

Vol. 6, No. 4, 2021

HOUSEHOLD WASTE MANAGEMENT SYSTEM PLANNING
IN THE POLTAVA REGION

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<https://doi.org/10.23939/ep2021.04.258>

Received: 21.10.2021

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Abstract. Today in Ukraine, the municipal waste management system is focused on landfill waste, mainly their disposal in landfills and unauthorized dumps, most of which do not meet the requirements of environmental safety. Accordingly, the main task at the state and regional levels is to implement a systematic approach to waste management, which will ensure both a gradual reduction in waste generation and an increase in their processing and reuse.

Implementation of this task requires the implementation of a set of measures provided by the National Waste Management Strategy in Ukraine until 2030 (approved by the Cabinet of Ministers of Ukraine dated November 8, 2017, No. 820 (Order of the Cabinet of Ministers of Ukraine 2017, No. 820-r) and the National Waste Management Plan until 2030 (approved by the Cabinet of Ministers of Ukraine on February 20, 2019, No. 117-p (Order of the Cabinet of Ministers of Ukraine 2019, No. 117- r). According to documents, a crucial step for each region of Ukraine is developing a regional waste management plan based on a phase of strategic planning of all processes of waste management. The importance of this stage increases as a result of the completed process of power decentralization in Ukraine, and, accordingly, delegating authority to address most community development issues to the local powers.

Keywords: household waste management system, cluster approach.

1. Introduction

The National Waste Management Strategy in Ukraine until 2030 (Order of the Cabinet of Ministers of Ukraine 2017, No. 820-r) provides for the application of

a cluster approach to the formation of municipal waste management systems.

Before planning management systems in the region based on a cluster approach, it is worth focusing on the very concept of "cluster". The most common is the use of the concept of "cluster" in the application of a systems approach and its principles (Korolyuk, 2010). In particular, the fundamental importance of a separate system property of the "cluster" – the synergetic effect – is most often emphasized. Here is the definition of O. A. Korenchuk (Korenchuk, 2008): "a cluster is an ordered set of stable interconnected organizations and individuals, which ensures the achievement of a positive synergetic effect in joint activities that exceeds the simple sum of the potentials of its components". O. A. Korenchuk notes that the manifestation of synergies, "... is the result of cooperation and effective use of partners' opportunities for a long period, a combination of cooperation and competition, the proximity of a customer and a manufacturer, network effects and diffusion of knowledge and skills due to staff migration and business allocation, where there are no boundaries between sectors and activities...".

Thus, "cluster" is defined as a systemic formation, the main target property of which is a synergistic effect, the receipt (manifestation, achievement) of which determines the purpose of the cluster system (CS), its system-forming factor.

On the other hand, defining the "cluster" as an object of governance, and the "cluster approach" as a component of the mechanism of regional governance,

management categories are associated with these concepts: “horizontal” - from the standpoint of a chain model of governance “public needs → interests → goals → decisions → managerial influences → results → control” (Surmin et al., 2007) and “vertical” – from the standpoint of levels (local, regional, national) of regional policy subjects (Varnalia, 2005).

Considering the cluster approach from the standpoint of the levels of regional policy subjects, it is necessary to take into account the territorial aspect important for the cluster system, which determines their object subordination to a particular level. In addition, the geographical proximity of the cluster members is a generally accepted condition for its formation. Bypassing the analysis of the aspects of the positive impact of the spatial proximity of the elements of the system, it should be noted that today, there are no methods for clearly defining the territorial boundaries of the cluster system. On the one hand, the boundaries of the cluster must cover a sufficient amount of resources, on the other hand, take advantage of close mutual location.

Attributing the objects of the cluster approach to the regional level of regional policy subjects contributes to the fact that cluster support can be more effectively coordinated with regional development programs. Sectoral interpretation of the cluster system allows to effectively coordinate cluster management with the national level of regional policy subjects. In addition, considering the system approach and, in its aspect, the role of government influence on cluster systems indirectly through the external environment, the form of belonging of the cluster object to the regional level is quite optimal. This level allows us to effectively and differentially manage the environment as the main factor influencing the cluster system and adequately assess the state of its development (Cluster Development Handbook, 2006).

A separate feature of designing a cluster approach at the vertical level of regional policy subjects is to determine the traditional direction of the effect of the cluster system outside the regional socio-economic system. Much attention in this perspective is paid to the characteristics of the growth of competitiveness of cluster members in comparison with the external market environment. This, in turn, leads to raising the goals of the cluster system to the national level of regional policy subjects.

Given the above, it is clear that the cluster approach should be one of the key elements of regional policy in the field of waste management. That is why the National Waste Management Strategy focuses on

the use of a cluster approach in the implementation of strategic planning of all waste management issues in the regions.

2. Methods and Materials

In the Poltava region, the first cluster approach was implemented as part of the development of European experts in 2016 “Subregional Waste Management Strategy for Poltava region” (Subregional strategy..., 2016), which began its practical implementation in 2017 as part of the “Comprehensive solid waste management program in the Poltava region for the period 2017–2021” (Comprehensive program..., 2017).

Further development of the waste management system in Poltava region based on a cluster approach is already under the Regional Waste Management Plan until 2030 (RWMP) (Project, 2021), a project developed by a team of experts of the National University “Yuri Kondratyuk Poltava Polytechnic” and today it has passed strategic environmental assessment procedure.

According to the recommendations for the development of RWMP, the criteria used in the formation of clusters for household waste management are the following (Order of the Ministry of Ecology and Natural Resources 2019, No.586):

- covered population and volumes of waste generation in the cluster: recommended coverage of the population – not less than 150 thousand people (equivalent to about 50 thousand tons of waste generation per year);
- the minimum capacity of new regional landfills, which is determined by the number of residents covered by the services and the corresponding amount of waste generated;
- maximum distances for waste transportation, taking into account specific local conditions, such as transport infrastructure, terrain, conditions of transportation in winter, etc.;
- local restrictions on the location of the landfill due to poor geological/hydrogeological conditions, areas prone to flooding, proximity to protected areas, etc.

The RWMP project envisages the gradual implementation of a cluster model of household waste management in the Poltava region based on the consistent implementation of three scenarios.

Each of these scenarios is primarily focused on creating so-called “optimal coverage areas”, which can be clusters or subclusters (subregions). Their definition is necessary for optimal planning of the household waste management system within certain territorial boundaries.

When selecting such scenarios the following things were considered:

1) variants of territorial boundaries of potential coverage areas, in particular:

- boundaries of individual territorial communities with their main indicators (population, the ratio of the urban and rural population, area, specific natural and geographical features, provision with transport routes);

- boundaries of several territorial communities grouped into subclusters/subregions around regional waste treatment facilities (RWTF);

- boundaries of consolidated associations of subclusters into clusters around RWTF with complex technologies;

2) scenarios on different ways of collecting (including separation) and processing of domestic waste in the limits of the defined clusters within which the goals specified by this Regional Plan can be achieved.

3. Results and Discussion

During the development of the Regional Waste Management Plan in the Poltava region and the analysis of possible options for the formation of clusters and scenarios for the formation of a municipal waste management system, the following alternatives were considered:

Alternative (scenario) No. 1: waste treatment is planned to be carried out at facilities specially identified within one or more territorial communities;

Alternative (scenario) No. 2: waste treatment is planned to be carried out at regional sites, specially defined within one zone of optimal coverage as objects of common use, regardless of the chosen institutional solution;

Alternative (scenario) No. 3: waste treatment is planned to be carried out at regional sites, specially designated for several (two or more) zones of optimal coverage as objects of common use, regardless of the chosen institutional solution.

The main objects of the infrastructure of household waste management, which are focused on servicing the whole territory within the cluster or most of it, are planned as follows:

- regional landfills for household waste;
- sorting and processing complexes which are based on objects of mechanical and biological processing of waste and the object of thermal disposal;

- sorting and reloading stations or reloading stations;

- sorting stations/stationary or mobile lines.

Accordingly, the main criteria used to determine the territorial boundaries of clusters are the following:

- the number of the covered population is 150–250 thousand inhabitants;

- the potential possibility of creating a regional landfill for solid waste in each cluster (SW);

- the prospect of creating in each cluster (or most of them) a regional waste treatment facility (RWTF) with integrated technology;

- minimization of current costs for waste transportation and capital and operating costs for waste disposal;

- technological and organizational possibility of minimizing the volume of waste disposal.

The auxiliary criteria used to determine the territorial boundaries of the clusters are the following:

- the new administrative structure of the region (60 united territorial communities (TC));

- formed relationships between communities and existing projects of cooperation of territorial communities, etc .;

- local restrictions on the location of the landfill due to the mismatch of geological/hydrogeological parameters, the propensity of areas to flood, proximity to protected areas, and more.

Taking into account all the above criteria, three variants of cluster models were considered within the RWMP: 4-cluster, 3-cluster and 5-cluster (Fig. 1)

Based on the technical and economic assessment of the cost of transporting waste from communities to waste treatment facilities within each of the cluster formation options (this assessment was made for each of the 60 TC), communities with different costs of municipal waste management system were identified, first of all, by the factor of expenses for main transportations (Fig. 1).

Accordingly, based on the results of this technical and economic assessment and the results of its discussion among territorial communities, option No. 1 was adopted as a basic one for the Poltava region, which provides for the formation of 4 clusters, the boundaries of which correspond to the boundaries of new administrative districts: Poltava; Kremenchuk; Myrhorod; Lubensko-Pyryatynsk (Fig. 1a, Table 1).

a) Option No. 1 - planned

4-cluster model: 26 TC belong to the green zone by the factor of the lowest additional costs for main transportation.

**b) Option No. 2 - planned****3-cluster model:**

18 TC belong to the green zone by the factor of the lowest additional costs for trunk transportation.

**c) Option No. 3 - planned****5th cluster model:**

23 TC belong to the green zone by the factor of the lowest additional costs for trunk transportation.



Fig. 1. Options for the formation of clusters of household waste management system for Poltava region

Table 1

No.	Cluster name	Population, persons	Volume of household waste, tons / year
1	Poltava	595912	185 924.5
2	Kremenchug	396055	123 569.2
3	Myrhorod	204873	63 920.4
4	Lubensko-Pyryatynsk	190138	59 323.0

Within the framework of the Regional Plan for the Poltava region, an assessment of various scenarios for the implementation of the municipal waste management system was also made.

Scenario No. 1 - *waste treatment is planned to be carried out at facilities specifically identified within one or more territorial communities.*

This scenario is the initial stage of implementation of the Regional Plan and aims to reduce the total number of landfills in the region and create conditions for the implementation of the plan to close unauthorized landfills and landfills that do not meet sanitary and environmental requirements, which is one of the main guidelines.

Accordingly, within the framework of this scenario, it is planned to move from 725 sites of household waste disposal, which as of 2021 are operated in the Poltava region, to 44 landfills of household waste disposal, which are controlled and certified facilities. Coverage zones are formed around these objects - one or more territorial communities - 44 coverage zones.

Scenario No. 2 - *waste treatment is planned to be carried out at regional sites, specially defined within one zone of optimal coverage as objects of common use by territorial communities, regardless of the chosen institutional solution.*

Accordingly, within the framework of this scenario, the transition to the expansion of coverage areas is planned due to the closure and reclamation of most waste disposal sites (landfills as temporary facilities). As a result, it is planned to unite territorial communities around regional landfills and reprocessing facilities, i.e. to form subclusters (or subregions).

Scenario No.2 can be implemented as a transition to the main strategic scenario No.3, or at the choice of certain communities and the appropriate feasibility study, it can be an alternative to scenario No.3.

Scenario No. 3 - *waste treatment is planned to be carried out at regional facilities, specially designated for several (two or more) zones of optimal coverage as objects of common use, regardless of the chosen institutional solution.*

Accordingly, within the framework of this scenario, the transition to the formation of enlarged

coverage areas (clusters) is planned due to the organization of the waste transportation system to the RWTF of complex processing and regional landfills.

The assignment of community areas to the conditional “green”, “yellow” and “orange” zone is based on a preliminary assessment of the relative costs required for the organization of the municipal waste management system, primarily the cost of transporting waste to regional clusters waste treatment (RCWT).

Accordingly, the most optimal conditions for the organization of the municipal waste management system, according to the established technical and economic indicators in the RWMP, are typical for the communities of the “green zone”. From the technical, economic and environmental points of view, the planned solutions for the municipal waste management system for the “yellow zone” communities are rational and require the use of additional technical and economic solutions of the “orange zone” community to reduce the cost of waste transporting to certain RWTF, first of all, planning of the construction of transshipment and sorting-transshipment facilities.

Accordingly, the planned alternative scenarios and/or the possibility of their consistent implementation implements the main guideline of the RWMP - the phased implementation of the strategy of municipal waste management in the region and the gradual reduction of waste disposal sites that create a significant burden on the environment.

4. Conclusions

Summing up, the results of the analysis of alternative options and scenarios provided in the RWMP for the formation of a municipal waste management system in the Poltava region for the strategic period until 2030, we can state:

- firstly, the planned decisions in the RWMP are aimed at reducing the man-caused load on the environment and negative impacts on people’s living conditions, primarily by gradually reducing the disposal of household waste and, above all, those that do not meet current sanitary and environmental requirements;

- secondly, the priority task of the selected solutions is to increase the volume of household waste recycling, for which the emphasis in the RWMP is on the creation (construction and reconstruction) of infrastructure facilities for waste management in the region with the use of integrated technologies;

- thirdly, the main planned tool for implementing decisions in the field of household waste management in the Poltava region is the inter-municipal cooperation of territorial communities.

In general, the joint efforts of all territorial communities of the Poltava region, responsible executors of planned activities, and all stakeholders in creating an effective system of household waste management at both regional and local levels will improve the environmental situation in the region, increase welfare and health of the population of the Poltava region.

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