level and on local institutions and their organizational structures and institutional capacity. The economic aspect is categorized as a special component and presented in red. Sustainability of the solid waste management system relies on the assurance that SWM services and activities are cost-effective and affordable. Moreover, without direct economic benefits, investment and subsidies, the waste management system is not sustainable. To achieve economic sustainability it is necessary to fulfill two different criteria: (1) the macro-economic indicators, which represent the overall economic situation of a country, region or a city and (2) specific economic waste management indicators, which give an overview of sustainability in waste management (e.g. cost accounting, system costs recovered from user fees and payments).

3. RESEARCH METHODOLOGY

The methodological basis for this paper includes an interdisciplinary approach which is based on the knowledge and experiences accumulated from environmental sciences, natural and technical geosciences, informatics, economic sciences and informatics technologies. The waste management data was collected through comprehensive on-site research carried out in RS

through the research project "Waste Management in the Republic of Srpska". The project application was developed in cooperation with the Department of Geography and Regional Sciences (Austria) and the International Association of Scientists "AIS" in Banja Luka (BIH) and co-financed by the Environment Protection and Energy Efficiency Fund of Republika Srpska. The main aim of the project was to conduct systematic and critical research, using structured data collection, of the municipal solid waste management in RS, in order to detect, identify and solve the problems and challenges which this branch of the economy has to face. In addition, the study analyzed the generation, collection, transportation, recycling and disposal options in municipal solid waste management in RS [22: 227]. The main part of the data was collected through questionnaires, delivered to municipalities (62) and waste management companies. The collected data was entered into a computer database and analyzed with the statistical program SPSS. In addition to the questionnaire and the literature review, the waste management data was also collected by conducting several structured interviews with decisions makers, communal enterprises and the civil sector. The interviews were addressed to wide range of active stakeholders within the system. For instance, representatives of the Government (Senior Associate for Waste Management at the Ministry of Spatial Planning, Civil Engineering and Ecology); representatives of local governments; service provider managers (technical directors at regional landfill company Ramici in Banja Luka and in Bijeljina; managers of several communal enterprises; managers of several waste management companies); NGO and CBO representatives and scientific researchers from Bosnia and Herzegovina and Serbia (University of Banja Luka; University of Sarajevo; University of Belgrade; University of Novi Sad; Union University).

Furthermore the methodology used in this paper follows the developed ISWM methodology [23], where the indicators and criteria have been identified, supplemented and designed around the three model components. The Model encompasses seven indicators which are selected according to a series of quantitative and qualitative criteria. The quantitative indicators are based on the original methodology (e.g. analytical framework) which is tested on numerous case studies around the world. For each of the criteria comprising a qualitative indicator, there is a device to allow the very different aspects of performance - each ideally being assessed by its own distinct and traceable criterion - to be combined into one indicator; that way, the resulting overall percentages can be converted back into a qualitative assessment. The model recognizes the five phases of waste management development. Each phase is color-coded using a "traffic light" system, to assist with a rapid visual assessment of the tabulated data. The color red indicates areas of the system requiring immediate observation and reformation.

The level of the environmental sustainability is analyzed by a set of qualitative and quantitative criteria. For instance, quantities criteria cover the percentage of the service coverage in the tested region, either waste collection coverage, controlled waste disposal and treatment or share of the recycled waste. In addition, for each component tested there is the qualitative criterion. Qualitative criterion is composed of several questions measuring each indicator separately, for instance the quality of waste collection, the degree of environmental protection in waste treatment and disposal and evaluation of resource management.

Further, the sustainability processes in solid waste management cannot be achieved without the effective participation of relevant stakeholders and a legal framework. Therefore, the indicator of participation is analyzed from both sides: user and provider participation. The indicator for user participation is measured by the six qualitative criteria for determining the degree of user participation in the solid waste management system. The questions are related

to user involvement in the planning, policy formation, implementation and evaluation of those services, existence of legal rules and regulations which require consultation with and participation of stakeholders outside the institutional structures, existence of user satisfaction measurements, the existence and use of public feedback mechanisms for SWM services, implementation of comprehensive, culturally appropriate public education, behavioral changes and/or awareness raising programs and level of involvement NGOs and CBOs dedicated to conservation and environmental protection. The second indicator is related to provider participation. It again encompasses a set of qualitative criteria measuring the degree to which economic niches in service delivery and recycling are open and accessible to non-state stakeholders and non-municipal service providers from the formal, private, community or "informal" sectors. The second indicator for measuring the institutional sustainability is built on two criteria: (1) adequacy of national frameworks for solid waste management (measures the existence and implementation of the waste management related legislation at national level) and (2) the degree of local institutional coherence (measures the strength of the local institutional capacities).

The level of economic sustainability is identified by two indicators: firstly, by the macro-economic indicators comprising three quantitative economic criteria: (1) gross domestic product (GDP), (2) unemployment rate and (3) inflation rate; secondly, by specific economic waste management indicators analyzed through a bundle of qualitative questions. The second indicator includes information related to investments, subsidies, cost accounting, affordability of user charges and charging policies.

The final result of the model analysis is the assessment profile consisting of a one-page summary of the benchmark indicators and supplementary background data. In addition to the set of indicators, the assessment profile is supplemented by background information (name of the researched region, population and the Human Development Index (HDI)) and by key waste related data (waste generation per year (t/year), waste generation per capita per year (kg/year) and municipal solid waste composition with a focus on main components).

4. RESULTS AND DISCUSSION

Analysis of waste management in a geographical region is a complex task that encompasses comprehensive on-site research and requires measuring a range of various hypotheses. Equally important is the understanding of the mechanisms and factors that currently drive the development of solid waste management. This is a crucial step in moving forward and planning sustainable waste management systems. Therefore, the key for effective waste management analysis is a clear understanding of waste management data, such as data about the volumes, mass and nature of each type of waste produced; the collection and transportation system, and treatments and disposal methods.

Municipal solid waste management (MSWM) presents a significant problem in Republika Srpska. The main challenges are reflected in an inappropriate management of MSWM, insufficient and underdeveloped technology, unfavorable economic situation and the lack of consciousness of the population; all of these have tremendous environmental impacts. In recent years, the governments, from the central to the local levels, have been making strong efforts to improve MSWM. Regulations and policies have been elaborated and adopted; waste management infrastructures are being developed and the improvement and commercialization of the sector has been encouraged [22: 227].

Furthermore, in Republika Srpska there is a significant difference in the development of waste management between municipalities. In order to demonstrate the various levels of development within the entity, two case cities have been selected and closely observed. First, the capital city of Banja Luka is the example of higher development, greater waste collection coverage, and more controlled disposal, etc.; the municipality Šipovo is the opposite example.

The city of Banja Luka is the cultural, political, administrative, economic and financial center of Republika Srpska and the second-largest city in Bosnia and Herzegovina, after Sarajevo. According to the preliminary results of the 2013 Census of Population, Banja Luka has 199,191 inhabitants [26]. The city covers an area of 1 250 km², which is divided administratively into 57 communities [27].

The second observed municipality, Šipovo, is located in southeastern Republika Srpska, with a total area of 510 km² and a population of 10,820. The municipality is situated in the mountainous area intersected in the west-east direction by the Pliva River, whose length is about 30 kilometers, and in the south-north direction by the 35-kilometer-long Janj River [28]. The assessment profiles of solid waste management for these two case studies clearly show the rapid differences in development, illustrated in figure 2. The disparity is identified in every indicator and criteria. The **waste collection** in Banja Luka is carried out by two companies covering approximately 90% of households: the communal enterprise "Čistoća" AD (which covers the urban part of the city and some suburbs) and the private company EKO-EURO TIM (which covers the rest of the suburbs). Waste management services in Šipovo are performed by public communal enterprise "Lisina". As opposed to in Banja Luka, waste collection in Šipovo is mainly oriented toward the urban part of the municipality, with total coverage of 50.23%. The analysis of waste composition is available only for the city of Banja Luka (see Chapter 3). The comparative study of waste collection services' quality confirms the challenges facing all smaller municipalities in Republika Srpska. "Lisina" has two waste collection trucks (production years 1987 and 1992), which, due the poor maintenance and long-term use, are often not in use; this results in accumulation of waste around collection points. As previously emphasized, the waste collection in rural parts of the municipality Šipovo is not performed regularly, which directly results in the creation of wild dumps.

The principal method of **waste disposal** in municipality Šipovo is on an unregulated local landfill. Disposal on the site started in 1983. However, landfilling was not controlled (no depositing of overburden), and therefore the landfill itself is unregulated, unprotected, unfenced and leaves waste in direct contact with the environment. According to the estimations, so far approximately 35,000 tons of various waste (e.g. mixed communal, industrial, bulky, medical, hazardous waste, etc.) has been disposed of at the site. Moreover, the landfill site does not have an environmental permit or any legal permission for the operations, except the decision from the municipal Assembly. Aside from the local landfill, there are a large number of wild dumps (22) within the municipality. As a contrast, disposal of collected waste from Banja Luka is conducted in the regional sanitary landfill "Ramići". The regional sanitary landfill "Ramići" is located in the northwestern part of the city Banja Luka. The landfill site is operated by the public enterprise "DEP-OT" from Banja Luka, which was founded in 2003 with the aim of transforming the existing landfill site into a sanitary landfill. The company was founded by the City of Banja Luka and municipalities of the Banja Luka region – Gradiška, Prnjavor, Laktaši, Srbac, Kotor Varoš, Čelinac and Kneževo. Each municipality has a different founding share: Thus, for example, the City of Banja Luka owns 62.03%, municipality

Gradiška 14%, Prnjavor 10%, and Laktaši 8%, etc. The primary activity of the company is in waste treatment and disposal; however, it also conducts other activities such as waste recycling, remediation of environment – wild dumps remediation, consulting services, and commerce in raw materials. In accordance with the Law on Waste Management and Regulation of waste categories with catalogue landfill, the landfill is classified for non-hazardous waste.

In both researched regions there is no formal or organized system for separating waste. However, the **recycling rate** in Banja Luka is significantly higher. Within the municipality Šipovo there are no recorded formal initiatives for waste recycling; there are only itinerant waste collectors, who are collecting/buying the recyclables from "door to door". Otherwise, in Banja Luka initiatives for the waste recycling are gaining importance. For instance, the few important commercial enterprises are involved in industry; these have recycling yards, collect the recyclables (paper, plastic, metal) from businesses, and prepare and export the materials to neighboring countries. The increased interest in waste recycling in Banja Luka led to the implementation of comprehensive, culturally appropriate public education, behavioral change and several awareness-raising programs (e.g. awareness campaigns by Communal Enterprise, DEPOT, schools, NGOs, etc.).

Legal requirements for public participation and consultation are present in both regions, particularly by siting new facilities (e.g. landfill sites). However, feedback mechanisms to deal with the concerns of service users are only partial. For instance, in Banja Luka the service users have an information hotline for reporting their problems, and they can get information about waste collection frequencies or the other related information on the Internet page of the provider or the city's official portal. The private sector participation in both municipalities is possible, but in Šipovo no formal activity has yet been identified. On the other hand, in Banja Luka, private companies are actively performing all services in waste management. The bid process for the different activities, such as waste collection, street sweeping, and maintenance of green areas, is organized by the city government, and the private sector is included within open and accountable bid processes for the provision of SWM services.
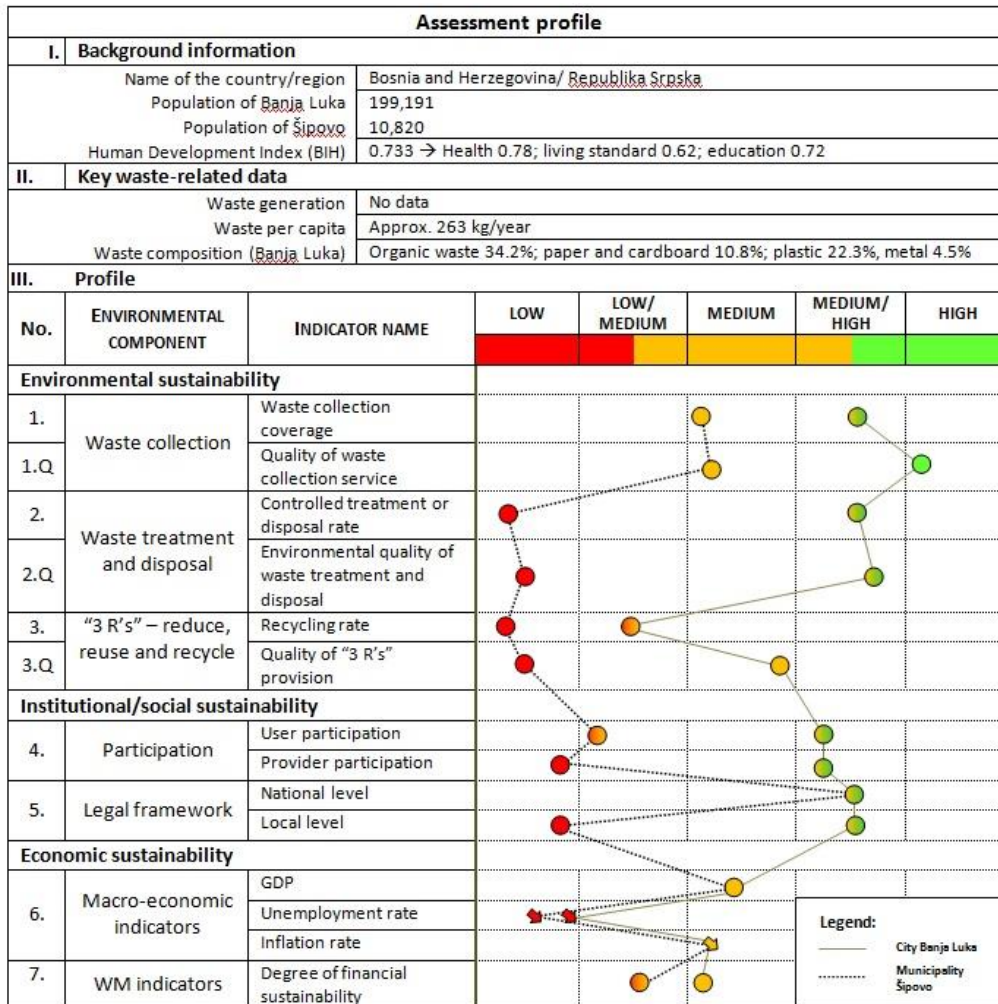
Assessment profile							
I.	**Background information**						
	Name of the country/region	Bosnia and Herzegovina/ Republika Srpska					
	Population of Banja Luka	199,191					
	Population of Šipovo	10,820					
	Human Development Index (BIH)	0.733 → Health 0.78; living standard 0.62; education 0.72					
II.	**Key waste-related data**						
	Waste generation	No data					
	Waste per capita	Approx. 263 kg/year					
	Waste composition (Banja Luka)	Organic waste 34.2%; paper and cardboard 10.8%; plastic 22.3%, metal 4.5%					
III.	**Profile**						

Figure 2. Assessment profile for selected municipalities

The assessment of the **legal framework** at the local level clearly confirms the differences between municipalities and passivity or activity for improvement of waste management. For instance, the Department of Public Utilities, Housing and Traffic and the Department of Communal Police are responsible for the organization and supervision of waste management in Banja Luka. Responsible departments have organizational strength and capacity as well as the legal basis for developing Integrated Solid Waste Management. Several plan documents for both the city and region of Banja Luka have been adopted over the last few years (e.g. Waste Management Plan for the city of Banja Luka, Adoption Plan for Communal Enterprise, Adoption Plan for the sanitary landfill, Local Ecological Action Plan, Program of communal consumption for Banja Luka, City development strategy 2007-2015). Compared with Banja Luka, the municipality Šipovo has significantly lower institutional capacities and slower refers to the waste management development. The analysis has shown an absence of the most basic planning documents (e.g. Waste Management Plan, Adoption Plan for local landfill site, Adoption Plan for the remediation of wild dumps) and waste management data (i.e. absence of data on volume and waste characteristics).

However, regarding **financial sustainability** both regions face challenges. Banja Luka, as a significantly larger municipality, has a higher budget for waste management. For example, the communal enterprise "Čistoća" AD had approximately 9 million KM of operating revenues in 2011, with a total net gain of 139,007 KM. Meanwhile in Šipovo the communal enterprise had operated with 34,523 KM of total net losses from 836,733 KM of operating revenues. Positive financial management in Banja Luka is reflected through further investments: For example, a company is planning construction of a recycling yard, with support of the city. However, in both municipalities the service providers have difficulties with rates of payment, either from households or from business and industry. They manage to collect only two-thirds of their claims. Reasons are various, but the high unemployment rate in both regions is certainly a factor.

5. CONCLUSIONS

The main principle of municipal solid waste management in Republika Srpska, similar to that of most transition and developing countries, consists of three basic stages: (1) local collection from the point of arising, (2) transport from the collection area to the treatment/disposal point(s) and (3) final disposal (or reuse following treatment) of the waste materials. A comparative analysis of two different municipalities identifies and confirms the major challenges in sustainable waste management development in Republika Srpska. The difficult economic situation in the country is a major obstacle to rapid waste management development. The first steps in building a legal framework for environmental protection and waste management have been taken. Adoption of numerous rules and regulations in the country, in accordance with the EU directives, and adoption of procedures for setting up regional sanitary landfills, has facilitated a comprehensive approach to waste management. Despite the non-existent legislation in separate waste collection, there have been some positive improvements in waste recycling, mostly through the initiatives by private waste companies and the informal sector. However, the legal status and organizational structure of waste management companies are very different from municipality to municipality. In addition to the diversity in the ownership structure, a variety of services performed by companies should be noted, such as the distribution of drinking water, sewage and wastewater management, maintenance of municipal hygiene, horticultural production, hazardous waste collection, recycling, maintenance and repair of motor vehicles, funeral-related activities, cemetery maintenance, management and maintenance of the green market, chimney services and managing shelters for stray dogs.

Results of the carried study show clearly, that the smaller municipality (representative of other small municipalities) reacts more passively to the waste management development, which has direct influence on environmental pollution and human health. However, although Banja Luka is in the intermediate state of implementation of its MSW management system – it has reasonable levels of waste collection coverage and controlled disposal – there are still considerable areas that need to be improved (e.g. separate collecting, recycling rate and quality of recycling services, monitoring and effective control, reliable information and financial sustainability).

The final assessment profile clearly illustrates developments at different levels within the researched municipalities, either the "burning" components which have to be improved immediately, or the "green" indicators which are leading the development. Therefore, the application of the ISWM model to solid waste management planning process can be

recommended in order to evaluate the current state of development and to identify the challenges, weaknesses, opportunities and threats for the researched region. The results of the findings can help decision-makers to suggest, justify, propose and implement further strategic frameworks and change the challenges into opportunities.

6. REFERENCES

[1]   G. Tchobanoglous and F. Kreith, *Handbook of Solid Waste Management (2nd Edition)*, McGraw-Hill Professional, 2002.

[2]   L. Guerrero, G. Maas, and W. Hogland, "Solid waste management challenges for cities in developing countries", *Waste Management*, Vol. 33, 2012, pp. 220–232.

[3]   N. G. Turan, S. Çoruh, A. Akdemir and O. N. Ergun, "Municipal solid waste management strategies in Turkey", *Waste Management*, Vol. 29, 2009, pp. 465–469,.

[4]   S. Kumar, J. K. Bhattacharyya, A. N. Vaidya, T. Chkrabarti, S, Devotta, and A. B. Akolkar, "Assessment of the status of municipal solid waste management in metro cities, state capitals, class I cities, and class II towns in India: An insight", *Waste Management*, Vol. 29, 2009, pp. 883–895.

[5]   *Solid waste management in the world's cities, water and sanitation in the world's cities*, London: Earthscan, UN-HABITAT, 2010.

[6]   M. Topić, F. Zimmermann and W. Fischer, "Waste Management Planning: An analysis of the waste management system in Bosnia and Herzegovina", u *Planska i normativna zaštita prostora i životne sredine, Asocijacija prostornih planera Srbije, 7. naučno-stručni skup sa međunarodnim učešćem*, 2013, str. 205–213.

[7]   *Bosnia and Herzegovina – Solid Waste Management Strategy,* Aeo Technology, EU-PHARE, Sarajevo, BH, 2000.

[8]   F. Cherubini, S. Bargigli, and S. Ulgiati, "Life Cycle assessment (LCA) of waste management strategies: Landfilling, sorting plant and incineration", *Waste Management,* vol. 34, 2009, pp. 2116-2123.

[9]   P. Schübeler, K. Wehrle and J. Christen, "*Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries"*, UNDP/UNCHS (Habitat)/World Bank/SDC Collaborative Programme on Municipal Solid Waste management in Low-Income Countries. St. Gallen, Switzerland: SKAT, 1996.

[10]   T. Tedesse, A. Ruijs and F. Hagos, "Household waste disposal in Mekelle city, Northern Ethiopia", *Waste Management,* Vol. 28, 2008, pp. 2003–2012.

[11]   C. D. Wilson, Lj. Rodic, A. Scheinberg, A. V. Costas and G. Alabaster, "Comparative analysis of solid waste management in 20 cities", *Waste Management and Research*, Vol. 30, 2012, pp. 237–254.

[12]   M. N. Sim, C. D. Wilson, A. C. Velis and R. S. SMITH, "Waste management and recycling in the former Soviet Union: the city of Bishkek, Kyrguz Republic (Kyrgyztan)", *Waste Management and Research*, Vol. 31, 2013, pp. 106–125.

[13]   M. Topić, Der Weg zur nahhaltigen Abfallwirtschaft in Bosnien und Herzegowina – aktuelle Entwicklungen und Herausforderungen", GEOGRAZ, Vol. 53, 2013, pp. 16-21.

[14]   C. D. Wilson, A. V. Costas and Lj. Rodic, "Integrated sustainable waste management in developing countries", *Proceedings of the Institution of Civil Engineers, Waste and Resource Management 166*, 2013, pp. 52–68.

[15]   F. McDougall, P. White, M. Franke and P. Hindke, *Integrated solid waste management: a Life Cycle inventory (2nd Edition)*. Oxford: Blackwell Science, 2001.

[16]   A. Klunert and J. Anschutz, *„Integrated Sustainable Waste Management: the Concept: Tools for Decision-makers, experiences from the Urban Waste Expertise Programme (1995-2001)",* Waste, Netherlands, 2001.

[17]   M. Abou Najm and M, El-Fadel, "Computer-based interface for an integrated solid waste management optimization model", *Environmental Modeling & Software*, Vol. 19, 2004, pp. 1151–1164.

[18]   J. K. Seadon, "Integrated waste management – Looking beyond the solid waste horizon", *Waste Management*, Vol. 26, 2006, pp. 1327–1336.

[19]   E. R. Marshall and K. Farahbakhsh, "Systems approaches to integrated solid waste management in developing countries", *Waste Management*, Vol. 33, 2013, pp. 988–1003.

[20]   S. N. Othman, Z. Z. Noor, H. A. Abba, O. R. Yusuf, and M. A. A. Hassan, "Review on Life Cycle assessment of integrated solid waste management in some Asian countries", *Journal of Cleaner Production*, Vol. 41, 2013, str. 251–262.

[21]   C. D. Wilson, Lj. Rodic, J. M. Cowing, A. Whiteman, J. Stretz and A. Scheiberg, "Benchmark Indicators for Integrated & Sustainable Waste Management (ISWM)" presented at the ISWA World Congress 2013, Vienna, Austria, 2013.

[22]   M. Topić, Lj. Preradović, M. Stanković, F. Zimmermann, W. Fischer, G. Preradović, D. Pešević and D. Topić, "Upravljanje otpadom u Republici Srpskoj: Analiza postojećeg stanja sa posebnim osvrtom na komunalna preduzeća", Međunarodno udruženje naučnih radnika AIS; Institut za geografiju i regionalno istraživanje, Banja Luka, 2013.

[23]   M. Topić. "Waste Management in Republika Srpska – Strategies and Measurements for Future Waste Collection, Treatment, Recycling and Prevention". Doctoral Thesis, University of Graz, Austria, 2014.

[24]   H. Klampfl-Pernold, U. Gelbmann, C. Abl, R. Pomberger and G. Schmidt, *Quantensprünge in der Abfallwirtschaft: Entwicklung eines innovationsorientierten Phasenmodells der europäischen Abfallwirtschaft*. Shaker Verlag, 2006.

[25]   H. Klampfl-Pernold, G. Schmidt and M. Heihl, "Ist die Abfallwirtschaft (noch) am Ende", presented at the DepoTech 2012 Tagungsband für 11 DepoTech-Konferenz, Leoben, Austria, 2012.

[26]   *Preliminary Results of the 2013 Census of Population, Households and Dwellings in Bosnia and Herzegovina; First release*, Agency for Statistics of Bosnia And Herzegovina, Sarajevo 2013.

[27]   *Sistem upravljanja komunalnim čvrstim otpadom u Gradu Banjoj Luci,* Urbanistički Zavod Republike Srpske, Banja Luka, 2002.

[28]   *LEAP – Lokalni akcioni plan zaštite životne sredine Opštine Šipovo 2012–2018*, Opština Šipovo, BH, 2012.