

Electronic Model of Waste Treatment Scheme

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Abstract: The researchers developed an electronic model of waste management scheme for the Belgorod region territory which allows to carry out a comprehensive visualized spatial analysis, the evaluation and the forecasting of education, placement and movement of various types of waste within the region territory. This model is the component of waste treatment territorial scheme and the information basis for the management decision development to prevent and reduce the negative impact of waste on human health and environment.

Key words: Electronic model, database, electronic maps, geographic information systems, waste treatment scheme, municipal solid waste

INTRODUCTION

One of the major sources of air pollution are the production and consumption waste in particular, Municipal Solid Waste (MSW), industrial, construction and agricultural waste (Chernyaeva, 2013; Magomet and Mironenkova, 2015; Kurylenko *et al.*, 2012; Oribe-Garcia *et al.*, 2015).

The analysis of existing waste treatment systems and the main directions of their development (for example, Starostina *et al.*, 2015; Sanjeevi and Shahabudeen, 2015; Vadoudi *et al.*, 2015; Pantini *et al.*, 2015; Shmarin *et al.*, 2012) is the basis for the formation of regional waste management schemes which in its turn determine the main directions for the formation of programs and research in the field of waste management to reduce its volume and the degree of negative impact on the natural components and population health. In this aspect, an electronic model of waste treatment scheme is one of the major constituents for the territorial scheme which includes the algorithms for the organization and the implementation of activities in respect of collection, transportation, processing, recycling, disposal, the placement of waste, the appropriate DataBases (DB); providing input, processing, analysis and presentation of data procedures, a comprehensive visualized analysis as well as the opportunity to assess the implementation of scenarios for the waste management system development.

MAIN PART

The researchers set the task to develop an electronic model of waste treatment scheme on the territory of the

Belgorod region, providing an opportunity a current system assessment as well as the prediction of its development with the visualization of assessment and prediction results on the respective electronic maps.

A complex analysis was performed (Ivashchuk *et al.*, 2016) concerning the characteristics of waste sources (location, types of waste, hazard class, amount); collection, transportation, processing, recycling, disposal, waste placement facilities; waste traffic patterns; the balance of quantitative waste characteristics. On this basis the main problems of the existing waste management system are revealed, the databases were developed containing an accumulated array of statistical data.

Using the tools of spatial analysis the created databases allow to create the necessary electronic cartographic materials for the submission of the following analysis: the distribution of MSW volume, industrial, agricultural and medical waste on the territory of the region; the placement of waste on the region territory; the distribution of gathering, processing, recycling and waste disposal places; the peculiarities of waste movement existing scheme through the territory of the region. The result of this analysis is the scientific substantiation and the formation of waste traffic prospective scheme within the considered territory; the development of recommendations on the effective development of a waste management system with the identification of possible targets. Figure 1 shows the algorithm for an electronic model creation concerning waste treatment scheme.

The acquisition and the analysis of the raw data (the statistical data and vector data representing geographic objects), the selection of model objects, the determination of the essential attributes, the layers that

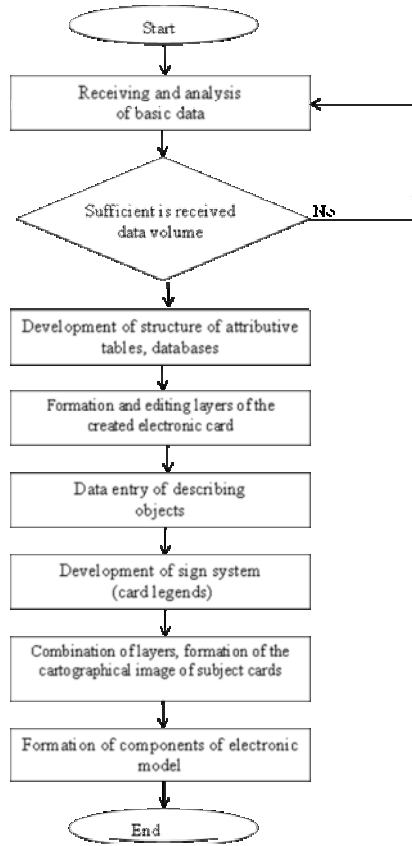


Fig. 1: Electronic model creation algorithm concerning waste treatment use

describe these objects are performed at the initial stage. Then the decision on the data amount adequacy is developed; the structure of attribute tables is developed; the creation and the editing of the layers concerning created maps and its tables; the input of tabular and textual data with the characteristics of objects; the development of a sign system (map layout elements); the overlapping of layers with the cartographic image development of thematic maps and its editing.

The development of electronic maps, visualizing the processes for the collection, transportation, processing, recycling, disposal and waste placement was carried out using ArcGIS platform where additional tools may be created using Python module for specialized task solution. Preliminary data processing was carried out in Excel.

An example of attribute data and vector object display is shown on Fig. 2. This figure shows the distribution of waste by types within the settlement boundaries using pie charts; their diameter indicates the total amount of MSW; the color of the settlements shows the total amount of MSW produced on their territory. The opportunity of the necessary SQL-query creation for the sampling from the database, for example, the following type: `SELECT * FROM Rovenki_poseleniya_Spatialjo WHERE = "Vsego_chel">1000 AND "Vsego_TBO">200`. Thus, for example, the settlement sample was obtained with the population of over 1000 people. The volume of their waste is >200 m³.

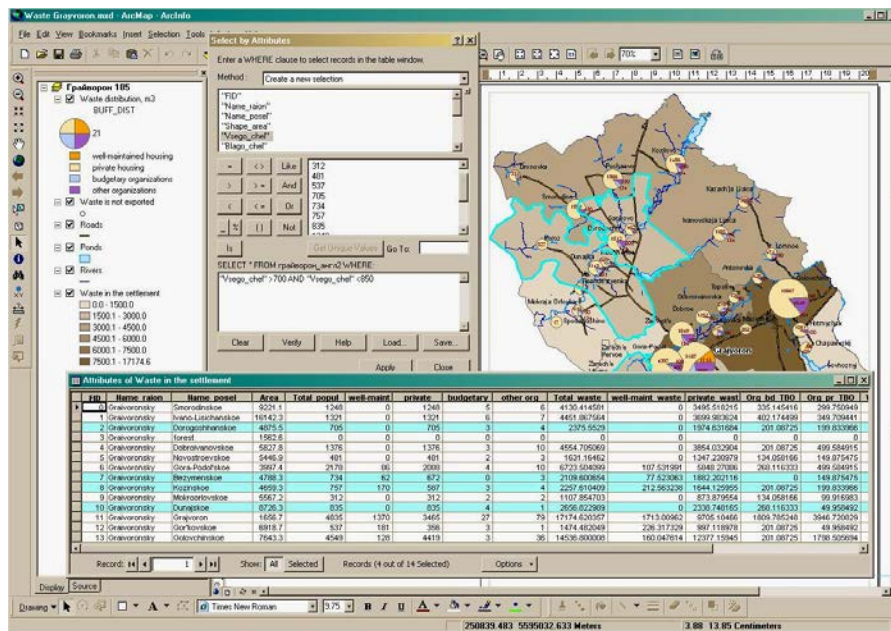


Fig. 2: Attribute data and vector object display fragment in in ArcGIS (the development of MSW volumes on the territory of the municipality)

The perspective scheme of waste movement and the targets for its implementation were developed on the basis of performed research. The relevant electronic maps show the spatial structure of objects for waste placement (the existing landfills and the landfills planned for the decommissioning, modernization and construction of new and reconstructed facilities for the disposal, recycling, waste management, the location of waste transfer points, planned waste disposal areas, waste movement vector on the region territory and beyond it.

CONCLUSION

The developed electronic model of waste treatment schemes in the Belgorod region is an information system, including DB, electronic maps and the tools for data input, storage, update, processing, analysis, presentation and data visualization. The system allows an on-line analysis of a situation in real time to forecast the development processes changing various man-made and anthropogenic factors and create the optimal solution variants to improve the ecological situation of the region

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