

# Waste management in Ukraine: organizational aspects

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**Abstract.** Environmental management emerged as a consequence of an unprecedented strain on the Earth by humans. Each our activity leaves a trail, such as pollutions of air and soil, contamination of water, deforestation, and also tons of wastes. We are confronting environmental problems that are more taxing than ever before. Now we have everyday changes of the climate which is why there is an urgent need to find ways of life that is less damaging to the Earth. Waste management is a particular specialization of the environmental management which studies how to achieve a zero-waste life. The difference between the situation with waste in Ukraine compared to other developed countries is the large volume of waste generation and the lack of infrastructure for waste management. At the same time, the availability of such infrastructure is an essential feature of all economies of developed countries. Also, it is showed to increase of the amount of illegal and uncontrolled landfills and to degrade of the condition of existing dumps. This paper is aimed to explain how the Ukrainian government could educate people about problems of wastes and encourage us to change our habits.

## 1 Introduction

By adopting the concept of sustainable development, Ukraine has agreed that economic growth and sustainable development require an urgent reduction in environmental impact through changes in the production and consumption of resources and goods [1]. Effective management of natural resources, as well as methods of utilization of waste and pollutants are important tasks to achieve this goal. Furthermore, the modern individual behaviors of the discarding of waste are often deeply rooted in habits of the population [2]. Therefore, encouraging consumers, businesses, industries, countries to reduce waste and their rational utilization should be a priority of every government program. Separate researches propose to modify the current waste management process based as on active participation of citizens and considering the local people and expert's viewpoints [3], as on people who spend time on volunteer activities are also likely to spend time on waste management efforts [4]. An intervention is needed to bring stakeholders together to solve these waste challenges [5].

In this way, following modern studies [6, 7, 8, 9] systematic environmental management including waste management is required. This is especially true given that there are an accumulation of waste in both the industrial and domestic sectors, which has a negative impact on the environment and human health; improper disposal and

removal of hazardous waste; disposal of household waste without taking into account possible dangerous consequences; inadequate level of waste use as a secondary raw material due to imperfect organizational and economic principles of their involvement in production; inefficiency of implemented economic instruments in the field of waste management in Ukraine.

Besides awareness of the consequence of waste management practices to the environment is limited as many are not conscious of the connection between waste management and the environment [10].

Researching waste management issues in Ukraine, the situation of closing the Lviv landfill should be considered in detail. Waste from Lviv and some settlements of the region was stored at the Hrybovysia landfill, which has been operating since 1957, occupies more than  $33 \times 10^4$  m<sup>2</sup>, and is the third largest in Europe and one of the largest polluters in the Lviv region.

In 2003, the chief state sanitary doctor of the Lviv region issued a resolution to terminate the operation of the landfill for the city of Lviv. In following years, there were repeated instructions to stop the operation of the landfill, but they were ignored by the city authorities and challenged in courts, as a result of which the landfill continued to accept waste. According to the resolution of decommissioning since 2006 landfill ran illegally.

Despite the landfill ban, in 2006, a few months after being elected mayor, Andriy Sadovyi said the landfill was almost full, but asked the Hrybovychi community to agree

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to continue operating the landfill for next five years, after which he promised to close it. Instead, promises to solve waste recycling problems were not fulfilled for next 10 years, and some work was directly sabotaged or banned by Andriy Sadovyi and his team. Thus, in 2007, the city authorities banned degassing of landfills - primary measures for its reclamation and closure.

In May 2016, after the fire was extinguished, rescuers who were investigating causes of the fire were killed at the landfill due to a landslide with waste. In November 2016, a court ordered the Lviv authorities to close the Hrybovysia landfill. As of June 2017, monthly volumes of waste have accumulated in some areas of the city. In total in the city - about  $9 \times 10^3$  tons of waste.

Hence, goal of the research is a development at the government level organizational measures for effective waste management in Ukraine.

## 2 Presentation of the main materials of the research

The situation with waste management in Ukraine is a rather difficult. Because it is at an initial stage, there are only legislatively approved norms and regulations. Thus, it is proposed to utilize the practice of the European union.

**Table 1.** Hierarchy of waste management in European union.

Position in the hierarchy	Waste management	
	action	essence
1	Prevention	promote and support sustainable production and consumption models;
		encourage the design, manufacturing and use of products that are resource-efficient, durable, repairable, re-usable and upgradable;
		target products containing critical raw materials to prevent that those materials become waste;
		encourage the re-use of products and the setting up of systems promoting repair and re-use activities;
		encourage the availability of spare parts, instruction manuals, technical information, or other instruments, equipment or software enabling the repair and re-use of products without compromising their quality and safety;
		reduce waste generation in processes related to industrial production, extraction of minerals, manufacturing, construction and demolition, taking into account best available techniques;
		reduce the generation of food waste in primary production, in processing and manufacturing, in retail and other distribution of food, in restaurants and food services as well as in households;
		encourage food donation and other redistribution for human consumption, prioritizing human use over animal feed and the reprocessing into non-food products;
		promote the reduction of the content of hazardous substances in materials and products;
		reduce the generation of waste, in particular waste that is not suitable for preparing for re-use or recycling;
2	Preparing for re-use and recycling	identify products that are the main sources of littering, notably in natural and marine environments, and take appropriate measures to prevent and reduce litter from such products;
		prevent and significantly reduce marine pollution of all kinds;
		develop and support information campaigns to raise awareness about waste prevention and littering.
		promote preparing for re-use activities, notably by encouraging the establishment of and support for preparing for re-use and repair networks, by facilitating, where compatible with proper waste management, their access to waste held by collection schemes or facilities that can be prepared for re-use, and by promoting the use of economic instruments, procurement criteria, quantitative objectives or other measures;
		promote high-quality recycling;
		set up separate collection of waste: for paper, metal, plastic, glass and textiles from households and possibly from other origins;
		promote selective demolition in order to enable removal and safe handling of hazardous substances and facilitate re-use and high-quality recycling by selective removal of materials, and to ensure the establishment of sorting systems for construction and demolition waste for wood, mineral fractions (concrete, bricks, tiles and ceramics, stones), metal, glass, plastic and plaster;
		consider the setting of preparing for re-use and recycling targets for construction and demolition waste and its material-specific fractions, textile waste, commercial waste, non-hazardous industrial waste and other waste streams, as well as preparing for re-use targets for municipal waste and recycling targets for municipal bio-waste.
		ensure that waste undergoes preparing for re-use, recycling or other recovery operations;
		3
4	Disposal	ensure that, where recovery is not undertaken, waste undergoes safe disposal operations;
		regulating disposal operations, including through possible restrictions, and to consider a disposal reduction target, to ensure environmentally sound waste management.

By definition of the European Union in the Directive 2008/98/EC on waste “waste management means the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker” [11]. That is, waste management (or waste disposal) include activities and actions required to manage waste from its inception to its final disposal [12].

This Directive proposes the following waste management hierarchy which reflected a priority order in waste prevention and a measure of the safety of waste management’s results which are shown in Table 1 [11].

There is the National Strategy of Waste Management in Ukraine until 2030. And all of these actions exist there but just formal. Accordingly, the practice of waste management is needed to improve by the side of the government. Firstly, it will be the organization of waste management, precise in households.

In Ukraine, according to the Ministry of Regional Development, about 10 million tons of waste are dumped annually, of which only 600000 are recycled or burned. The rest is buried in landfills, of which, according to official data, there are more than 6000 in Ukraine. They occupy  $9000 \times 10^4 \text{ m}^2$ ; another  $1000 \times 10^4 \text{ m}^2$  are unauthorized landfills.

In order to assess the state of waste management in Ukraine, we use the following types of information (from official statistic resource of Ukraine):

1. Expenditures on environmental protection by type of economic activity in 2019 (shown in Fig. 1).
2. Waste generation and management from 2010 to 2018 (shown in Fig. 2)
3. Expenditures on environmental protection by types of environmental measures in 2019 (shown in Fig. 3).

Consideration of Ukraine's expenditures on environmental protection by types of economics activity can give us enough answers about how much Ukraine spends on each of them and what type of activity takes the biggest percentage of the expenditures.

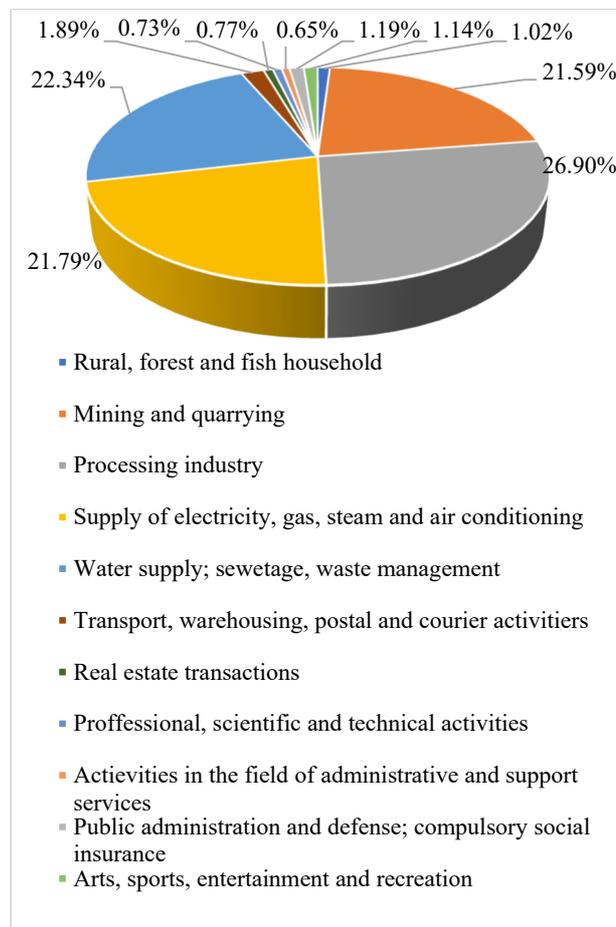
It should also be noted that the analysis of expenditures on environmental protection by type of environmental measures shows us which types of measures are the most sponsored. From which we can draw conclusions about the rationality of such expenditures for environmental protection by types of environmental measures.

However, we must remember that expenditures management is an important and one of the most difficult issues in country's waste management activities. The level and dynamics of environmental expenditures depend on country's profits or losses and the level of efficiency of waste management.

The analysis of such information allows us to assess the effectiveness of waste management and expenditures on environmental protection in modern Ukraine. In addition, the analysis of waste generation and management can show us do we rationally manage our waste and how much Ukraine forms, utilizes, burns and deletes to special places or objects all types of waste.

The pie chart shows expenditures on environmental protection by type of economic activity in 2019. In 2019

the number of expenditures on environmental protection was up to  $43735862,1 \times 10^3$  hryvnias. The largest percentage was the cost of processing industry, that is 26,701%. Water supply; sewerage, waste management take the second place in the pie chart by percentage of expenditures on environmental protection at the level of 22,173% that is not very higher then percentages of supply of electricity, gas, steam and air conditioning and mining and quarrying which have following percentages.

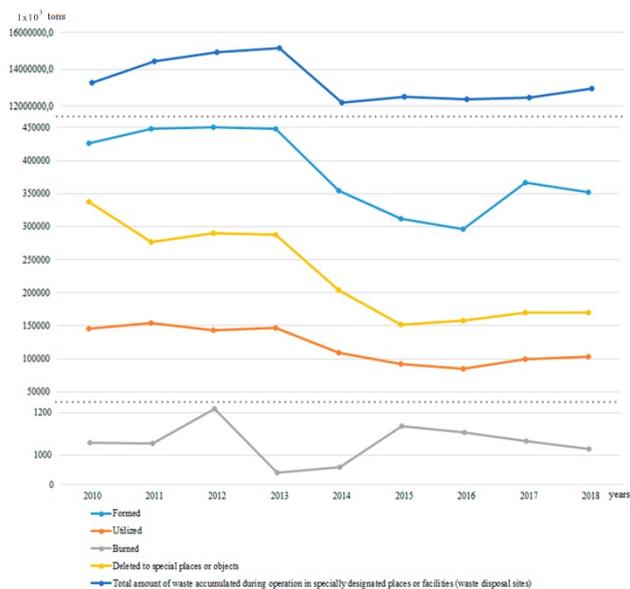


**Fig. 1.** Expenditures on environmental protection by type of economic activity in Ukraine in 2019.

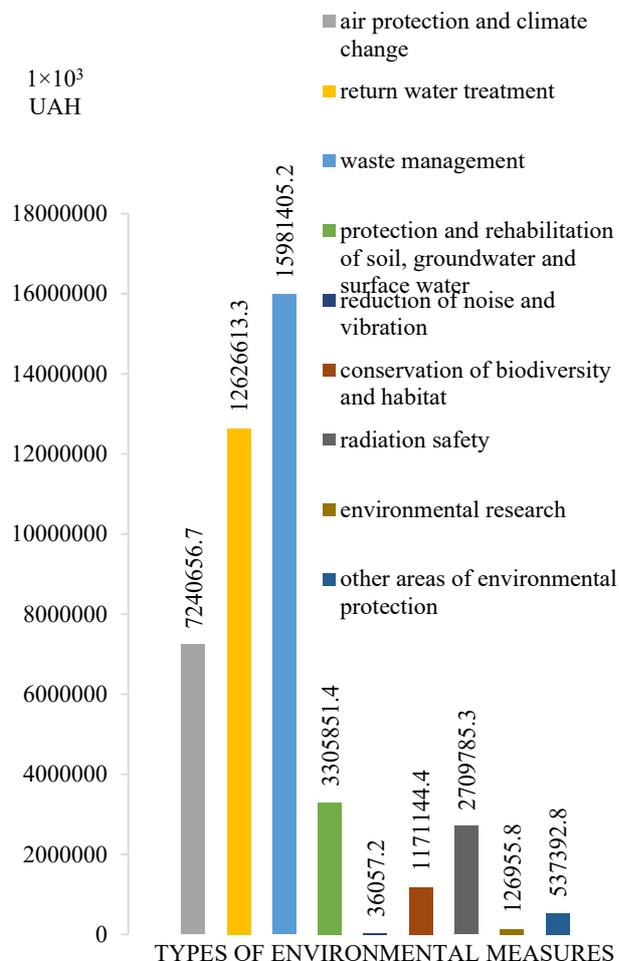
According to the letter from the Ministry of Ecology and Natural Resources "Regarding specially designated places or objects for waste disposal", we determine that special places or objects - places or objects (waste disposal sites, storage facilities, landfills, complexes, structures, subsoil areas, etc.), for the use of which the permission of specially authorized bodies for waste disposal or other waste operations has been obtained [13].

21,626% and 21,427%. Paying attention to remaining indicators, we can see that ten of them do not gain even 1%, and other do not exceed level of transport, warehousing, postal and courier activities, that is 1,873%.

Analyzing official data of expenditures on environmental protection by type of economic activity, there is not separately waste management. This fact makes it difficult to see the real state of these expenditures.



**Fig. 2.** Waste generation and management in Ukraine in 2010-2018.



**Fig. 3.** Expenditures on environmental protection by types of environmental measures in Ukraine in 2019.

The graph shows us waste generation and management in Ukraine by years. We can see that we have extremely high level of total amount of waste accumulated during operation in specially designated places or facilities (waste disposal sites). From 2010 to 2013, the growth

trend of this indicator is clearly visible, but in 2014 there was a sharp decline in its level. After which this indicator was stable within limits with the lowest indicator  $12205388,8 \times 10^3$  tons (in 2014) and the highest  $12972428,5 \times 10^3$  tons (in 2018). Also, as in situation with total amount of waste accumulated during operation in specially designated places or facilities (waste disposal sites) we can see that from 2010 to 2013 this indicator had been growing until 2014.

However, in 2014 it had a really sharp decreasing until 2016 after that it had fast growth in 2017 and a little decreasing in 2018. The line of the deleted to special places or objects has decreasing from 2010 to 2011 after that it has enough stable condition until 2013. The amount of deleted waste began gradually decrease until 2015 and then it was stable within limits until 2018. That limits were from maximal  $169801,6 \times 10^3$  tons (in 2017) and minimal  $157379,3 \times 10^3$  tons (in 2016). As we can see data about utilized waste is almost on the same level for each year but also a barely noticeable decrease from 2013 to 2016 in the amount of utilized waste. The maximum value of this indicator is  $153687,4 \times 10^3$  in 2011 and minimal in 2016 is  $84630,3 \times 10^3$  tons.

Summarizing this information, we can tell that the indicator of waste generation is regular higher than the indicator of utilized, deleted and burned wastes.

Thanks to this bar chart, we can consider the amount of expenditures on environmental protection by types of environmental measures in Ukraine in 2019. The total amount of these expenditures is  $43735862,1 \times 10^3$  hryvnias. In general, there are following types of environmental measures: air protection and climate change, air protection and climate change, return water treatment, waste management, protection and rehabilitation of soil, groundwater and surface water, reduction of noise and vibration, conservation of biodiversity and habitat, radiation safety, environmental research and other areas of environmental protection. The largest amount of expenditures compared to others are: waste management, return water treatment, air protection and climate change. Waste management is the biggest and takes the first place in the bar chart with indicator  $15981405,2 \times 10^3$  hryvnias. The second place belongs to return water treatment which is  $12626613,3 \times 10^3$  hryvnias. On the third place are air protection and climate change with indicator on level of  $7240656,7 \times 10^3$  hryvnias. Noise and vibration reduction are the lowest and least influential in the chart and takes only  $36057,2 \times 10^3$  hryvnias. It should also be noted that in comparison with all these indicators environmental research also has a fairly low mark of  $126955,8 \times 10^3$  hryvnias, which is very negative because such researches will help reduce the cost of all other types of environmental measures.

From this bar chart, it is seen that expenditures for waste management is occupied the largest share of total expenditures on environmental measures, and this is a positive trend in waste management at the state level in Ukraine. Worth remembering, new waste management goals require significant changes in the waste management system structure which introduces new problems and one of them is an increase in the costs for the system users (citizens) [14].

The system of general scientific and special, empirical and theoretical research methods is used in the work. In particular, the following methods were used: analysis-synthesis; explanation; formalization; generalization; comparison; deduction, induction; grouping, graphic, systematization etc. In addition, the analogy method was used to consider the existing systems of waste management in the European Union and Ukraine in order to shed light on problematic issues in garbage management in Ukraine.

### 3 Results

In this paper for increasing the efficiency of waste management, it is offered organizational solutions for household waste management for the Ukrainian government.

When organizing a system of household waste management, we must remember the interconnectedness and responsibility of the government (authorities of different levels of government), business entities and citizens. Only the coordinated interaction and understanding of these subjects of household waste management will allow in the near future to get an effective system that takes into account all the requirements of the present, and sustainable development, and the needs of future generations.

Therefore, we propose to pay special attention to the prevention of household waste management by raising the level of public awareness through such organizational measures that should be implemented at different levels of government in the country and among businesses and citizens (shown in Table 2).

Such measures will help to increase the level of waste management culture among the population. It should be noted that the level of education of the population in matters of household waste management directly depends on the state initiative and active public position of each citizen.

### 4 Discussion

The problem this article aims to solve in the need to decide the critical situation that has developed with the formation accumulation, storage, processing, utilization and disposal of waste and is characterized by the further development of environmental threats.

Such circumstances lead to a deepening environmental crisis and aggravation of the socio-economic situation in society and necessitates reform and development taking into account domestic and world experience of the entire law and economic system which is regulating the use of natural resources in general and waste management in particular.

The high level of waste generation and low rates of their use as secondary raw materials have led to the fact that in Ukraine every year in industry and utilities accumulate significant amounts of solid waste of which only a small part is used as secondary material resources, the rest end up in landfills.

**Table 2.** Recommendations about organization of prevention of household waste generation to Ukrainian government.

Sphere	Recommendation
Waste accumulation	every citizen should receive from the waste collection company a memo on the management of household waste with detailed instructions on their sorting and specially equipped places;
	place information on the rules for preparing waste for sorting on each special sorting tank;
	on specially equipped sites for sorting of household waste there should be clear indications about their types;
Education	conducting educational events in all schools, universities and crowded places (shopping malls, markets, recreation areas, etc.) about the sorting of household waste and ways to re-use, recycling;
	mandatory introduction of issues related to household waste management in schools and universities.
Production and consumer sphere	create conditions for anti-wastefulness promotions in supermarkets;
	gradually transfer the consumption of food and life by the population on the terms of sustainable nutrition / development, taking into account the regionality and seasonality of products and goods;
Digitalization	due to the large amount of packaging in household waste to oblige each manufacturer to indicate on the packaging about its danger in case of getting into unsorted waste.
	by the concept of "Country in a smartphone" to develop a waste application, aimed at informing the population of the settlement about the place, time and assortment of waste collection; activation of the eco-activity function nearby is possible.

The article provides recommendations on how best to organize the process of preventing the generation of household waste. Further research should be aimed at improving the efficiency of waste management such as: industrial, construction and repair waste, hazardous, agricultural waste, specific types of waste (packaging, waste electrical equipment, batteries and accumulators, medical waste).

### 5 Conclusions

The proposed organizational mechanism for household waste management should be the first practical step towards the implementation of an effective management system for all types of waste at the government and regional levels. This will create conditions for raising living standards by introducing a systematic approach to waste management, reducing waste generation and increasing its recycling and reuse.

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