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Waste Management – Approaches, strategies and differences between Romania and Norway

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Abstract: An important aspect of environmental protection is represented by the strategies and approaches regarding waste deposits. European Union has established standards and regulations of waste management and deposits. In some cases those orders can be taken into consideration with all the aspects but there are some deposits which have been rehabilitated from the ecological point of view in the past. For those areas, all the effects of waste upon the environment and population are important to be understood. In the actual context of climate changes more frequent and powerful natural disasters are expected, thus leading to an increased amount of disasters-related to waste. Another important aspect is that the Cities which are an important area of Earth's surface material, energy, and information exchanging; also represent the central focus in national, regional political, economic, scientific and cultural aspects. With the rapid economic development, city is suffering from a series of serious problems such as air pollution, solid waste pollution, vegetation reduction, deterioration of water quality and living environment. According to latest predictions, 4.9 billion people, or 60% of the world's population is expected to move in urban places by 2030. The studies and analysis show significant differences in urban population. Those studies showed that there is a huge discrepancy between the changes in developed regions and the less developed regions.

This paper will make an analysis of Norwegian vs. Romanian approaches in managing both differences and strategies by the 2 states as regards waste. Another purpose of the paper is to understand the policy of Norway government in order to propose new methods and studies for waste deposits that are important to be taken into consideration by the authorities.

Keywords: waste management, GIS, Norway, Romania

1. INTRODUCTION

City is the important area of earth's surface material, energy, and information exchanging; also it is the centre in national, regional political, economic, scientific and cultural aspects. A mere 10% of the global population were urban dwellers in 1900, but that percentage exceeds 50% now [1]. With the rapid economic development, city is suffering from a series of serious problems such as air pollution, solid waste pollution, vegetation reduction, deterioration of water quality and living environment. According to latest predictions, 4.9 billion people, or 60% of the world's population, is expected to move in urban locations by 2030. The studies and analysis show significant differences in urban population [2]. Those studies showed that there is a huge discrepancy between the changes in developed regions and the less developed regions. In this context waste management is a global environmental issue which is in the attention both scientists and local and governmental authorities, in order that is a very significant problem in the world today.

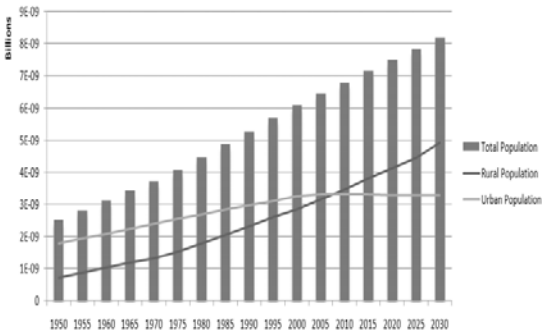

Figure 1. Population increase

Increase in population (Figure 1) and relative wealth has led to a greater demand for food. Population growth is estimated to continue at a slowing rate until about 2100 and peak at about 10.1 billion. It is projected that agriculture can supply enough food for the growing population, but at a cost to the environment [3]. In the future, we will need to increase agricultural production without increasing and ideally decreasing environmental impacts. Furthermore, in the future, farmland will need to serve multiple purposes, such as carbon storage in addition to food production [4].

Although very developed, some cities still dispose of a considerable amount of waste

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without proper segregation, which has led to both economic and environment depreciation. Direct disposal of waste is responsible for environmental degradation, health hazards and economic descend. Following the principle that it is better to prevent than to allot funds after degradation, because it is more expensive and inconvenient, when it comes to waste, it is better to segregate it at the initial stages where it is generated, rather than going for the second option. Proper waste management by means of analysis of the waste situation of the area should be carefully considered and planned.

The paper describes the actions and the objective of a bilateral programme Romania-Norway that sustain the reduction of economic and social disparities within the European Economic area respectively, reinforcing cooperation between the scientific communities from Romania and Norway in the field of research. Thus, the results of this application can be seen as a transfer of innovation from a more experienced country in the field of waste management to a country with a lower expertise. The Consortium was formed due to the major requirements in identifying effective methods to respond to the negative impact of waste management on the adjacent areas for a more efficient use of these waste products with minimum impact on the environment in terms of climate change. Partners in Norway have a wide expertise in waste management, expertise that will be transferred in Romania

The actual EU recommendations and directives have as principal aim to set a course of action for Member States without prescribing the means. Also, Member States have to decide on how to transpose these into national legislation and if they fail the Commission must initiate legal action in the European Court of Justice. In this context, citizens can invoke the directive in cases before their national court of law if a specific EU directive is not adopted into national legislation, or if its adoption is incompletely or late [5].

In order to comply with EU legislation and standards for waste management, Romanian authorities have transposed the policies into Romanian legislation and the transition periods for full compliance are: temporary storage of hazardous industrial waste – 2009, non-hazardous industrial waste – 2013, municipal landfills – 2017. Another task for the Romanian authorities that has been realized before 2015 was to close 150 old municipal landfills and 1,500 illegal dumpsites, and establish 30 national integrated solid waste management (SWM) systems. Regarding the manner in which this task was completed, in the urban environment around 90% of the residents benefit from solid waste management services, but only 6.5% of the rural population have access to such organized services.

European Union (EU) policies represent key drivers of solid waste management policies in the Members States and the allocation of substantial grant funding for implementation of such policies is of particular relevance in the new Member States, candidate countries, and potential candidates. The European Commission is charged with the task to set clear environmental targets and standards for Member States and to monitor that they adopt and enforce EU directives. In order to comply with the EU waste management policy, long-term systematic approaches, including investing in a regional system for waste collection, recycling, and disposal, and closure of non-compliant waste disposal sites and incinerators have to be developed.

Related to solid waste management issue, Romania has made significant progress, but challenges remain; primarily weak capacity to implement and manage projects [6]. The economy develops proportionally with the consumption's expanding, waste volumes grow steadily but landfill expansion has not kept pace. Unfortunately, rural areas lack adequate solid waste management infrastructure, and even where infrastructure exists, success has been elusive. In 2010 less than 5.0 percent of waste was recycled, so reaching a waste recycling target of 55 percent by 2013 was not accomplished, leading to the conclusion that household recycling adoption rates have been low even in the largest urban centres. Therefore, comprehensive public awareness and communication efforts in addition to improvements in infrastructure are required [5].

2. AIMS AND ACTIVITIES: NORWAY AND ROMANIAN APROACHES

The impact of climate change by increasing the intensity and frequency of rainfall will worsen the effects of natural disasters. Predicted effects of these adverse events include damage to waste management related infrastructure resulting in increasing the risk of environment contamination, ecologic catastrophes, and major risk of living conditions degradation in human settlements. Thus, reducing the impact on the waste management sector as a result of these events related to climate change is therefore a priority.

Waste deposits have significant potential for long-term pollution due to the slow degradation of biodegradable content and insufficient washing of leachate through content material. The current infrastructure is so vulnerable to floods and water scarcity (translated here by the risk of fires, which might result in contamination of the air) given the incidence of extreme weather events. The impact must be well understood, appropriate measures are needed to ensure that waste deposits resistance at such events is adequate. Even waste landfills with levels of protection against floods are likely to be flooded before the decomposition of hazardous materials. Because these landfills are located predominantly in the lowland near residential areas, the risk is ongoing thus policies and strategies should be adopted to be effective in alleviating it. The impact on people, property, livelihoods, heritage and the environment of natural and human-caused disasters has grown in Europe over the last ten years [7]. While the increased vulnerability of our societies to disaster is partly the result of inappropriate urban planning, more intensive land use, environment degradation and insufficient preparedness, climate change seems to be causing a rise in the frequency and intensity of

extreme weather events resulting in more drought, heat waves, wild land fires, storms, floods and coastal catastrophic events.

Inadequate waste management facilitate climate change and atmospheric pollution and directly affects many species and ecosystems.

Landfills, considered being last resort method in the hierarchy concerning the landfill releases methane gas, a very strong greenhouse, which is associated with climate change. Methane is formed by the micro-organisms present in landfills because of biodegradable waste such as food, paper and waste grounds. Depending on how they are built, landfill sites could also contaminate soil and water. After being collected, wastes are transported and treated. In the process of transportation, carbon dioxide – the most prevalent greenhouse gas – and air pollutants, including particulates are released into the atmosphere.

Part of the waste could be recycled or incinerated. Energy from waste can be used for heat or electricity production, which could replace the energy produced by using coal or other fuels. Recovery of waste for energy production could thus contribute to reducing emissions of greenhouse gases.

Waste can pose a problem or a resource just depending on how we manage them.

Responsibility for waste management activities lays on waste producers, according to the principle "polluter pays" or, where appropriate, according to the principle "producer's responsibility". Local public administration authorities play an especially important role in ensuring implementation at local level of waste management obligations assumed by Romania by the Treaty of Accession to the European Union. (ratified by Law no. 157/2005, published in Official Monitor no. 465/1.06.2005).

Referring to the Waste Management in Romania, there is a strategy in this domain developed in 2003, and published in early 2004. This strategy was developed in accordance with of European legislation in the field of waste management and following the provisions of the Emergency Government Ordinance no.78/2000 on the regime of waste, approved in 2001. The strategy was intended to cover the period 2003-2013, and was set to be subject to periodical revisions (Romania, 2004). The strategy is based on the principle of protection of primary resources including the environment, the prevention principle, 'the polluter pays' principle correlated with the principles of producer and user responsibility, the substitution principle, and the principle of proximity correlated with the principle of autonomy. In this context the responsibility for the collection and management of municipal solid waste belongs to the municipalities and public authorities [8].

Another important aspect to take into consideration is that: according to Law 211/2011 the waste may be:

- hazardous waste such as: explosive, oxidising, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, mutagenic, sensitizing, toxic for reproduction, ecotoxicity;
- not dangerous such as: biodegradable waste, packaging waste, household waste;

The law obliges to individually classification of the waste and GD 856/2002 stipulate the contents and a list of waste and for each waste type is assigned a code of 6 digits.

Norway generated 11.9 million tonnes of waste in 2014. This was an increase of 7 per cent from the year before. Since 1995, the total waste volume in Norway has increased by 60 per cent. Household waste comprises an increasingly bigger share of the total waste amount. In 2014 households generated 20 per cent of all waste in Norway [9].

In this context, the recovery rate for non-hazardous waste reached 80 per cent in 2014. Material recovery and incineration with energy recovery are the most common treatments as it is presented in Figure 2.

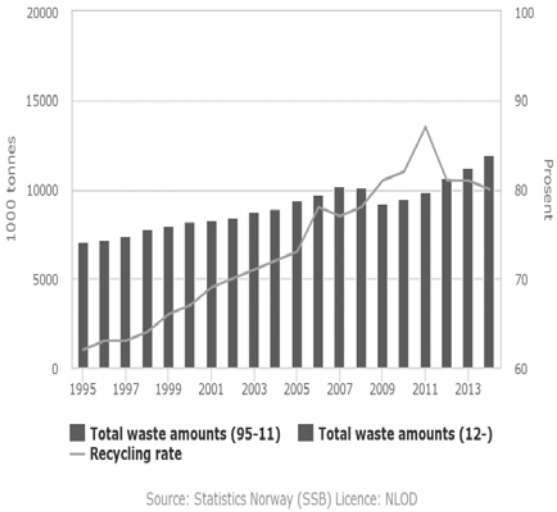

Figure 2. Total waste amount and recycling rate

Regarding Romania, a report from the European Environment Agency released in early 2015 shows that our country was situated almost last for the recovery of packaging waste and electronic transactions even before becoming a member of the European Union. Recycling rate was declared in 2004 by only about 1% of the total garbage produced by the population. The level of separate collection improved poorly thereafter, reaching only 3% in 2012, the last year for which Eurostat data concerning municipal waste is available. Consequently, 97% of the waste produced by the population reaches the garbage dumps of towns, because they are too filthy to be reused. "Recovery of waste from the garbage can be done in a proportion not exceeding 2-3%, but even these percentages represent material of poor quality, with a high degree of contamination", Constantin Damov, co-founder of Green Group, holding company specialized in recycling explained, for "Romania Libera" newspaper.

Referring to EUROSAT prediction of quantities of waste in the year 2014 in thousands of tones, Romania in situated on third place in Europe (Figure 3) [10].

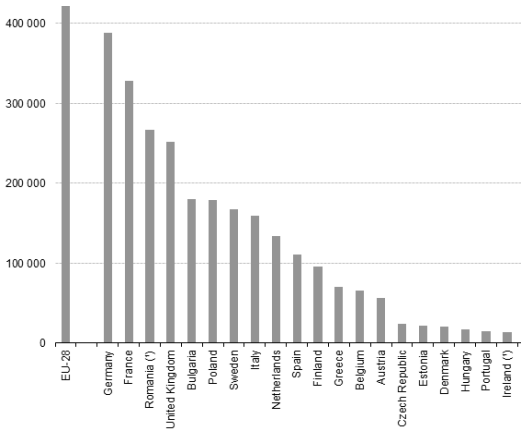

Figure 3. Total waste in Europe according to EUROSAT

A Geographic Information System, or GIS, is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyse, and display all forms of geographically referenced information [11]. Or, in simple terms: a computer system capable of holding and using data describing places on the earth's surface (Figure 4).

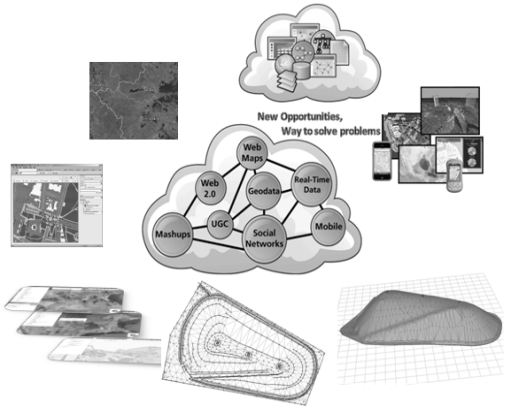

Figure 4. The major components and layers of a Waste Management component in GIS

The four major components of a GIS according to Figure 4 are encoding, management, analysis and reporting, have specific considerations for waste deposits:

Encoding. Deals with issues concerning the representation of a waste management system and its spatial components. To be of use in a GIS, a transport network must be correctly encoded, implying a functional topology composed of nodes and links. Other elements relevant to waste management, namely qualitative and quantitative data, must also be encoded and associated with their respective spatial elements. For instance, an encoded road segment can have data related to its width, number of lanes, direction, peak hour traffic, etc.

Management. The encoded information often is stored in a database and can be organized along spatial (by region, country, census units etc.), thematic (for highway, transit, railway, terminals etc.) or temporal (by year, month, week etc.) considerations. It is important to design a GIS database that organizes a large amount of heterogeneous data in an integrated and seamless environment such that the data can be easily accessed to support various waste management application needs.

Analysis. Considers the wide array of tools and methodologies available for waste management issues. They can range from a simple query over an element of a waste management system (what is the peak hour traffic of a road segment?) to a complex model investigating the relationships between its elements (if a new road segment was added, what would be the impacts on traffic and future land use developments?).

Reporting. A GIS would not be complete without all its visualization and data reporting capabilities for both spatial [12] and non-spatial data. This component is particularly important as it offers interactive tools to convey complex information in a map format. A GIS-WM (GIS for waste management) thus becomes a useful tool to inform people who otherwise may not be able to visualize the hidden patterns and relationships embedded in the datasets (potential relationships among traffic accidents, highway geometry, pavement condition, and terrain).

The great appeal of GIS stems from their ability to integrate great quantities of information about the environment and to provide a powerful repertoire of analytical tools to explore this data. The example below (Figure 5) displays only a few map layers pertaining to urban transportation planning.

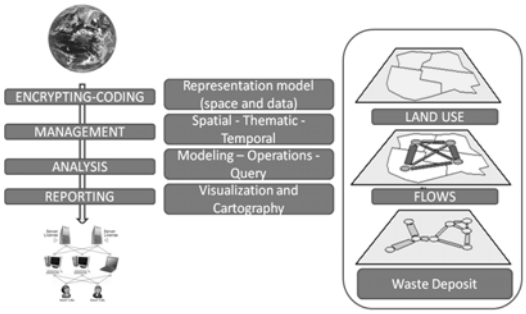

Figure 5. Components and layers of a GIS

The layers included would be very different if their application involved modelling the habitat of an endangered species or the environmental consequences of leakage from a hazardous materials site [13].

3. CREATING 3D MODELS OF LANDFILLS IN ROMANIA

In order to understand the amount and the manner in which waste affects the environment is necessary to find out the real quantity of waste deposits. There are several methods for data collecting on field, namely: using total stations, GNSS technology, Terrestrial Laser Scanning technology, photogrammetry or Remote Sensing.

By processing the data collected using one of the above mentioned technologies, surfaces and volumes

with different accuracy or different types of digital models can be obtained. In the following figures landfills digital models can be observed:

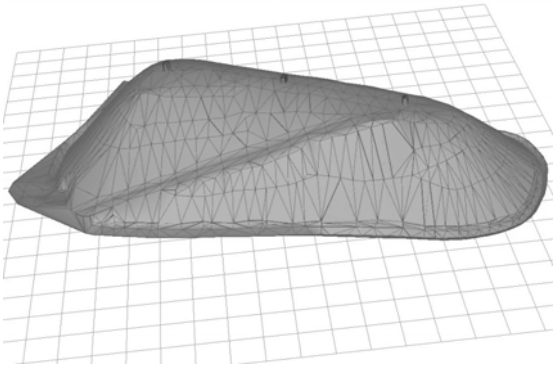

Figure 6. Visualization of the Făget landfill digital model

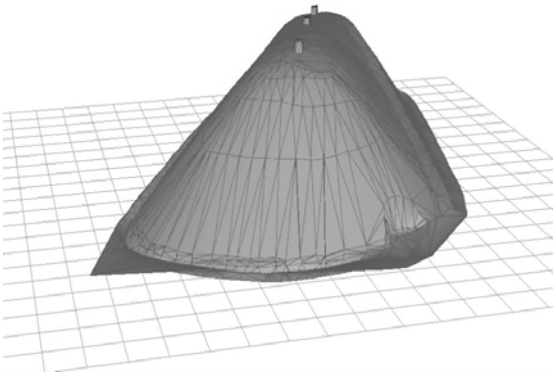

Figure 7. Wireframe of the Făget landfill

Figure 8. Făget landfill

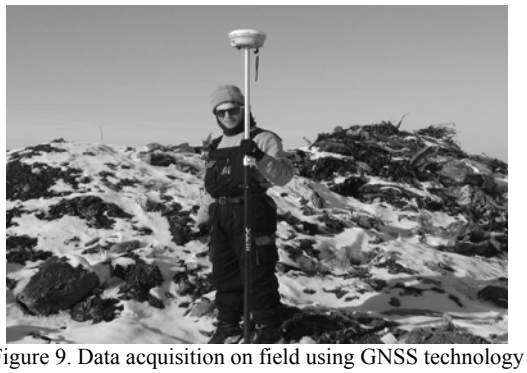

Figure 9. Data acquisition on field using GNSS technology

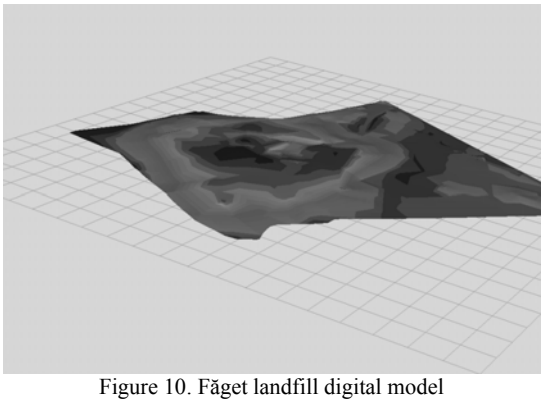

Figure 10. Făget landfill digital model

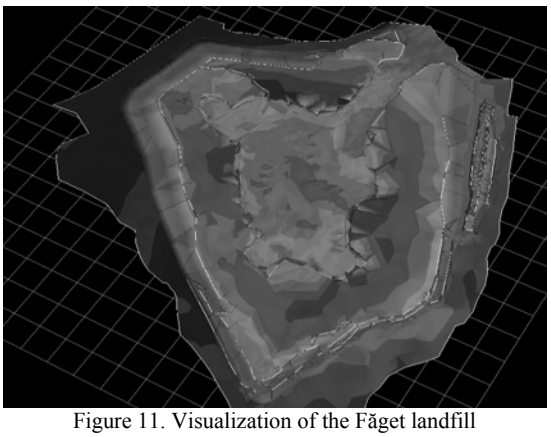

Figure 11. Visualization of the Făget landfill

In Romania, the organisation, collection, transport and treatment of urban waste is under the responsibility of the local public administration, which then decides to either place it under their own management or outsource to private operators. There are approximately 500 authorised operators for waste management services, with the largest 10 holding more than 80 % of the market share. In this case in order to improve the situation, a number of objectives have been set for the years ahead, while several measures for their fulfilment have already been undertaken.

4. CONCLUSIONS

A lesson learned from the Norway approach is that a potential solution in social and environmental sustainability in municipal solid waste management is to combine community-based recycling and sound landfill management strategies.

Regulating the flow of waste pickers into the landfill has advantages like improved income and security.

As regards the optimal strategy for managing 3D waste landfills, that would be by integrating them into GIS. The requirements imposed by EU solid waste management policies can be easily fulfilled by keeping the waste landfills database up to date and effective. GIS facilitates the possibility to have data structures and management software designed for easy updating, both by specialized engineers working directly on data structure with no need for a particular interface, and by public agencies employees, which

do have analytic and management skills, but lack those needed for the management of the digital data base.

Implementing a management system like the one proposed by the authors offers advantages at multiple levels. One of the major advantages of the analysis carried out by means of a specialised GIS software is the ability to easily change the model and to investigate the alternatives. GIS technology is also characterized by the following advantages:

- improving the quality of services;
- the ability of the maintenance and update of data;
- control of data quality and operations;
- automatic verification of compliance with the restrictions, rules and norms in using the data;
- eliminate functional duplication of data;
- an opportunity to respond in real time in case of emergency events;
- rapid recovery of data.

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