Integration of significant social aspects in waste management system of the Republic of Serbia

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Abstract

Inadequate waste management is one of the biggest environmental problems in the Republic of Serbia. In the hierarchy of waste management, landfills still represents the most usual solution. The waste is deposited mainly on municipal unsanitary landfills, witch does not fulfill the technical requirements. Althoug the reuse rate of recyclebles increases over last few years, current level is is insufficient. This situation, among other, is the consequence of undeveloped attitude of the society towards waste and lack of understanding. The lack of awareness, irrational menagement with high costs, poor quality of service and not enough care for the environment are the result of poor images in waste management system organization. All those problems that follows a society that is going through too long process of transition are reflected in policy of waste management. This paper considers perception and understanding of social issues. Special attention was given to the new policy for the development of public awareness on waste management at the local level and importance of public participation in the decision making process. Basic concepts were considered: legal framework for enabling sustainable solid waste management; public perception; corruption; problem of redundant workers. Analysis results on the waste management social indicator and its corresponding sub-indicator categories were integrated via the decision-making process supported by Analytic hierarchy process (AHP). The final results imply that the maximum importance was assigned to the Public awareness and perception.

Keywords: waste management, social criterion, sub-criteria, AHP tool

Introduction

A great number of research results indicates that the amounts of the municipal waste generated on the national level could be specified on the basis of the socio-economic development of a particular country. In favor to previouse statement underdeveloped countries generate between 0,6 and 1,0 kgof the municipal waste per capita per day, developed countries between 0,8 and 1,5 kg, while the amount of waste produced by the population of the most developed countries spans from 1,1kg up to 4,5kg per day [15]. The waste generation is to a great extent influenced by the socio-economic characteristics of a particular country, meaning purchasing power of the citizens and their overall consumption. At the same time, waste generation is connected to people's attitude to waste: their way of use of materials, and waste managing, their interest in waste reduction and minimization, level to which they separate waste and dump it illegally [6].

The one of the most significant environmental issues in Serbia is inadequate solid waste management. Furthermore, the laws and national strategies in Serbia related to the waste management are in accordance with the EU directive but didn`t applied in practice. Also, the citizens are not familiar with the national laws of waste management. Local officials are turning toward larger issues than of communication with the citizens. Most of them are convinced that much more important is to achieve something visible, what can be used for promotion in the next campaign, rather than to spend time on communication activities, which are used for rising public awareness on waste management issue. Current state is primarily due to undeveloped standpoint of the society towards waste, hence lack of understanding of importance of waste management and lack of understanding of the positive effects of this process.

Unstable and underdeveloped democracy in Republic of Serbia is characterized by: high unemployment rate, low average household income, uncompetitive economy, high level of corruption, low level of unionization, reclassification of labor force, cheap and unprotected labour force, etc. In many countries, especially in those with undeveloped legal mechanisms, failure to resolve the problem of waste is justified by the NIMBY effects (Not in My Back Yard) [5]. Citizens do not feel and do not perceive the problem of waste management as their own, but as someone else's. Consequently, someone else is always responsible for resolution of that problem, either state, local government, industry or a neighbour [1]. In Serbia, interest of the public for direct participation in the design and implementation of environmental policy is declining, which is accompanied by a general apathy related to active and responsible participation in politics in general. Over last few decades, existence, social problems and health care are the most concerning issues regarding the citizens of Serbia. People are realizing that the environmental issues will not come to the agenda until all "more important" issues are resolved. On the other hand, citizens in, in whose vicinity, the pollution

is so high that it literally became a tangible problem, have a slightly clearer awareness of the dangers resulting from the improper disposal of waste. Also, the level of corruption remains very much present in the public. Moreover, Serbian citizens consider corruption as one of most significant problem facing their country, after unemployment. Most of the them attempting to apply for a job in the public sector. The large percentage of them admits giving money, giving a gift or doing a favor in order to be hired.

This paper presents a developed AHP method for evaluation of level of social acceptance of waste management. The goal of this paper is to define and rank by importance key social sub-criteria categories that are the most influential on waste management sector. The significance of the identification and rating is evident when it comes to defining the ways of solving and neutralising the negative sub-criteria that would lead to faster and more sustainable development of solid waste management system.

Method

Thomas Lorie Saaty (1977) in his book identifies different indicators which are the most important for some sectors. Among indicators, which have influence on waste management [3, 12, 14], social key sub-indicator categories that influence of waste management sector can be defined as:

1. Public awareness and perception (S1);
2. Education and the public willingness to accept innovations (S2);
3. The level of persistence of stakeholders (S3);
4. The level of corruption (S4);
5. The contribution of the informal sector (S5).

Research and the collection of data were based on the results from questionnaires developed for decision makers (DM), as well as views and opinions on the relevance of the criterion and their associated sub-criteria. The questionnaire is composed of a few basic elements: an introduction, questions and instructions for the respondents. Considering that evaluated social sub-criteria are predetermined, the respondents were supposed to express only importance preferences.

Decision makers could be a certain group of people or an individual [10, 4]. One of the questions that arises is who are the interested parties are and why should they participate in the decision making process. In order to obtain an answer, the analysis of decision-makers is performed. Furthermore, a list of all the stakeholders who have a role in solution creation is made, i.e. the decision making on the optimal solution of the waste management problem in Republic of Serbia and others countries in the region. Analysis of decision-makers begins by identifying all the stakeholders who are in any manner related to the problem. Many stakeholders are involved in the waste management and good communication between them is the key to a good system.

A decision maker, by using the AHP method, evaluates the sub-criteria based on their own experience and judgment [8]. However, decision-makers need to consider not only what experts know but also what the public thinks and feels.

As for the relevance of the Analytic Hierarchy Process (AHP), it is enough to say that the method was studied in detail and further developed through a number of scientific researches on prestigious international universities. A wide range of applications of the AHP method is suffice evidence that, recently, the AHP method is one of the most popular and most widely used method for multi-criteria decision-making process that is used for solving real problems. Many researchers and practitioners have indicated the strengths of AHP method as system that support decision-making, e.g. Karlsson (1998) and Narasimhan (1983). Table 1 provides an overview of all published work in the past few years of AHP method dealing with waste management problems.

Table 1. A literature review on the use of AHP method in waste management problems [2].

	Authors and year	Subject
Municipal solid waste sector	Tavares et al, 2011	Location of MSW facility
	De Feo and De Gisi,2010	Location of landfill site
	Garfì et al., 2009	Waste management strategy
	Wang et al,2009	Location of landfill site
	Contreras et al.,2008	Waste management strategy
	Önüt and Soner,2008	Location of transhipment site
	Su et al., 2007	Waste management strategy

By using the AHP method, criteria evaluation related to the social criterion was made based on the pair-wise comparison. Sub-criteria are evaluated based on the relevance to the social criterion. Comparison of sub-criteria was conducted based on their performance. Towards this scale, available values with pairs of comparisons are members of

the set: {9, 7, 5, 4, 3, 1, 1/3, 1/5, 1/7, 1/9} (table 2). An intermediate numerical values 2, 4, 6, 8 and 1/2, 1/4, 1/6, 1/8 were not used in this research.

Table 2. Fundament a ratio scale for pair wise comparisons in AHP [13].

Judgment term	**Numerical term**
Absolute preference (of element in row over element in column)	9
Very strong preference	7
Strong preference	5
Weak preference	3
Indifference	1
Weak preference (of element in column over element in row)	1/3
Strong preference	1/5
Very strong preference	1/7
Absolute preference	1/9
An intermediate numerical values 2,4,6,8 and 1/2,1/4,1/6,1/8 can be used as	

Results and discussion

The results of analysis will help to identify mostly important social sub-criteria of development of waste management systems. Due to AHP method requirements, social criterion is classified in five sub-criteria in which way the decision problem hierarchy is formed. Selected Decision Makers (DM1- one official in charge of the waste management in private company, DM2 - one research, faculty members of the University of Novi Sad, DM3 - one waste management expert and DM4 - one official in charge of the waste management in public company) evaluated the hierarchy in compliance with AHP obtaining thus the individual sub-criteria values.

Table 3. Social sub-criteria vs. Goal, decision matrix (DM1-DM4)

DM1

	S1	S2	S3	S4	S5	***w***	***Rank***
S1		5	1	1	7	0.300	2
S2			1/3	1/7	3	0.075	4
S3				1	5	0.255	3
S4					7	0.329	1
S5						0.040	5

DM2

	S1	S2	S3	S4	S5	***w***	***Rank***
S1		3	5	7	9	0.513	1
S2			3	5	7	0.261	2
S3				3	5	0.129	3
S4					3	0.063	4
S5						0.033	5

DM3

	S1	S2	S3	S4	S5	***w***	***Rank***
S1		5	1/5	1	7	0.219	2
S2			1/5	1/3	1	0.059	4
S3				3	5	0.498	1
S4					3	0.168	3
S5						0.056	5

DM4

	S1	S2	S3	S4	S5	***w***	***Rank***
S1		1	3	1/7	1	0.116	2
S2			3	1/7	1	0.116	2
S3				1/7	1	0.062	4
S4					5	0.607	1
S5						0.099	3

Abbreviations: *w* – weight; S1- Public awareness and perception; S2- Education and the public willingness to accept innovations; S3- The level of persistence of stakeholders; S4- The level of corruption; S5- The contribution of the informal sector.

Table 4. Individual consistency of all DMs

	DM1	DM2	DM3	DM4
CR	0.03	0.05	0.08	0.05

Table 3 includes the priority vectors (weights (*w*)) of social sub-criteria in relation to goal of all four DMs. All DMs were consistent (Table 4). Consistency Ratio (CR) is taken with the aim of gaining insight into whether and to which extent DMs deviated from the allowed level of consistency. If CR is larger than 0.10 (Saaty suggests > 0.10), then decision maker should return and revise (or modify) the comparisons in order to improve their own consistency [11].

The results presented in the Table 3 indicate that the two of DMs assigned the maximum weight to the sub-criterion the The Level of Corruption (DO1 (0.329), DO4 (0.607)). The Perception of public awareness in addition to another sub-criterion, the Implementation of education on the necessity of waste management, were, according to DM4, considered equally significant, carrying the weight of 0.116. In the opinion of DM2, the Perception of public awareness was assigned weights (0.513) occupying the first place. DM3 allotted the utmost importance to the sub-driver the Level of

persistence of stakeholders (0.498), while the Perception of Public Awareness was assigned the weight of 0.219 and considered second-rate. Three of DMs The contribution of the informal sector were considered the least important.

Table 4. Final Ranking of all DMs

	DM1	DM2	DM3	DM4	Number of points	**Final Rank**
S1	2	1	2	2	7	**1**
S2	4	2	4	2	12	**4**
S3	3	3	1	4	11	**3**
S4	1	4	3	1	9	**2**
S5	5	5	5	3	18	**5**

Final classification – ranking of sub-criteria of waste management system

Table 4 refers to the performance rating of each sub-criteria scenario per criterion. The sub-criterion ranked in the first place has the most influence on waste management. The results in the Table 3 imply that the maximum importance was assigned to the Public awareness and perception. The level of corruption has taken the second place according to all DMs. The level of persistence of stakeholders was considered thirdly, while the The contribution of the informal sector was considered the least important.

Conclusions

The competent authorities do not react in an effective way when it comes to the initiatives for substitution of regulations. Long-term strategy of Republic of Serbia in the area of environment protection shall mean the improvement of population's living quality by providing desirable conditions of environment and conservation of nature based on sustainable environment and waste management. Key steps shall include strengthening of the existing and development of new measures for establishment of integrated waste management system, further integration of environmental policy into other sector policies, acceptance of extended individual responsibility for environment and more active participation of public in decision making processes. In order to raise the awareness of the local population in the targeted municipalities, the strategy and the methods to communicate with the citizens must be developed in a way to provide efficient results.

If you start from the weakest link it could accelerate the achievement of the objectives in the field of waste management for the longer time period. Due to the above, it is suggested to take the initiative for the adoption of the new strategies that will focus on solving problems defined by sub-criterion the Public awareness and perception. Raising public awareness is one of the key segments of the policy on the waste management. In order to raise the awareness and to increase the level of the citizens' participation in the decision making processes it is necessary toencourage and to promote a variety of practical options that have the best chances to become sustainable and easy replicable without donor's or external support and intervention. The results obtained can be used for ranking of waste management criteria in the sustainability assessment.

For future research in Waste Management scope, it is suggested to put other variables into consideration in order to develop a better measurement criteria, that finally can be expected to be an alternative concept.

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