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WASTE MANAGEMENT SKILLS FORMATION IN MODERN CONDITIONS: THE EXAMPLE OF UKRAINE

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ABSTRACT

The article is devoted to the question of justifying the feasibility of acquiring competences in the field of waste management at the national, industrial, regional and individual levels. The purpose of the article is to characterize the state of waste management in Ukraine in the pre-war period, to summarize the experience of waste management in European countries, and to highlight the peculiarities of the formation of waste management skills in Ukraine in the post-war recovery period. Considering the dynamic of capital investments on environmental protection in Ukraine, it's sustained the necessity of addition measurements in the area of waste management in order to increase the results of this activity, namely by determining the basic skills waste management. The article examines the share of utilized waste in the total amount of waste generated by the regions of Ukraine. The analysis is complemented by an analysis of the dynamics of industrial production and it is concluded that in the conditions of a low share of waste utilization and the growth of the index of industrial production, it is necessary to develop waste management skills in industry. A study of the public's perception of the situation with waste management was conducted. Based on the generalization of domestic and foreign experience in waste management, the skills that are necessary for realization of all levels of the waste management hierarchy were considered, namely: skills for prevention of waste generation and its reduction, preparation for waste reuse, waste recycling and another types of waste disposal were highlighted.

Keywords: waste problems, waste disposal, utilisation, Ukrainian, EU legislation, waste management, skills, experience

JEL Classification: M21, Q52

INTRODUCTION

The issue of waste management urgency is becoming louder not only from international and domestic environmental organizations but also from local centers that suffer from the pollution of the landscape and natural resources, including air, water, rising disease, increasing the negative impact of waste decomposition products for the life of the population. Waste problems, which is not a unique experience in Ukraine today, as European countries faced the same problem in the 80s and 90s of the last centuries. This problem is especially sharp during the war in Ukraine, namely considering the people's movement from the East to the West of the country.

The accumulation of waste and its inefficient disposal have prompted European governments to address the issue of waste management as a real problem and to develop a system of measures that can be successfully resolved with the least harm, and sometimes even benefit to individual communities. Ukraine is far behind the European Union in many indicators of pre-war waste efficiency. According to published data, 2.7 % of municipal solid waste (MSW) was incinerated in Ukraine in comparison to 26 % in the EU; in Ukraine, only 3.2 % of solid waste was processed, and in the EU – 26 %; 90 % of solid waste was buried in Ukraine, while in the EU only 31 % [1]. In general, the developed measures did not solve the existing problems in the field of waste management, focusing on old provisions and approaches. The situation is significantly complicated by the consequences of war, destruction, harmful emissions of gases and chemicals, etc.

According to experts' opinion, the amount of waste will double over the next 20 years in many cities, but consistent plans for waste management due to the demographic and social changes are often lacking [2]. Therefore, it is important to determine the situation of waste management in Ukraine on the basis of analysis and generalization of this activity experience and, taking into account value achievements and results, to form the skills needed in the field of waste management.

LITERATURE REVIEW

The importance of waste management issues attracts the attention of domestic and foreign scientists, who not only consider the problem itself but also explore ways and experiences to resolve it. The development and approval of normative documents on waste management clarify the actions and requirements for waste management, creating a basis for the development of relevant practical measures. In the EU, the issue of waste management is regulated by Directive № 2008/98 / EC on waste [3]. Ukraine has passed the Law "On Waste" [4]. The works of scientists propose a systematic and comprehensive approach to waste management problem solving and identify issues that are priority, and require more detailed consideration of the issues regarding the mandatory. Namely, Zapukhliak I. has concluded that there are still not sufficiently settled separate sorting of household waste as well as public awareness tools; there is no established system of control and responsibility in the field of waste management; the hierarchy of waste management needs to be followed; there are needs to develop a waste management infrastructure and appropriate level of transparency [5]. It should be noted that the adoption and implementation of relevant legislation require harmonization with European legislation on waste management. The Ukrainian Institute of the Future has developed an infographic [6], which presents the legislation on waste management that currently regulates this area and which needs to be adjusted for successful future reform. Samoilov O. mentioned that despite the Ukrainian legislation and principles of waste management being developed in compliance with European experience, the mechanisms of their implementation in the practice are implicated very slowly [7].

Wojciechowska A. Kravchenko O., Melen-Zabramna O., Pankevich M. [8] paid attention to the best practices of waste management, familiarization with which allows highlighting the types of activities and individual measures of improving the state of waste management on a national level.

Horbal N., Adamiv M. [9], Andrusiv U. [10], as well as Sillanpää M. [11] consider waste management in a circular economy issue. Namely, authors [9] have mentioned that „…circular economy is based not only on the improvement of waste management, production technologies and the use of resources, but also on a fundamental change in social values, thinking, and consumer behaviour". Therefore, it is important to investigate the behavior of waste management subjects, to determine their understanding and attitude to this issue.

Author's team [12] defined the circular economy as" a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling". So, it's necessary to get more knowledge on these achievements and identify in what way they could be used in waste management.

The regional and industrial aspects of the issue of waste management have been studied by Sala D. and Bieda B. [13, 14], and Kumar S. [15] with considering the complexity of procedures and decisions in waste management. The international experience is valuable for better understanding what skills are important to achieve progress in waste management.

AIMS AND OBJECTIVES

Developed normative principles of waste management and implemented measures in this area have formed pieces of evidence and prerequisites for improving the situation in waste management. However, achieving results from appropriate measures incorporation in reducing waste generation and increasing waste utilization cannot be considered at the level of an individual city, region, or country. This is a global problem, and practical results can be a good example for the development of waste management skills. If developed countries successfully have implemented waste management practices and developed significant experience in this area, it is necessary to create an environment for forming and dissemination of waste management skills in Ukraine. Moreover, the war in Ukraine introduced new conditions and requirements in the field of waste management, which will need to be addressed at all levels of its management and administration, taking into account the pre-war experience and the consequences of hostilities, and the possibility of solving them.

The purpose of the article is to characterize the state of waste management in Ukraine in the pre-war period, summarize the experience of waste management in European countries, and highlight the peculiarities of waste management skills formation in Ukraine in the post-war recovery.

METHODS

Given that the problem and achievements of waste management has been studied with results, published in both domestic and foreign literature, we use the method of generalization to identify them.

Taking into account that the problem of waste generation, as well as disposal and its management have features for different regions, the article uses the method of grouping the regions of Ukraine by the share of waste disposal. Waste disposal, as required by the EU Waste Directive of 19 November 2008, is any operation that results in waste benefiting from the replacement of other materials. Annex II of the Directive lists disposal operations [3]. Some waste types could be utilized but for this, special conditions and relevant knowledge of its sorting and separation are required.

The share of waste disposal is defined as the ratio of the volume of waste disposed to the total amount of waste generated. The grouping method involves determining the groups (n) by the approximate Sturgess formula [16]:

$$K = 1 + 3.322\ lg\ lg\ n, \quad (1)$$

where n is the number of observations.

To determine the interval (i) of grouping we use the formula:

$$i = \frac{x_{max} - x_{min}}{n}, \quad (2)$$

where x_{min} is the minimum value of the feature; x_{max} – the maximum value of the sign.

The analysis of waste disposal share is accompanied by an analysis of regions' industrial production index. The result of such comparison has substantiated the feasibility of developing the skills of industrial enterprises' responsibility in the waste management field. The article uses content analysis of waste management practices in European countries and in Ukraine. Accordingly, the development of waste management skills is recommended to be worked out taking into account the existing experience and the state of waste management, considering the individuals, communities, industrial enterprises, and firms' behavior.

The scheme of conducted in the article methodology of research is presented in Fig.1.

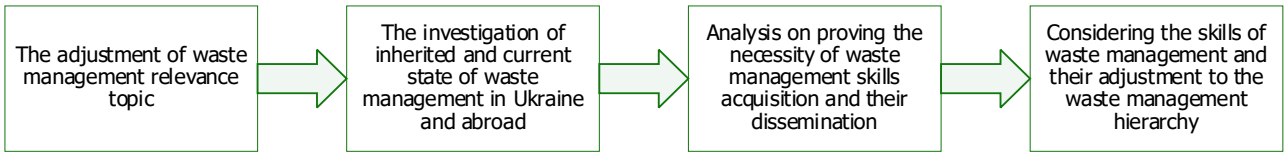

Figure. 1. The scheme of conducted in the article methodology of research.

In order to form information about the attitude of the public to the issue of waste management, a survey of people aged 17-68, who represent the stakeholders of the university, was conducted. These representatives are close to the field of formation and dissemination of waste management skills.

Presenting main material. Activities in the field of waste management require investments. Fig. 2 presents the dynamics of capital investments for environmental protection and separates the dynamics of costs for waste management.

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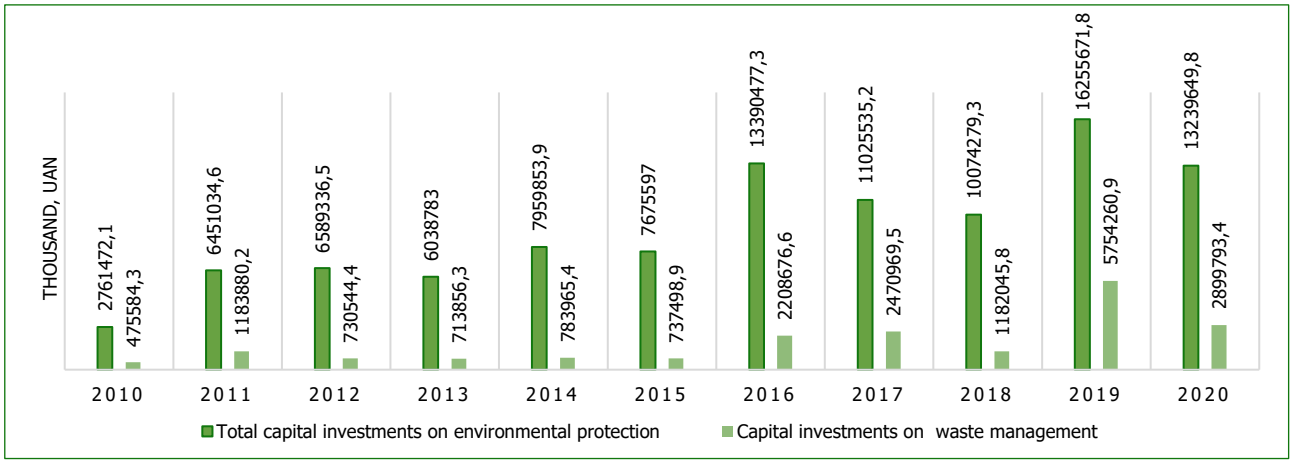

Figure 2. Capital investments on environmental protection, by type of environmental domain, at current prices, thsd. UAH *(Source: formed on the base [https://ukrstat.gov.ua/operativ/operativ2016/ns_rik/ns_rik_reg/onps_e/kionps_e.htm])*

During 2010-2020 years the environmental protection costs increased more than three times, and the growth index of waste management costs is higher (5.097) than the growth index of environmental protection costs (3.794). We associate the increase in waste management costs with the implementation of new approaches and methods in this area. Hence, the target use of the investment depends on how effective the measures will be, and this is connected with waste management skills.

Today, the domestic waste management system is focused not on waste disposal (reuse), but on primitive collection and removal to landfill (in the case of consumption waste) and export and/or placement on industrial sites (in the case of industrial waste). The situation is caused by a number of factors, including the lack of adequate infrastructure to enhance the recycling process. The environmental policy, which carried out tasks in the field of waste management, was one-sided and aimed only at environmental measures to eliminate the negative effects caused by waste. Due to the low level of funding for environmental activities, both in industrial and individual segments, a significant number of problems in the field of waste management remained unresolved. As a result, trying to neutralize the negative impact of waste, from year to year only the pressure on the environment has increased as a result of more waste accumulation from production/consumption and the number of landfills. That is, positioning waste as an environmental pollutant inquires to get rid of this pollution, namely, burial in the ground or dumping on the ground (landfill), dumping on specially equipped landfills, burial in special containers in the mine, etc.

At the same time, the legislative bases on waste prevention are adapted to the world and orient business entities in the waste management field to the obligation to: prevent waste generation and reduce waste generation; do not allow the mixing of waste, if it is not provided by existing technology and complicates the management of waste or it is not proven that such action meets the requirements of environmental safety [5]. These requirements respond to the tendency of linear economy replacement to a new paradigm of solving the global problem of sustainability - a circular economy with its own principles, in particular [11]: if the linear model produces, uses, and utilizes, the circular model of the economy is based on the principle of 3-R: reducing the use of resources and the advantage of renewable materials; the most efficient use of products; recovery of by-products and waste for further use in the economy. However, the current situation in Ukraine in the field of waste management is unsatisfactory, in particular in the field of packaging waste collection, processing, and disposal, as well as an introduction to economic circulation. In 2019, about 6.1 % of packaging waste was recycled and disposed of, of which: 2 % was incinerated, and 4.1 % of packaging waste went to recycling points and waste processing lines. The lack of an efficient packaging waste collection system annually leads to the loss of significant resource potential for the processing industry in the form of waste paper and cardboard from 0.5 to 0.6 million tons, glass – 1 million tons, polymers – 0.6 million tons [17].

From 2018, according to the Law of Ukraine "On Waste", the disposal of unprocessed household waste at landfills is prohibited, and Ukrainians must sort garbage and dispose of it in appropriate containers. The decisions taken should help reduce the amount of garbage annually from 95 % (2016) to 30 % (2030), but by 2019 it was possible to reduce the amount by only 1.2 %. According to experts, it is not just the unwillingness of the majority of Ukrainians to sort garbage – according to unofficial data, this is done by about 4% of the country's population. But also, in the fact that Ukraine still lacks the necessary infrastructure, therefore, garbage is mostly sorted by enthusiasts who are not indifferent and who are willing to spend time and resources to recycle waste [17]. Thus, the priority area of waste management activity that, in

our opinion, will help improve the waste situation, is to create conditions for the formation and development of waste management skills. And this applies not only to the level of consumers of products but also to the state regional authorities, which form the policy of waste management as well as to business that generate an immense quantity of waste.

In the way to follow the task of skill formation we refer to the academic definition of the concept of skill as the tendency or need to act and behave in a certain way; a habit that acquires through exercises, and experience [18]. Skills development is influenced by knowledge of the subject area and is based on regulations and useful experience that has results in areas, for which waste management is also relevant. Assessing the state of waste management is also a kind of knowledge that will characterize and formulate appropriate measures to change and improve the situation. And it is best to do it on the base of specific activities, the implementation of which will form a certain experience allowing the development of appropriate skills. Table 1 presents data on the dynamics of waste generation and utilization in the context of Ukraine's regions. Grouping of regions by share of utilized waste will allow making a conclusion about what work is carried out in this direction, what experience has been formed, and what is necessary to do to develop skills in waste management in modern conditions.

Table 1. Waste generation and disposal by region, thousand tons. *(Source: [20])*

	2017			2018			2019			2020		
	Total waste generation	Wastes utilization	Share of waste disposal, Q_w	Total waste generation	Wastes utilization	Share of waste disposal, Q_w	Total waste generation	Wastes utilization	Share of waste disposal, Q_w	Total waste generation	Wastes utilization	Share of waste disposal, Q_w
Ukraine	366054.0	100056.3	0.27	352333.9	103658.1	0.29	441516.5	108024.1	0.24	462373.5	100524.6	0.22
Vinnitsa	2341.7	350.5	0.15	1782.2	481.7	0.27	2711.2	208.9	0.08	1557.7	143.1	0.09
Volyn	733.1	112.2	0.15	555.4	118.6	0.21	668.1	35.9	0.05	630.2	35.1	0.06
Dnipropetrovsk	243114.7	83802.1	0.34	243598.8	85056.3	0.35	252234.5	90474.5	0.36	309398.4	87132.9	0.28
Donetsk	22434.6	5395.5	0.24	24110.2	6671.4	0.28	26407.9	5407.2	0.20	26981.2	4663.9	0.17
Zhytomyr	550.3	82.8	0.15	486.2	48.9	0.10	474.5	53.3	0.11	397.2	33.4	0.08
Zakarpattya	173.4	0.2	0.001	186.3	0.4	0.002	153.1	0.2	0.001	145.0	0.3	0.002
Zaporizhya	5129.4	2705.5	0.53	5294.4	3325.8	0.63	5403.3	3788.4	0.70	5531.0	3485.7	0.63
Ivano–Frankivsk	1948.8	651.6	0.33	1969.8	553.0	0.28	2991.7	870.2	0.29	1729.8	525.3	0.30
Kyiv	1265.6	20.2	0.02	1394.0	33.8	0.02	1414.3	9.7	0.01	2153.6	18.2	0.01
Kirovohrad	37623.3	1471.4	0.04	37902.0	1854.6	0.05	37410.3	1696.2	0.05	498.7	78.5	0.16
Luhansk	644.0	90.3	0.14	557.5	45.5	0.08	443.4	42.1	0.09	260.0	39.6	0.15
Lviv	2483.1	603.0	0.24	2139.3	354.5	0.17	2047.1	327.7	0.16	3121.1	403.2	0.13
Mykolaiv	2327.9	61.3	0.03	2410.2	61.2	0.03	2327.3	61.2	0.03	2502.1	88.3	0.04
Odesa	739.9	10.5	0.01	728.5	9.2	0.01	638.8	2.3	0.00	456.2	1.7	0.004
Poltava	35121.8[2]	2780.5	0.08	19825.7[2]	2771.7	0.14	97442.8	3064.7	0.03	98051.3	2055.5	0.02
Rivne	457.7	23.6	0.05	484.2	23.2	0.05	519.9	39.3	0.08	886.2	15.0	0.02
Sumy	580.4	228.4	0.39	852.2	198.0	0.23	863.8	156.9	0.18	728.5	139.5	0.19
Ternopil	1905.8	98.7	0.05	1651.8	240.7	0.15	1062.6	277.7	0.26	279.9	67.4	0.24
Kharkiv	1803.4	121.5	0.07	1628.5	285.0	0.18	1752.3	194.2	0.11	1487.8	247.1	0.17
Kherson	399.8	31.1	0.08	392.5	33.4	0.09	375.9	28.2	0.08	90.8	24.0	0.26
Khmelnytskiy	928.2	397.0	0.43	900.5	500.9	0.56	900.4	400.8	0.45	500.9	409.1	0.82
Cherkasy	1295.1	766.9	0.59	1484.6	787.3	0.53	1259.6	697.5	0.55	1124.2	633.6	0.56
Chernivtsi	369.0	111.8	0.30	308.0	91.1	0.30	318.7	117.1	0.37	208.9	82.6	0.40
Chernihiv	732.7	130.6	0.18	717.4	109.8	0.15	695.9	69.1	0.10	498.4	73.1	0.15
City of Kyiv	950.3	9.1	0.01	973.7	2.1	0.0022	999.1	0.8	0.0008	3154.4	128.5	0.04

As can be seen from the Table 1, the share of utilized waste is typical for all regions. Due to inadequate solid waste management systems in settlements, usually in the private sector, there were identified 22.6 thousand unauthorized landfills covering an area of 0.56 thousand hectares in 2020, 21.7 thousand of which were liquidated in 2020 with an area of 0.53 thousand hectares [19]. The black quadrants in Figure 3 indicate the negative dynamic of waste management in

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regions during the 2017-2020 years, and the wight ones – the positive tendency. So, 56 % of the regions' waste management trend characterizes the decrease in waste utilization over the 2017-2020 period. On the basis of statistical data on waste generation and utilization in the context of the regions of Ukraine, the share of waste utilization was determined (Table 1). In order to generalize the state of management, we will group the regions according to the values of the obtained shares of waste disposal. The number of groups (n) is determined by the formula (1), where N = 25. The obtained value of n is 5.65 groups or apr. 6 groups.

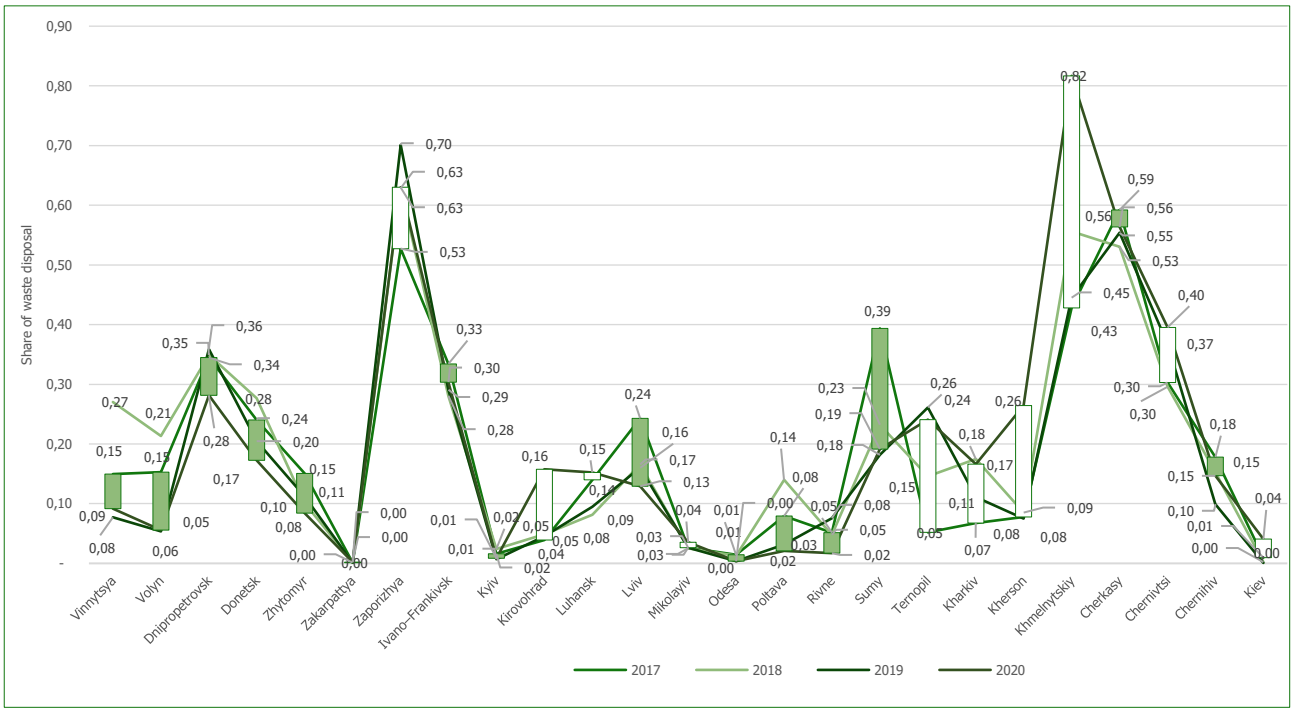
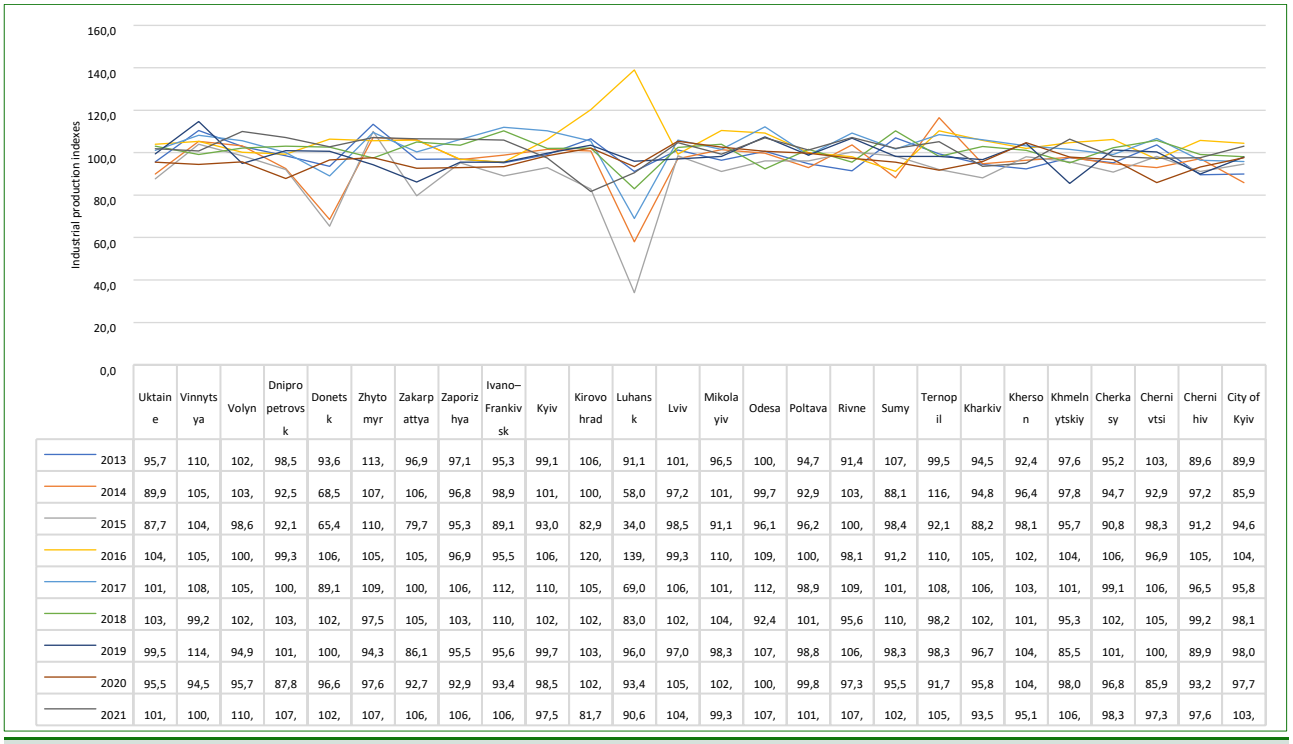


Figure 3. Dynamics of waste generation and disposal in the regions of Ukraine for the period 2017-2020. *(Source [21])*



	Ukraine	Vinnytsya	Volyn	Dnipropetrovsk	Donetsk	Zhytomyr	Zakarpattya	Zaporizhya	Ivano–Frankivsk	Kyiv	Kirovohrad	Luhansk	Lviv	Mikolayiv	Odesa	Poltava	Rivne	Sumy	Ternopil	Kharkiv	Kherson	Khmelnytskiy	Cherkasy	Chernivtsi	Chernihiv	City of Kyiv
2013	95,7	110,	102,	98,5	93,6	113,	96,9	97,1	95,3	99,1	106,	91,1	101,	96,5	100,	94,7	91,4	107,	99,5	94,5	92,4	97,6	95,2	103,	89,6	89,9
2014	89,9	105,	103,	92,5	68,5	107,	106,	96,8	98,9	101,	100,	58,0	97,2	101,	99,7	92,9	103,	88,1	116,	94,8	96,4	97,8	94,7	92,9	97,2	85,9
2015	87,7	104,	98,6	92,1	65,4	110,	79,7	95,3	89,1	93,0	82,9	34,0	98,5	91,1	96,1	96,2	100,	98,4	92,1	88,2	98,1	95,7	90,8	98,3	91,2	94,6
2016	104,	105,	100,	99,3	106,	105,	105,	96,9	95,5	106,	120,	139,	99,3	110,	109,	100,	98,1	91,2	110,	105,	102,	104,	106,	96,9	105,	104,
2017	101,	108,	105,	100,	89,1	109,	100,	106,	112,	110,	105,	69,0	106,	101,	112,	98,9	109,	101,	108,	106,	103,	101,	99,1	106,	96,5	95,8
2018	103,	99,2	102,	103,	102,	97,5	105,	103,	110,	102,	102,	83,0	102,	104,	92,4	101,	95,6	110,	98,2	102,	101,	95,3	102,	105,	99,2	98,1
2019	99,5	114,	94,9	101,	100,	94,3	86,1	95,5	95,6	99,7	103,	96,0	97,0	98,3	107,	98,8	106,	98,3	98,3	96,7	104,	85,5	101,	100,	89,9	98,0
2020	95,5	94,5	95,7	87,8	96,6	97,6	92,7	92,9	93,4	98,5	102,	93,4	105,	102,	100,	99,8	97,3	95,5	91,7	95,8	104,	98,0	96,8	85,9	93,2	97,7
2021	101,	100,	110,	107,	102,	107,	106,	106,	106,	97,5	81,7	90,6	104,	99,3	107,	101,	107,	102,	105,	93,5	95,1	106,	98,3	97,3	97,6	103,

Figure 4. Industrial production indexes by regions. *(Source: [21])*

Substituting in formula (2) the maximum value of Qw (0.8167) and the minimum - for (0.0021), we obtain an interval equal to 0.1358. Using the method of equal intervals, we group according to this feature six groups of areas that are included in the formed closed intervals (Table 2).

Table 2. Grouping of regions of Ukraine by share of waste utilization.

Number of regional distribution groups by share of waste disposal	Distribution intervals	Number of regions included in the group	Regions
The first group	0.0021-0.1378	11	Vinnytsya, Volyn, Zhytomyr, Zakarpattia, Kyiv, Lviv, Mykolaiv, Odesa, Poltava, Rivne, city of Kyiv
Another group	0.1378-0.2736	8	Donetsk, Kirovohrad, Luhansk, Sumy, Ternopil, Kharkiv, Kherson, Chernihiv
Third group	0.2736-0.4094	3	Dnipropetrovsk, Ivano-Frankivsk, Chernivtsi
Fourth group	0.4094-0.5452	-	-
Fifth group	0.5452-0.6810	2	Cherkasy, Zaporizhia
Sixth group	0.6810-0.8167	1	Khmelnytsky
Total		25	

The grouping performed in this article is supplemented by the analysis of the industrial production index by region (Fig. 4), in particular: 73 % of regions included in the first group had a positive dynamic of the industrial production index; 30% of the regions included in the second group had a positive dynamic of the industrial production index as well; 63 % of regions in the third group had a positive dynamic of the industrial production index; 50 % of regions in the fourth group had a positive dynamic of the industrial production index; 100 % of the regions included in the fifth group had a positive dynamic of the industrial production index.

Thus, we can summarize that 76 % of regions have a low share of waste disposal (19 oblasts belong to groups 1 and 2), thus, practical measures for the development of waste management skills should also take into account these differences. This situation also requires special approaches to the acquisition of waste management skills in the industrial sector.

In order to study the public's perception of waste management problems, a survey of stakeholders of the Ivano-Frankivsk National Technical University of Oil and Gas was conducted. 33 people aged from 17 to 68 were interviewed. The results of the survey showed that 100 % of respondents are concerned about the state of waste management in their region; 87.9% of respondents assessed the need for additional knowledge on waste management; 94% of respondents stated the need for informational support for waste management; 72% of respondents believe that activity in the field of waste management requires self-development; 84.9% of respondents consider international waste management experience to be important. Therefore, the activity of acquiring waste management skills deserves more attention.

RESULTS

The result of the analysis has shown that a quarter of the regions are characterized by a low share of waste disposal. Disposal involves the use of secondary raw materials for further recycling. That is, the process of disposal provides the secondary use or recycling of waste that cannot be used more in this form. According to the obtained experience, a necessary prerequisite for achieving high levels of recycling is the high-quality sorting of household waste at the place of their generation. For example, the level of plastic recycling increases 10 times if it is collected separately (compared to the mixed waste scheme) [22]. One of the ways to develop waste management skills is to involve institutions where the degree of segregation is significantly lower. This also applies to universities, where a significant number of stakeholders are concentrated, the most important distinguishing factors of which are the place of permanent residence, year of study, and form of study [23]. However, the organization of interaction with them allows not only to implement the relevant knowledge, in particular on waste sorting but also to disseminate it, ensuring the coverage of a diverse environment of participants.

The issue of waste management, namely its disposal, is also related to business. And in Ukraine, there are also a number of issues that need to be addressed and depend on both infrastructure and staff training on waste management. According to retailers working in the field of waste recycling, such activities are not always profitable, and waste recycling companies are reluctant to disclose financial information. For contractors and plants, collection and processing of waste are mostly

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unprofitable due to small volumes of raw materials and low sorting. Hence, processing plants import secondary raw materials to load their enterprises, while in Ukraine the improvement of their processing and utilization will help meet the needs of waste processing plants in raw materials [24]. At the same time, pre-sorting garbage by the population significantly reduces the cost of the utilization process for businesses. However, this need is faced with the lack of proper infrastructure, so the rates of proper waste disposal in Ukraine are extremely low. As a result, 93% of garbage ends up in landfills that harm the environment and the health of residents, and only 4.5 % goes for recycling [24]. So, the implementation of waste management policy in accordance with European best practices requires the acquisition of relevant skills in the industrial sector, in particular - the introduction of extended producer responsibility can be one of the first steps toward changing these indicators [25]. According to the National Waste Management Strategy, by 2030 the Ukrainian government wants to recycle 50% of waste. This requires making sorting available to all citizens. The example of business refutes the idea that the population is not ready for this. A transparent organization of garbage collection and processing will facilitate people to better understand their contribution to environmental protection.

Foreign researchers on waste management note that collecting high-quality waste streams for reuse, recycling, and disposal also requires the involvement of citizens and integrated infrastructure development from municipal to EU level [26, 27]. Acquisition and dissemination of waste management skills are facilitated by the activities of public organizations as well. In particular, DESPRO supports pilot projects in the field of household waste management. Pilot projects were implemented in Vinnytsia and Poltava regions. The projects were based on three methodological approaches: integrated solid waste management; cooperation of territorial communities (hyperlinks to the law; step-by-step planning [28]. Sumy region has significant experience in acquiring waste management skills, implementing the project "Waste Management on a Closed Cycle". The project aimed to introduce innovations in waste collection and disposal in the direction of implementing a circular economy in waste management [29].

An important role in the acquisition of waste management skills belongs to the experience of European countries in waste management [2, 3]. In particular, Sweden, where 99% of waste is recycled, most of which is used as fuel for power plants. The country even buys garbage in other countries (Ireland, Italy, Norway) because it lacks its own. Austria is actively using biotechnology, which involves the use of a fungal enzyme that breaks down plastic and polyester. The German government has drafted a law requiring manufacturers to produce packaging for goods that are decomposable or recyclable. In Finland, batteries, light bulbs, and other hazardous waste can be handed over to any store that sells these items. Each pharmacy accepts expired medicines, and there are clothing collection points throughout the country that are sent to countries in need with the support of the Red Cross.

The international experience of waste management deserves attention. For example, in Poland, work is underway to increase the pace and scale of waste recycling. Its solution lies in resolving the problem of mandatory sorting of garbage by all residents of Poland, which was introduced in July, 2017, and from this date that garbage is sorted into 4 types. Ideally, Poles sort paper into a blue container, plastic into yellow, bio-waste into brown, and glass into the green. If this population does not do so, Poland will not be able to count on 1.3 billion zlotys from the EU for the development of the processing industry. In addition, if waste is not sorted, it will also be impossible to meet another EU requirement – to recycle half of all Polish waste. And this threatens the country with fines [8]. The study found that the level of the separate waste collection depends on the place of collection. The analysis of waste recycling and recovery levels for the ten Polish largest cities has shown that the cities implement accepted goals of municipal waste recovery. The poor-quality collected municipal waste, which must first be sorted into renewable fractions, results from the lack of proper education of inhabitants [30]. The issue of training specialists in the field of waste management deserves attention at the regional level. In particular, according to the National Waste Management Strategy until 2030 and the National Waste Management Plan until 2030, each region of Ukraine must develop its own regional waste management plan, which takes into account the structure of the economy, different types of waste, available and necessary capacity for environmentally friendly treatment [7]. Training of specialists for the level of regional state administrations and local self-government bodies is a necessary condition for the development of high-quality regional plans that will meet European standards and approaches to systems [31]. The international context of waste management activity is presented in Table 3.

For Ukraine, waste management experience is related to the implementation of EU directives, in particular, Directive 2008/98/EC on waste [4], which provides for the following priority of waste management: prevention; preparation for reuse; processing; another type of disposal, for example – to restore energy; liquidation. This priority is important because the more effective the first three steps of waste management are, the less waste will be incinerated and landfilled as well as disposed of. It should be noted that today the economic system in many countries works on the principle of "take-do-throw-away", i.e., is linear and does not reflect the catastrophic situation with waste generation, improper recycling, disposal, and environmental pollution [27]. In 2014, the European Commission decided not to adopt amendments to waste

legislation, but to use a new horizontal method, which provides for changes not only in the field of waste but will cover the full economic cycle of production.

Table 3. Activities in the field of waste management: international context. *(Source: formed by authors according to the EU experience on the base of [8, 32, 33])*

County	National level	Enterprise	Community	Householding /Individuals
Poland	In accordance with the requirements of EU legislation, by 2020, Poland is obliged to process and prepare for the reuse of at least 50% of waste throughout the country	Companies invest and implement technologies allowing the use of recyclable waste as secondary raw materials	Implementation since 2007 the co-generation module at the waste landfill, which allows receiving electricity and heat. There is a regional communal waste processing system (RIPOK)	A single waste separation system is operated in Poland since 2017
Germany	The government has approved the following strategies: establishing environmental quality standards; requirements to reduce emissions in accordance with the best available technology; production regulations; setting emission limits	The duties of manufacturers include prevention of waste generation and disposal of the goods produced by them after they lose their consumer properties	Application of advanced coal burning technologies for East German power plants. Programs for the protection of nature, in particular the rivers Elbe, Rhine, Danube	It is the duty to sort all waste and put it in different containers
Japan	The adopted legislation declares limits on industrial emissions, limits products, limits waste, improves energy conservation, encourages recycling, limits land use, organizes environmental pollution control programs, assists victims, and provides for sanctions	Researchers make a huge contribution to the global experience of energy-saving technologies: the development of vehicle engines, the introduction of public and personal transport on electric traction (electric cars), which have high fuel efficiency and low emissions	Creation of a "smart city", the infrastructure of which mainly works on alternative energy sources, 100% safe for the environment. Local governments enter into voluntary pollution control agreements with companies located in the region Education of both the public and business circles	Introduction of a zero-waste system in households. Garbage sorting into 34 different categories
Ukraine	In 2017, the Government of Ukraine approved the National Waste Management Strategy in Ukraine until 2030	In 2019, the Cabinet of Ministers of Ukraine approved the national waste management plan until 2030, which provides for the implementation of economic incentives for the introduction of environmentally friendly production technologies and the expansion of processing (recycling) opportunities, ensuring the functioning of centralized facilities for the processing (recycling) of various types of waste	According to the Ministry of Regions, 25 waste sorting lines in different regions of Ukraine provide waste sorting (waste sorting) in Ukraine, but their efficiency is low	In Ukraine, there is practically no culture of separate collection of household waste. Such systems are implemented sporadically and have low efficiency. The service for separate collection of household waste is introduced for 2-4% of settlements, and a quarter of the population is not covered by services for centralized removal of household waste at all

Europe has embarked on the path of introducing the "circular economy concept" [5]. Current global trends in waste management and the real situation on this issue in Ukraine require a reconsideration of the attitude to the chain of life of products and 27 services that we consider as garbage can be used as raw materials.

Given the current situation, in particular the Russian-Ukrainian war and its socio-humanitarian consequences, it should be noted that the issue of waste management will arise with new challenges not only for Ukraine, but also the western neighbours. Therefore, the experience of waste management could be transformed for the communities of Ukraine through the implementation of joint international projects and the dissemination of best practices in waste management.

The environmental capacity of waste management will increase if new behaviors for waste accumulation and disposal are developed through the acquisition of skills by all stakeholders - including the population of the region, country, etc. The impact of Russian-Ukrainian war, which causes and contributes to various forms of environmental damage, has a huge impact on the emergence of environmental problems during and after hostilities. Experts who had studied the experience of resolving environmental issues due to armed conflicts and wars note that a proper approach to waste can create opportunities to rebuild and support regions and help transform society through sustainable recovery [34]. In particular, unforeseen problems with energy supply during conflicts can facilitate the transition to alternative energy sources, and depletion and destruction of territories are seen as an opportunity to restore environmental friendliness or create a new national legal framework for sustainable resource management. However, these opportunities depend on how much attention has been paid to the environmental issue before, during, and after the conflicts. It is impossible not to agree with the opinion that awareness and work on environmental protection before and during the war are important, and this allows us to consider the damage as acceptable. Another thing, if the issue of the environment is ignored after the war, then there is a risk of losing opportunities to encourage sustainable recovery, as well as the creation of a state for future resource conflicts [34].

Based on the analysis of the waste management state by comparison of the amount of disposal and generalization waste in Ukrainian regions, as well as domestic and foreign experience in this matter, Table 4 introduces information on skills needed in waste management issues.

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The traditional ways of getting appropriate skills in waste management are not enough to provide adequate changes in organizations. The basic level of skills is mandatory. But each organization has to follow the path of consistent meanings for acquiring necessary knowledge in the considered field.

Table 4. Ways and means of developing waste management skills.

Activities in the field of waste management	Necessary skills	Ways and means of developing waste management skills
Prevention of waste generation and its reduction	skills to implement extended producer responsibility; skills of personal responsibility on waste management; skills of economical and efficient use of resources; skills of environmental protection; waste management planning skills	▪ Organization of studies and holding the meetings on the base of such educational technologies: method of brainstorming (to generate possible ideas to improve waste management, discuss them, and as a result generate suggestions); situational analysis (the description of the problem of waste management, analysis the situation, diagnose the problem and express the ideas and decisions); round table on reasonable questions on the topic under discussion; discussion on relevant situations; ▪ Participating in local projects promoting measures for efficient and sensible waste management; ▪ Participating in international projects that disseminate experience in waste management
Preparation for waste reuse	skills of separate collection and sorting of waste; skills for determining optimal areas for the location of regional waste transfer stations, sorting lines, waste processing plants and landfills; skills of waste management logistic	
Waste recycling	skills in the application of methods of utilization and disposal of consumption and production waste; skills of drawing up a passport of industrial waste	
Another type of waste disposal, for example - for energy recovery	waste disposal skills for energy recovery (biogas)	
Waste disposal	skills of storage and disposal of waste	

DISCUSSION

Due to the legislative changes made in Ukraine in 2018, regulations on waste disposal were introduced. In addition, the Law of Ukraine "On Local Self-Government" (Article 30) regulates the competencies of municipal bodies in the field of municipal and housing, including the obligation to address issues related to the collection, transportation, disposal, and disposal of municipal institutions. In the pre-war period in Ukraine, there were 17 enterprises for processing waste paper, 39 – for processing polymers, 19 – for processing PET raw materials, and 16 – for processing cullet. 34 sorting lines operated in 28 settlements; sorting complexes were built in 17 settlements. In 1462 settlements separate collection of household waste is introduced. A number of pilot projects have been implemented in Ukraine to address the issue of waste management [22].

Undoubtedly, the given in article analysis characterizes the pre-war situation in Ukraine in terms of waste management. Obviously, the situation is extremely difficult for the country, especially for the Eastern regions, where there has been total destruction of both civil and industrial property and the emergence of waste, the disposal of which will require special attention, concrete measures, and appropriate funding. Nevertheless, the situation in the West part of Ukraine is crucial too because of a large number of refugees and relocated industry and business entities. The need to address the issue of waste management is complicated by the fact that. As a result of the Russian-Ukrainian war in 2022, 7.1 million people have been displaced, 4.6 million have taken refuge in other countries, and are likely to return to regions of Ukraine that have not suffered significant damage and can accept migrants [35]. However, the experience gained in the pre-war period allows for generalizing the state of waste management that was typical in the past and could be taken into account with nowadays shortcomings and threats in the formation of a new waste management strategy and policy. The conducted research is important for the formation of the program and measures of waste management for the regions that did not have significant destruction.

CONCLUSIONS

The study summarized that the current state of waste management in Ukraine could be divided into three periods: before, during, and after the war. It's difficult to consider the problem of waste management during the war so the main attention is paid to the current military issues and civilian support, namely refugees. But the consequences of the war affect immense devastations that have complicated the existing before the war waste management state. The conducted research has shown that capital investments in waste management have increased during the last three years. But the share of recycled waste was low, and the main reason for this was not enough means, infrastructure, and practical mechanisms for their

realization. In order to correct the situation, despite the legislation's improvements in compliance with European standards and laws, the reasons for enhancing the training of waste management skills were sustained in the article.

On the basis of region group distribution, there were pointed out the ranges of them that are differentiated by the share of waste utilization. The authors of the article came up with this approach because the share of waste disposals indicates the state of waste utilization and the possible potential for its increase. The supplementation of carried out analysis by the index of industrial production allows concluding the connection between the low level of waste disposal and the high level of industrial production. This situation encourages to develop the business responsibility skills in waste management. A survey was conducted regarding the public's assessment of waste management in their region, as a result of which the need to acquire waste management skills was confirmed.

Taking into consideration the results of research as well as the study of the foreign experience of European countries, which shows positive results from waste management measures implementation, there were considered the content and means of developing the waste management skills through the hierarchy of waste management. We can predict that improving waste management in Ukraine will lead to the development and implementation of circular economy provisions, in the context of which waste management will benefit from waste disposal and reuse.

It should be noted that the acquisition of waste management skills requires consideration of the algorithm for the formation of waste management skills, and this topic can become the object of further research.

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ФОРМУВАННЯ НАВИЧОК ПОВОДЖЕННЯ З ВІДХОДАМИ В СУЧАСНИХ УМОВАХ: ПРИКЛАД УКРАЇНИ

Стаття присвячена питанню обґрунтування доцільності набуття компетенцій у сфері поводження з відходами на національному, галузевому, регіональному та індивідуальному рівнях. Метою статті є охарактеризувати стан обходження з відходами в Україні в довоєнний період, узагальнити досвід обходження з відходами європейських країн, висвітлити особливості формування навичок обходження з відходами в Україні в період післявоєнного відновлення.

Якщо врахувати динаміку капіталовкладень на охорону навколишнього середовища в Україні, підтверджується необхідність проведення додаткових заходів у сфері обходження з відходами з метою підвищення результатів цієї діяльності, а саме шляхом визначення базових навичок обходження з відходами. У статті досліджено частку утилізованих відходів у загальному обсязі генерованих відходів за регіонами України. Аналіз доповнено аналізом динаміки промислового виробництва та зроблено висновок, що в умовах низької частки утилізації відходів та зростання індексу промислового виробництва необхідно розвивати навички відповідального обходження з відходами в промисловості. Проведено дослідження сприйняття населенням ситуації з обходженням із відходами. На основі узагальнення вітчизняного та зарубіжного досвіду обходження з відходами розглянуто навички, необхідні для реалізації всіх рівнів ієрархії обходження з відходами, а саме: навички запобігання утворенню відходів та їх зменшення, підготовки до повторного використання відходів, переробки відходів, – та висвітлено інші види утилізації відходів.

Ключові слова: проблема відходів, утилізація відходів, перероблення відходів, українське, європейське законодавство, обходження з відходами, навички, досвід

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