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IS IT POSSIBLE TO IMPLEMENT THE IDEA OF ZERO WASTE IN WASTE MANAGEMENT IN POZNAŃ?

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ABSTRACT: The aim of the study was to find out the awareness and readiness of Poznań residents to implement the Zero Waste (ZW) idea in the city. Residents' knowledge of the hazards of municipal waste generation and their familiarity with and degree of adherence to ZW principles were investigated. The research was carried out through a questionnaire survey. The article is a form of answering whether the inhabitants of a large city in Poland are ready to implement the ZW idea. The research presents the level of preparation (readiness) of the inhabitants of Poznań and the conditions enabling the implementation of ZW in the city. The results were statistically analysed. Conclusions indicate a significant readiness of the respondents to implement the ZW idea. A preliminary concept of reducing municipal waste by promoting ZW in the city was indicated. This is important because Poznań is currently rebuilding its municipal waste management.

KEYWORDS: Zero Waste Idea, Social Reception, possibility of implementation, City of Poznań

Introduction

Humans are generating more and more waste every year, polluting our planet. This is particularly noticeable in highly developed countries characterised by a high consumption of goods. In response to this process, many new movements are emerging in these societies to spread nature-friendly habits. One of these is the idea of Zero Waste (ZW). Literally translated, Zero Waste means 'no rubbish' or 'no waste'. The name reflects very well the idea, which seeks to eliminate littering of the environment and to use human creations prudently.

The subject of the study was to identify the state of knowledge and readiness of the Poznań community to implement the Zero Waste principles. The aim of the study was to find out whether the citizens are willing to accept the implementation of measures to improve and reduce the volume of municipal waste in the city. This would be done with a view to optimising the process based on the adoption of these principles. The reason for taking up the topic is the social importance of the problem and its complexity. In addition, the rising cost of waste charges is causing widespread interest in this issue, and its timeliness is due to the significant recent changes in waste management in Poznań. According to a resolution of the City Council, Poznań withdrew on 1.01.2022 from the Intercommunal Agreement "Waste Management of the Poznań Agglomeration" (pol. Gospodarka Odpadami Aglomeracji Poznańskiej – GOAP) (BIP Poznań, 2022). In 2023, the form of billing for the waste generated is to be changed. The city also intends to build its own waste recycling plant and two large Selective Municipal Waste Collection Points (pol. Punkt Selektywnej Zbiórki Odpadów Komunalnych – PSZOK) and several smaller ones (Teraz Środowisko, 2021).

The concept and principles of ZW are a very popular topic in the scientific literature, which is mainly due to the growing problem of waste management especially in developed and rapidly developing countries. This is due to the fact that their weight and volume are increasing and, above all, their high management costs. ZW makes it possible to reduce these costs significantly. The subject of the implementation of the ZW concept in the areas of administrative units in various countries and its effects have been described in numerous scientific works. This paper also presents examples of several cities and regions in the world following the ZW idea. However, it has not been widely analysed so far in the conditions of a large city in Poland. Therefore, taking into account the planned changes in the economic system in Poznań, it was decided to carry out such a task. For this purpose, the characteristics of the city were analysed, and a survey was conducted among the residents on their attitude to municipal waste, knowledge and degree of adherence to ZW principles. Based on the above data and strategies related to this movement, a concept for further action for the city was proposed.

The paper draws on literature relating to the history of the ZW idea and attempts to implement it in other cities and regions of the world. It also draws on

DOI: 10.34659/eis.2023.87.4.663

sources analysing the issue of ZW not only in academic publications of a long period of time but also the challenges and opportunities of transforming a city into a 'Zero Waste City' entity.

The research part of the paper is based on an online survey (COVID-19 pandemic) conducted among Poznań residents in 2021-2022, which concerned municipal waste management and knowledge of the ZW concept. The survey was conducted among 158 city residents. They were mainly women between the ages of 20 and 40, with a significant proportion of people with higher education. Quantitative research was used, carried out by means of a survey questionnaire containing a total of 20 questions (of which 3 were the so-called respondent's metric). The purpose of the questionnaire was to analyse several important factors, i.e., the level of involvement and accuracy in waste segregation, residents' consumer behaviour, knowledge of municipal waste management, attitude towards second-hand items, the amount of municipal waste generated, knowledge of the idea of living without generating waste (ZW). They also referred to objections to waste management in Poznań.

The results of the questionnaire were statistically analysed, and selected questions were cross-tabulated. On this basis, the characteristics of the people taking part in the survey were drawn up. Among other things, it showed the interrelationships between different attitudes and involvement in the context of living without waste in the city. The results served as a basis for determining the readiness of the residents to implement the ZW idea and for further promotional and educational activities to promote the above idea, which is proposed in the coming years.

An overview of the literature

Humans are generating more and more waste every year, polluting the planet. This is particularly noticeable in highly developed countries characterised by high consumption of goods (Zaman & Lehmann, 2013). In response to this process, many new movements are emerging in these societies to spread nature-friendly habits. One of these is the idea of Zero Waste (ZW). Literally translated, ZW means 'no rubbish' or 'no waste'. The name reflects very well the idea of seeking to eliminate littering of the environment and using human creations wisely. There are many definitions of ZW (ZWIA, 2022). They all boil down to using the environment ethically, economically and efficiently, and people interested in the idea are to be persuaded to change their behaviour and daily habits. They are to ensure a sustainable, circular way of managing a product that is designed to be used as a raw material in the next stage (ZWE, 2022). This is a form of 'journey' of a raw material temporarily placed in a specific product through various forms of use, where the composition of a product constitutes a kind of 'ecopassport' (Michniewska & Grodkiewicz, 2017).

DOI: 10.34659/eis.2023.87.4.663

The term "Zero Waste" was first used by chemist Dr. Palmer in 1973, who named his Californian company "Zero Waste Systems Inc.". It dealt with the recovery of substances from unused chemicals. Dr. Palmer (2004) also founded the Zero Waste Institute, which preaches the idea of ZW, with a focus on designing products appropriately so that they can be reused many times without being thrown away.

The ZW movement gained prominence between 1998 and 2002. In 1995, Dr D. Knapp of the company 'Urban Ore' in Berkeley, California, started a business focusing on rescuing quality items from city-owned landfills and then selling them at markets and at his headquarters. The growth of the company and the collaboration with the city government allowed the business to expand by offering advice and support to cities, institutions and private companies in implementing ZW policies in their areas (Urban Ore, 2023). During his travels around Australia, Knapp spoke to businesses, residents and boards of major cities. These included how to maximise material recovery and minimise waste through reuse, recycling and composting. In 2003, the principles of the Zero Waste International Alliance (ZWIA, 2022) were formulated at an international meeting in Beaumaris, Wales. These principles boil down to the so-called 5Rs, i.e. a hierarchy of behaviour, namely: Refuse, Reduce, Reuse, Recycle and Rot. ZW is a kind of lifestyle that is at the same time a set of habits and views related to functioning within the environment, which can even take the form of an ideology. One can also argue with defining 'ZW' internationalism in Polish and giving it an emotional meaning (Grażul-Luft, 2022). Its overarching goal is to realistically reduce the amount of waste produced, but also to appropriately recycle what has already been produced, amounting to creating a space where we are literally to have no rubbish. The ZW rules communicate that the emphasis should be on resource efficiency and waste avoidance (Michniewska & Grodkiewicz, 2017).

The ZW movement achieved its greatest prominence between 1998 and 2002, moving from theory to actively building a waste-free society. A list of best practices in line with the spirit of the movement was developed. An Eco-Cycle website with numerous bookmarks was created, presenting exemplary examples of waste-free functioning in the form of lists, videos and manuals (Eco-Cycle, 2022). A chronological summary of the development and achievements of the ZR movement is presented tabularly in the publications by Zaman (2015) and Nizar et al. (2018). A well-known populariser of the ZR movement is a French Californian, Bea Johnson, who, for one year in a family of four, reduced the waste generated to one jar, as described in her book (Johnson, 2013).

In addition to numerous companies (e.g. Subaru, Xerox, Anheuser-Busch, Wal-Mart, Nike, Toyota, Ford, etc.), the management of numerous cities (e.g. Oakland, San Francisco, Seattle, Washington, Halifax, Canberra, Adelaide, Stockholm, Banda Aceh City in Indonesia, etc.) and regions (some US states, New Zealand and provinces in Australia and Canada, etc.) have been convinced by the concept of the ZW Games.) and regions (some US states, New Zealand and provinces in

DOI: 10.34659/eis.2023.87.4.663

Australia and Canada, et al.), and the UK advertised the 2012 Olympic Games in London as the first 'ZW Games' (Nizar et al., 2018; Winter, 2007).

An extensive review of the world literature based on Scopus and Google Scholar databases was conducted by Zaman (2015). This included as many as 96 peer-reviewed items from the period 1995-2014 selected from over 1500 in the Scopus database. The aim of the study was to present the development of the concept of ZW, including waste management, based on a critical review of academic publications. These were grouped into subject areas and geographical areas, among others. The study adds to the body of knowledge for the development of a coherent and improved ZW strategy while also indicating significant differences in the understanding of the concept itself in different countries and geographical areas. Australia and the USA dominated among the items analysed. Australia's dominance in the above area is also due to the high publication activity of the author himself, who, by virtue of his employment (Zero Waste SA Research Centre for Sustainable Design and Behaviour, University of South Australia), is the author or co-author of numerous research items (Zaman, 2014, 2016, 2022), with the 2015 publication cited not included (also for time reasons). Two of these refer to the possibility of transforming cities into ZW cities (Zaman & Lehmann, 2011a, 2011b) and cities of the future (Hannon & Zaman, 2018). Zaman and Lehmann (2013) are the authors of the 'ZW index' as a tool for measuring the performance of waste management systems in cities.

In the overview publication by Zaman (2015), unfortunately, there is no item from Poland among the listed countries from which the publications originate. However, this does not mean that the issue of ZW has not been of interest to Polish researchers. One of the more recent ones is a publication by Dziekański et al. (2023), whose aim was to assess the spatial differentiation of the relationship between the green economy and the ZW concept of 709 municipalities of 5 voivodeships in eastern Poland in 2010-2020. The assessment was conducted using a synthetic measure based on Central Statistical Office data (pol. Główny Urząd Statystyczny – GUS). The authors treated the synthetic measure used as an instrument for monitoring and modelling the activities of municipalities, as a measure of the choice of actions taken or a measure of their economic situation.

Examples of the ZW concept in smart cities were presented by Jelonek and Walentek (2022). The study was designed to answer the question of why to apply the ZW concept in the urban waste management process. To the first 60 cities listed in the Global Smart City Index 2020 (IMD, 2021), the authors posed 7 questions relating to waste management issues addressed to their authorities. Unfortunately, only 12 answers were received, one of which concerned Warsaw, which was represented alongside Krakow.

Katowice was included in the publication Mesjasz-Lech (2018) among 6 European cities (Poland, Germany, UK, Italy). The aim of the research was to indicate the validity of creating environmental strategies for cities, taking into account the ZW philosophy, and to identify good practices in this regard. The

DOI: 10.34659/eis.2023.87.4.663

hypothesis of the relevance of differences for the amount of municipal waste was verified on the basis of statistical data in 2014 and 2010 in order to check whether changes in municipal waste management systems translate into changes in the amount of waste. The implemented measures for each city's ZW philosophy are also presented.

Very interesting results on the concept of ZW in the context of consumer support for environmental protection were presented by Bogusz et al. (2021). Using the Computer-Assisted Web Interview (CAWI) method, the inhabitants of 4 countries (Poland, Slovakia, Ukraine and the Czech Republic) were surveyed in 2021. The survey included 5 questions on so-called respondent metrics and as many as 24 factual questions. Results were obtained from more than 800 respondents from Poland, Slovakia and Ukraine (the Czech Republic was omitted due to the small number of return questionnaires). Statistical analysis of the data obtained showed that familiarity with the ZW concept was related to everyday household activities (segregating waste, minimising the use of plastics, donating clothes to others and not wasting food), which are associated with thoughtful shopping. Respondents consciously identify these activities with reducing waste.

ZW is more about an idea and a goal than a specific outcome we want to achieve. In the concept, there are no targets to aim for. ZW is a philosophy of continuously improving one's lifestyle so that waste is avoided. For this reason, it should be seen as a challenge to ourselves and the surrounding world (Michniewska & Grodkiewicz, 2017). According to numerous authors, the results of the research are the basis for public discussion at global, European and local levels relating to the creation of legislation and educational programmes in the context of waste management (Zaman & Lehmann, 2011a; Nizar et al., 2018; Mesjasz-Lech, 2018; Bogusz et al., 2021; Jelonek & Walentek, 2022).

The first regulation of waste at European Union level was contained in the Council Directive of 15 July 1975 on waste (Directive, 1975). It has historically undergone changes. The current document in force is Directive (2008) of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives. This document contains not only the basic definitions and concepts of waste but also the most important guidelines for waste management. The document indicates that in order to achieve a high level of environmental protection, it is essential that Member States, in addition to taking measures to ensure the responsible disposal and recovery of waste, take measures to reduce its production. This includes, in particular, the promotion of clean technologies and recyclable and reusable products, taking into account existing or potential market opportunities. The introduction of a requirement for Member States to develop waste prevention programmes is indicated. They would focus on the key elements of environmental impact and take into account the entire life cycle of products and materials. They should aim to break the link between economic growth and the environmental impacts associated with waste generation. Both stakeholders and the general public should be able to partici-

DOI: 10.34659/eis.2023.87.4.663

pate in the drawing up of these programmes and have access to those already in place. The Directive also sets out key principles, such as the obligation to handle waste in a way that does not have a negative impact on the environment or human health and to encourage the waste hierarchy. The five general principles include prevention (avoidance), preparing for re-use, recycling and other methods. In addition, and most importantly, it sets out mechanisms and recommendations for rational waste management at the government and local government levels. Not insignificant is also Decision (2022). The document lists among its priority objectives: moving towards an economy of prosperity that gives back more to the planet than it takes from it and accelerating the transition to a non-toxic, closed-loop economy in which growth is regenerative, resources are used efficiently and sustainably, and the waste hierarchy is applied.

In Polish legal regulations, the most relevant is the Waste Act of 14 December 2012. (Act, 2013) and the Act on Maintaining Cleanliness and Order in Communes of 13 September 1996 (Act, 1996). The latter specifically refers to municipal waste. Both, to a large extent, practically reflect EU directives.

In Poland, the Zero Waste movement has a relatively short history. Formally, the Polish Zero Waste Association was only registered in 2017 (PSZW, 2023). However, grassroots social movements had already started their local activities earlier. This makes it all the more important to catch up with the implementation of promoting the idea in Poland. Usually, however, similar grassroots social movements start their activities in urban areas. In the case of the ZW idea, this is all the more important, as consumption of goods is greatest in urban areas, as is the problem of subsequent waste management. Analysing the situation of the city of Poznań in this respect, it is possible to assess the processes taking place in other large Polish cities in terms of the potential interest of their inhabitants and authorities in implementing the ZW idea in their areas. Unfortunately, the ZW philosophy in Poland, although widely discussed, has not lived to see implementation on such a large scale as in cities in other countries. Although the measures taken go beyond the obligations arising from waste management legislation, they are still limited to standard solutions (Mesjasz-Lech, 2018).

Research methods

The research presented in this publication was carried out in Poznań, in the period 12.2021 – 02.2022. It was based on an anonymous survey questionnaire. It consisted of a short introduction containing the purpose of the survey, 17 factual questions on the topic of municipal waste, and 3 questions on the metrics of the respondents. It was assumed that respondents would be selected on the condition that they reside in Poznań. Due to the desire to collect a large spectrum of responses, it was necessary to ask a large number of questions. The development of the questionnaire was focused on ensuring simplicity and clarity in the ques-

DOI: 10.34659/eis.2023.87.4.663

tions and the answers that could be given (mainly marking ready-made options). Given the comfort level of the respondents taking part in the survey, a criterion was the number of less than 20 questions and the time needed to read through the questions and complete the questionnaire (max. 10-15 minutes). For this reason, the survey used 12 closed questions with the possibility of selecting one answer, four semi-closed questions (two of which offered the possibility of selecting more than one answer) and only one open question relating to the main issue of the work (question 16). The questions were presented in ascending order from simple to more complex, thus meeting the criterion of increasing the level of difficulty and involvement in completing the questionnaire.

The following factual questions were asked (in brackets, the number of prepared answer options, with reasons asked for some of the negative answers):

1. With what accuracy do you separate your waste? (5),
2. Do you empty, clean and crush recyclable packaging before throwing it in the bin? (3),
3. Do you dispose of glass and paper waste in plastic bags in the container? (3),
4. Do you avoid buying and using disposable products (e.g. nets, cloths, cups, straws)? (4),
5. When shopping, do you pay attention to avoiding products that are packaged in large amounts of materials, e.g. plastic or metal? (3),
6. Do you choose products that are environmentally friendly or packaged in recycled materials? (4),
7. When shopping, do you buy more groceries than you need? (3),
8. Do you think that the information on the packaging "use by ..." and "best before ..." mean the same thing? (3),
9. Do you ever throw away food that is "overdue" or spoiled by mould? (3),
10. Do you dispose of bio-waste in bags? (4),
11. Do you buy second-hand items when possible? (3),
12. Do you choose to repair broken equipment instead of buying new ones? (3),
13. What do you most often do with unnecessary things (clothes, furniture, white and brown goods, etc.)? You can give more than one answer! (6),
14. Do you dispose of hazardous waste such as batteries, medicines, thermometers, fluorescent tubes, and leftover paint at separate collection points in markets, pharmacies or PSZOK? (3),
15. Do you know or do you use Poznań's open cupboards, "GiveBox", "Po-Dzielnia", or Facebook groups for exchanging/dealing with things between inhabitants? (4),
16. Are you familiar with the idea of "Zero Waste"? If so, do they guide your daily life to any extent? (open question),
17. What are your biggest objections to waste management in Poznań? You could give more than one answer! (5).

DOI: 10.34659/eis.2023.87.4.663

The survey metric questions related to: gender of the respondent (2); age (6 age ranges); education (6).

It should be noted that, in addition, the questions were arranged in an order that allowed them to be grouped into thematic blocks. They were designed to elicit responses to specific issues regarding municipal waste and the management system in Poznań on the basis of data obtained from respondents. The first group consisted of questions 1 to 3, which concerned the accuracy and method of waste segregation by the residents and made it possible to check its level. The second group consisted of questions 4-6, aimed at analysing attitudes towards single-use and environmentally friendly products in individual consumer decisions and whether respondents were willing to spend more to reduce their waste. Questions 7 to 10 dealt with bio-waste and food management (buying the right amount, use-by-date terminology and frequency of disposal). Questions 11-13 sought to explore attitudes towards second-hand, broken, unnecessary items, how respondents handled them and whether they were involved in giving them further 'life'. Question No. 14 referred to identifying where hazardous waste is disposed of by residents. Questions 15-16 tested respondents' familiarity with the idea of the ZW movement, initiatives related to it and the degree of its presence in their lives. Question 17 concerned objections to waste management in Poznań. Here, respondents had a choice of prepared answers concerning the daily problems most frequently encountered by users, the waste segregation system, as well as the opportunity to give their own comments and suggestions for improving this system.

Another assumption behind the survey was to select a proportionate number of respondents by age group in order to determine the level of knowledge and involvement among young, middle-aged and older people. In this way, respondents were intended to represent a cross-section of the city's population.

The survey was conducted in electronic form (Google Sheets). This form was chosen due to the popularity of the platform, an intuitive interface for those completing. In addition, the COVID-19 pandemic limited traditional dissemination. The survey was made available to members of the Piatkowo Housing Estate Council (due to the desire to reach a group of respondents over 30 years of age), suppliers of the "Pyszne.pl" company (to reach an audience of 18-30 years of age – mainly pupils and students) and on the Facebook portal of the "Po-Dzielnia" organisation (popularity and so-called large media coverage among Internet users).

The results of the survey were collated in terms of individual response options (quantitatively). This allowed an analysis concerning the depiction of the situation in the city and preliminary conclusions to be drawn. In order to assess the qualitative situation at a further stage, the data obtained were subjected to statistical analysis using the IBM SPSS Statistics programme. The results were prepared in such a way that the different options were given numerical values. Each number was an identifier of the textual answer given. In this way, the pro-

DOI: 10.34659/eis.2023.87.4.663

gram was able to read out the numerical values, assign them to comparative categories and compare them with each other during the analysis. With the programme, it was possible to produce clear graphs showing the results and to juxtapose a selection of two or more questions with the answers using cross-tabulations. This made it possible to easily and clearly see the relationships between the answers to the questions asked in the survey. A comparative analysis was carried out on the answers obtained for questions 1 of: 2 – 6; 2 of 4; 3 of 10; 4 of 5; 5 of 16; 7 of 9; 11 of 12; 11 of 16 and 15 of 16. The analyses carried out in this way allow certain trends and relationships to be shown. They can be used as a basis for the recognition of the current status as a baseline for the potential implementation of the Zero Waste concept in Poznań in the coming years. In other words, they present a picture of the knowledge and potential of the city's residents and their willingness to actively and directly reduce the production of municipal waste.

Each comparison was subjected to a Chi-square test – $\chi 2$ (Pearson). The value of this statistic is an indication of how much the empirical distribution differs from the theoretical one. The higher the $\chi 2$, the greater the probability of finding a difference between the distributions, i.e. the existence of a relationship between the variables. In statistics, the value of $\chi 2$ is informative and the two-sided asymptotic significance, which is expressed as a percentage, is used as an indicator of the validity of the comparison of questions. Summaries were assumed to meet the criterion for statistical significance with an assumed probability of occurrence >95% (p=0.05). For cross tabulations, the number of degrees of freedom (df) is also given.

Question 16 was an open-ended question; however, due to the small discrepancy between the answers given, it was possible to assign them to four distinctive categories and include them in the statistical analysis. The following categories are: know, applies to a large extent; know, applies to a small extent; know, does not apply; do not know.

Two questions in the survey (13 and 17) could not be analysed using the programme due to the possibility of selecting more than one answer. In the statistical analysis performed, it was a prerequisite to have a number of responses equal to the number of respondents. Therefore, in order to facilitate interpretation, the answers obtained to the above-mentioned questions were presented in bar graphs together with information on the frequency of their occurrence.

Results of the research

Poznań in March 2021 was the 5th largest city in Poland by population (547,000). Population density (2.1 thousand/km^2) places the city in 7th position (GUS, 2021). In addition, nearly 100 thousand were unregistered people living and taking advantage of the opportunity to live in the city. These were mainly

DOI: 10.34659/eis.2023.87.4.663

students and people taking up temporary work, including citizens of Ukraine. The largest group in the city's age structure was those aged 30-44 (27%). When taking into account non-residents, the dominant age group changes significantly, accounting for the 19-40 age range (Badam, 2022).

Poznań and the neighbouring municipalities had been managing waste under the Inter Municipal Union 'Waste Management of the Poznań Agglomeration' since 2013. In 2021, all municipalities decided to withdraw from the association and dissolve it (Czerwonak, 2021). Thus, from January 2022, all municipalities will manage waste independently, and from January 2023. Poznań is to start a fundamental reorganisation of the waste management area (BIP Poznań, 2022). The function of GOAP in the city has been taken over by the Waste Management Plant (pol. Zakład Zagospodarwowania Odpadów – ZZO) (Sozosfera, 2021). The waste management fees in force from July 2022 are: PLN 28 per person for properties up to four dwellings and PLN 25 per person above this number of dwellings. For unoccupied, waste-generating properties (e.g. offices, business premises), the fee ranges from PLN 6.35 to PLN 423.33 depending on the declared amount of waste to be collected. For recreational and leisure properties, it is PLN 168 per year (Poznań, 2022). These are the average values among the 8 largest cities. However, the comparison due to different charging systems and discounts is approximate (Kaźmierczak, 2022).

The distribution and collection of the questionnaires took place over a three-month period in 2021/2022. The distributed questionnaires were completed 100% (all responses). The questionnaire was fully completed by 158 people declaring themselves to live in Poznań, of whom 126 people (80%) were women and 32 (20%) were men. There was a range of ages, but the largest groups were between 21 and 30 years old (42%) and between 31 and 40 years old (35%). A small proportion referred to people older than 60 (2) and between 50 and 60 (7). One respondent was younger than 18 years. The majority of respondents (125) had a university education, 32 had a secondary education, and only one had a vocational education. Due to the online distribution method of the survey and its anonymity, it was not possible to carefully select respondents in such a way as to ensure a balance in the number of responses obtained by gender, age and education. At the same time, the similarity of results in terms of gender, age and educational level was random. These responses were not correlated with each other and were not statistically significant. The arrangement of presented results were arranged in the order of the survey questions grouped by assumption. It should be noted that only comparisons of individual questions with each other were presented in this paper, as an attempt to compare responses with metrics such as gender, age, or education proved not to be statistically significant. In addition, the questionnaire was fully anonymous, which made it impossible to subsequently allocate the answers obtained to the addressed groups of respondents.

DOI: 10.34659/eis.2023.87.4.663

According to the answers to question 1, 60% of respondents describe their accuracy of waste segregation as high and 20% as very high, which means the vast majority of respondents (80%) segregate waste properly. Only 3 people indicated low accuracy, and 2 mentioned the impossibility of segregation (lack of acceptance by the community and consent of the flatmates). As many as 71% of respondents declare that their discarded packaging is always emptied, 27% of people do not do it often, and less than 2% do not do it at all. Overall, the majority of respondents take care to reduce the volume of their discarded waste. Nearly 82% of respondents dispose of waste without plastic bags (question 3). About 14% of respondents do this sometimes. Only 4% do so because of their convenience. The majority of respondents place a high value on disposing of household waste without using unnecessary bags.

Nearly half of respondents prioritise avoiding single-use products compared to just over 50% of those who avoid them only sometimes or if they remember to do so. Only 3% of people pay no attention to avoiding said products. Respondents' awareness of reducing single-use plastic is evident. 40% of respondents pay attention to the packaging of the products in the shop (question 4), 44% do so only sometimes, and 16% of respondents do not do so at all. Overall, the majority of respondents do not avoid this type of product in their consumer decisions. Only 4% of respondents prioritise the purchase of environmentally friendly products (question 6), while as many as 76% are willing to buy such a product if the price is affordable. Only 11% will decide to make such a purchase out of necessity. Among the "other" answers, 6 people do not pay attention to such packaging, 6 would like to but have no choice, and 3 place priority on the quality of the product.

41% of respondents believe that they buy the right amount of products for their needs (question 7), 52% note that they sometimes buy more than they need and only seven percent of people explicitly declare that they usually buy more than necessary. More than three-quarters of respondents know the difference between the definitions listed in question 8 ("useful for" and "should be consumed by"), while 27% do not know the difference or think they mean the same thing. This fact may lead some of these people to throw away food that is fit for consumption ("use by" date), misinterpreting the above terminology. More than half of the respondents do not allow food to be thrown away. 40% of people do this only sometimes, and only 9% of respondents do it often. Respondents, as a group, show care about not allowing food to be wasted. The vast majority of people dispose of bio-waste correctly (question 10). Less than 15% do so incorrectly. 19% of respondents dispose of bio-waste in dedicated bags, 56% dispose of it in bulk, while 10% of respondents compost it.

87% of respondents buy or try to buy second-hand items in their purchasing decisions (question 11). The opposite is true for only 13% of those who declare that they only purchase new items. Almost all respondents try to repair broken items but do not always decide to do so due to the economic aspect. Only 5% of

DOI: 10.34659/eis.2023.87.4.663

respondents choose to buy new items directly. The most common answer among respondents in the aspect of question 13 was to give unnecessary things to family, friends or the needy (85%). This was followed by selling, donating to PSZOK or using them in other ways to avoid throwing them away. Among the "Other" answers (8%), donating and exchanging items via the Internet dominates.

Exactly ¾ of the respondents properly handle hazardous waste by handing it over to the designated places, 16% do it only sometimes and 9% do not do it at all (question 14). The majority of respondents follow the rules for separate collection of hazardous waste. More than ¾ of respondents know of places focusing on the idea of sharing (question 15), but only 58% use them sometimes or regularly. Only 12% have not heard of such places. This information testifies positively to the respondents' familiarity with these places. The frequency of use is also at a satisfactory level. Very interesting were the results of the answers to question 16. As many as 84% of the respondents apply the idea of ZW in their lives. Among them, as many as 121 respondents implement it to a considerable extent. Only 4% know but do not apply it, and 12% have never heard of it. The majority of those taking part in the survey are people who are accompanied by the principles of ZW.

In the responses to question 17, there was not much disparity between the number of responses given. The most frequent comments relate to containers for segregated waste being too small (77 respondents), weatherproofing (71 responses), number of containers (59) and frequency of waste collection (53). Among the 'other' items, the most numerous comments (13 respondents) related to the functionality of the bins, objections to the cleanliness of the rubbish sheds and waste collection companies. Some people (15 responses) noted that there is too little education about how to deal with waste and a lack of information about the further "life" of waste, which would significantly increase the involvement of residents.

In the case of the second phase of analysis, cross-checking was carried out to find out the correlations that exist in the inhabitants' behaviour in the context of waste management in everyday life, translating this aspect into purchasing decisions and attitudes towards the environment and ZW principles. The comparisons also served to identify hotspots where there is a lack of sufficient awareness relating to the scale of the problem and education in this area. The analysis of the comparisons allowed some correlations to be made. Table 1, for example, shows that high and very high segregationists scrupulously empty the packaging before throwing it away (28 and 70 people). This is also done by 2 people who are unsegregated (χ^2 37.42, df 8, $p<0.001$).

Those who separate waste with very high accuracy most often dispose of it without plastic bags (22.5%). Those declaring high accuracy (60.5%) also mostly do so (questions 1 and 3, χ^2 45.54, df 8, $p<0.001$). Those who separate waste with very high accuracy mostly avoid disposable products (33.8%). The group declaring high accuracy is not so homogeneous. However, they mostly try to avoid such

DOI: 10.34659/eis.2023.87.4.663

products (56.8%) (questions 1 and 4, χ^2 76.95, df 12, p<0.001). A comparison of questions 1 and 5 shows that those who always or sometimes avoid products packaged in large quantities of materials are most often those who declare high or very high segregation accuracy (115 respondents in total) (χ^2 41.23, df 8, p<0.001). Those who are most likely to go for environmentally friendly products due to price are those with high waste segregation accuracy (8 in total).

Table 1. Comparison of answers to questions No. 1 and 2

Question No. 1 \ Question No. 2			Do you empty, clean and crushes your packaging that is recyclable before throwing it into the bin?			Total from question 1
			Yes, always	Not often	Does not happen	
With what accuracy do you sort your waste?	With very high accuracy	Answers from question 1	28	3	0	31
		% from question 1	90.3	9.7	0	100
	With high accuracy	Answers from question 1	70	23	2	95
		%from question 1	73,7	24.2	2.1	100
	With aver. accuracy	Answers from question 1	11	16	0	27
		%from question 1	40,7	59.3	0	100
	With low accuracy	Answers from question 1	1	1	1	3
		% from question 1	33.3	33.3	33.3	100
	No segregation	Answers from question 1	2	0	0	2
		% from question 1	100	0	0	100
Total from question 2		Answers from question 2	112	43	3	n=158
		% from question 2	70.9	27.2	1.9	

Only a few of the high and very high accuracy groups do not pay attention to price (6). In contrast, those characterised by low accuracy of waste segregation will only choose it if they have to (11.8%) (χ^2 34.94, df 12, p<0.001). A comparison of the answers to questions 2 and 4 shows that regardless of the degree of avoidance of single-use products, respondents mostly (70.9%) always crush the packaging before throwing it away (χ^2 16.57, df 6, p<0.011). 81.6% of those who throw away glass and paper in bulk most often also do so with biowaste (answers to questions 3 and 10). In contrast, the majority of people who dispose of bio-

DOI: 10.34659/eis.2023.87.4.663

waste in plastic bags dispose of the glass and paper fraction in bulk (73.9%) (χ^2 16.89, df 6, p<0.01). With regard to plastic packaging, it is interesting to compare the answers to questions 3 and 10. The result shows that a total of 70 respondents who always or sometimes try to avoid products packed in significant amounts of materials also avoid disposable products. The 13 respondents who do not pay attention to packaging only sometimes avoid disposable products (χ^2 45.62, df 6, p<0.001).

The correlations between the respondents answering questions 5 and 16 were very interesting. 108 respondents who are close to the idea of ZW mostly avoid products packed with large amounts of packaging materials. At the same time, only 8 respondents declared that they do not know ZW principles and do not avoid over-packaged products (χ^2 21.25, df 6, p<0.002). As can be seen from the answers to questions 11 and 16, second-hand items are purchased very often and frequently by people who are close to the idea of ZW (73 and 36 people). This is a behaviour characteristic only of this group of respondents (χ^2 19.15, df 6, p<0.004). At the same time, those who always buy second-hand items very often also decide to check the possibility of repairing broken equipment (44 always, 36 when it is profitable to do so). Only 14.3% of respondents do not buy second-hand items and never decide to potentially repair them when they break down (comparison of answers to questions 11 and 12) (χ^2 11.97, df 4, p<0.018). As indicated by the comparison of answers to questions 15 and 16, among the largest group of people (121) who are accompanied by the idea of ZW, as many as 81 are familiar with product-sharing sites and use them, including 34 on a regular basis (χ^2 41.93, df 9, p<0.001).

The last four comparisons show that there are clear correlations between respondents' behaviours and decisions based on their attitude towards municipal waste and following the '5Rs' principles.

Discussion/Limitation and Future Research

According to Hoornweg and Bhada-Tata (2012), in 2002, there were 2.9 billion urban residents who generated about 0.64 kg of municipal/per capita/day (0.68 billion tonnes per year). In 2012, it was already 1.2 kg of waste per capita per day (1.3 billion tonnes per year) with a population of 3 billion. By 2025, this figure is likely to rise to 4.3 billion urban inhabitants, generating around 1.42 kg per inhabitant per day of waste (2.2 billion tonnes/year). At the same time, about 75% of natural resources are consumed by urban areas, representing only about 2% of the world's surface but generating 70% of the world's waste (Nizar et al., 2018).

When analysing the results obtained in-house, they can be compared with those of Bogusz et al. (2021). However, it should be noted that the cited work, which had a similar idea, was addressed to a broad audience of 3 (and originally

DOI: 10.34659/eis.2023.87.4.663

4) countries without assigning the research survey only to the urban community of one centre. The survey itself was very similar (5 metrics questions and 24 content questions) and also implemented online due to pandemic conditions. Significantly more return questionnaires were obtained (821 in total, of which 180 were from Slovakia and 138 were from Ukraine), with some not being filled out completely. One can, of course, discuss the relatively small number of respondents in the self-reported survey in relation to the population of Poznań, pointing to low representativeness. However, in the work cited by Bogusz et al. (2021), a similar number of responses (Slovakia, Ukraine) allows an assessment of attitudes towards ZW of the entire populations of the countries analysed.

Similar to the Bogusz et al. (2021) publication, the survey was strongly dominated by women. Zatwarnicka-Madura (2013), in a meta-analysis of 32 studies on the impact of gender on pro-environmental behaviour, indicated that women exhibit greater pro-environmental attitudes and behaviours than men. The cited studies also showed significantly higher levels of socialisation, empathy and social responsibility among women.

The premise behind the survey was to select a proportionate number of respondents by age group in order to determine the level of knowledge and involvement among young, middle-aged and older people. In this way, respondents were intended to represent a cross-section of the city's population. Similar to the analysis conducted by Bogusz et al. (2021), a group of relatively young people (18-40/44 years) dominated among the respondents. This may be related to the skills and internet access of this group of respondents. Both studies had a target group with a similar educational background. Of course, it would be optimal to proportionally select the number of respondents by age group or knowledge level to represent a cross-section of the city's population. However, this is not possible for anonymous surveys, especially when distributing questionnaires via the Internet.

A study by Bogusz et al. (2021) shows that Poles were familiar with the concept of ZW in 70% of the surveys. In the case of the urban population of Poznań, this figure was as high as 84%, with Poznań residents indicating its application in their daily lives. A measurable indicator of the application of the concept of ZW is the attitude towards reducing the amount of waste produced by limiting shopping, not wasting food and reusing and/or repairing equipment. In the case of the Bogusz et al. (2021) study, respondents from Poland (without dividing into urban and rural environments) indicated the implementation of these principles to the extent of 52.5% of respondents. Our own research indicates that more than half of respondents limit the purchase of single-use plastic products. A significant proportion of Poznań residents notice and limit the purchase of over-packaged products (40%). At the same time, if the price is affordable, most purchase it. A similar proportion (41%) states that they do not buy excess products in relation to their needs. This is especially true for food products, which more than half try not to throw away.

DOI: 10.34659/eis.2023.87.4.663

In this context, the results relating to two concepts appearing on the packaging of food products, i.e. 'use by' and 'best before', are very interesting. The first term refers to the safety of the food and the potential negative impact on health once it has been exceeded, and the second refers to the quality of the food. If the consumer follows the manufacturer's storage guidelines, the food will certainly still be fit for consumption despite the expiry of the indicated date. The only change may be the loss of the original taste or texture, but this does not qualify the product for discarding (Sanepid Łobez, 2021). It is widely believed that the two concepts are confused in Poland. The research shows that in Poznań, this is the case for just over ¼ of the residents surveyed. At the same time, a very large number of respondents in Poznań admitted that they buy second-hand products (almost 90%) and also try to repair them and pass on the unnecessary ones to others. According to Rejman et al. (2015), when considering consumer decisions, the aspect of environmental and social responsibility should be taken into account, although the basic determinants of choice, which mainly include needs, preferences and the possibility of their implementation, should not be ignored.

Research results from the European Union (2020) report on the attitudes of EU citizens towards the environment show that 53% consider that protecting the environment is very important to them, and 43% of Europeans consider this issue to be important (in Poland 42% and 46% respectively). In turn, more than 3/4 of respondents agree that environmental problems have a direct impact on their daily life and health. However, a mere awareness of this impact does not guarantee the right public attitudes. Behavioural changes in this area are long-term and do not occur simultaneously (Płatkowska-Prokopczyk, 2017). The work of Bogusz et al. (2021) shows that the vast majority of respondents in the countries surveyed (90% in Poland, 94% in Ukraine and 80% in Slovakia) consider the problem of environmental degradation to be important. They indicate that economic development, mass production and consumption, and population growth have led and continue to lead to an increase in the negative human impact on the environment.

The Waste Management Report of the Polish Ministry of Climate and Environment shows that the vast majority of respondents (86%) are willing to reduce the purchase of material goods in the interests of conserving natural resources and reducing the amount of waste produced, with 44% declaring a firm attitude in this regard. This percentage is highest among Poles with a university education (91%) and those with the highest net income per family member (90%). Those with lower earnings – up to PLN 1,500 (19%) and those with basic vocational education (23%) are least likely to reduce their purchases (PBS, 2021a).

Research by DANAE (2019) for the Ministry of Climate and Environment indicated that those with the highest incomes are more likely to take measures to reduce the amount of waste generated at home (64.8%) than those with the lowest incomes (54.5%). However, what is more interesting is the reason for not doing so. For the lowest earners, the most common reason is a lack of knowledge

DOI: 10.34659/eis.2023.87.4.663

about waste reduction (41.6%), against 27.3% for respondents in the highest earning group. Interestingly, in the latter, the main reason is that it is not important to them (29.5% of respondents), while among the lowest earners, it is only 10.4% (Dąbrowski, 2021). Additionally, it is mainly men who indicate that they do not know how to proceed to reduce waste (40.2%) and believe that the level of waste generation in the household is minimal (28.8%) (DANAE, 2019).

Interestingly, among respondents to the survey commissioned by the Ministry of Climate and Environment, two options predominated, indicating the main decision-makers who should make decisions about how nature's resources should be used and protected in a given region. Those indicated were the residents themselves, e.g. of a particular municipality – 32%, and the regional (local government) authorities – 30%. The size of the respondents' income did not generally influence such indications (PBS, 2021a). This is a very positive result, indicating two very important aspects. On the one hand, residents themselves set higher requirements and expectations for their own behaviour regarding responsibility and care for the environment and its protection in the place where they live, and on the other hand, they address similar expectations to local authorities, which should represent their interests. This is reflected in studies by Kołodziejczak (2016) and Płatkowska-Prokopczyk (2017).

Kołodziejczak (2016) points out that it is very important for the proper functioning of local social innovation systems to implement the concept of embeddedness. According to the European Commission (2013), social innovation is defined as the development and implementation of new ideas (including products, services, and models) to meet social needs and create new social relationships and forms of cooperation. Among social innovations, distinctions are made between innovations aimed at the development of sustainable areas (in the social, economic and environmental dimensions of the functioning of societies), and innovations focused on organisational changes in relations between different institutions and their stakeholder groups. Their implementation does not have to be profit-oriented and does not require large financial outlays like technological innovations. A prerequisite for the implementation of social innovations is social participation and the use of human and social capital. Among other things, they can create new social relations, lead to new forms of governance and collective action and improve integration. It is emphasised that social innovations are those that respond to societal needs not traditionally met by the market or existing institutions. Emphasis is placed on issues such as designing and implementing better ways of meeting social needs or new ideas that solve existing social, cultural, economic and environmental challenges for the public good.

The concept of rootedness indicated in Kołodziejczak's (2016) work has its origins in the work of social anthropologists from the early 1940s. It has been adapted to the specifics of spatial economic research. Grzeszczak (1999) understands by rootedness the entrenchment of various actors in a particular environment or setting, as well as in the regional structure or in local practices. By con-

DOI: 10.34659/eis.2023.87.4.663

trast, according to Hess (2004), actors are rooted in networks of relationships and institutions, and the essential spatial scale of their analysis is the local or regional scale. Rootedness is related to the idea of sustainable development, indicating the necessity to adopt a transformation strategy that does not destroy the natural, economic and social resources located in a specific area and that makes it possible to continue development in the future. In a nutshell, it can be pointed out that the self-reported results of Poznań's residents indicate that they are, like in national surveys (PBS, 2021a), strongly connected to their contractual "small homeland". They feel co-responsible and are willing to implement the vast majority of ZW principles into their households. This is an expression of the practical implementation of local patriotism in the above form. They expect the same from their representatives in local government. Another problem is the difficult relationship between institutions and organisations, which generally work separately for social innovation, but there is no coherent cooperation between them, which prevents the creation of a local system of the above innovations. It is therefore important to create an institutional and financial basis for the innovative development of local government units on the basis of the concept of rootedness, the functioning of organisations and societies (Kołodziejczak, 2016).

The surveys also indicate that the residents of Poznań have a high level of awareness of the environmental impact of the waste they generate. This is also reflected in a nationwide survey by the Ministry of Climate and Environment (PBS, 2021b). Respondents identified the most important actions to effectively improve waste management in Poland. They believed that there should be measures to educate and promote correct waste management (15%), to control and take care of segregation (14%), to reduce costs for waste management and to introduce incentive subsidies (8%). Other suggestions made by respondents included: increasing the number of bins, points where waste can be returned/managed (8%), introducing deposits for bottles, glass (e.g. in the form of vending machines) (5%), and eliminating illegal dumps (2%).

Płatkowska-Prokopczyk's (2017) publication showed no significant differences between urban and rural residents in terms of their environmental awareness and environmental attitudes and behaviour. Therefore, it can be concluded that changes in the sphere of awareness and specific pro-environmental actions of the surveyed community are not related to the place of residence. Environmental awareness and knowledge alone do not guarantee appropriate attitudes and behaviour, and changes in this area are long-term and do not progress "overnight". The author's research has shown that although environmental knowledge is not always reflected in the daily attitudes and behaviour of the respondents, positive changes towards caring for the environment can be observed.

New ideas and concepts of urban development, such as 'Smart City' (SC) – are based on a description primarily of improving the functioning of the city using information and technology (ICT) tools (Batty et al., 2012). The term 'smart city' itself, introduced in 1990 (Al Sharif & Pokharel, 2022), does not have a sin-

DOI: 10.34659/eis.2023.87.4.663

gle precise definition that comprehensively captures the tenets of SC. A compilation of contemporary definitions is presented by Dziadowicz (2022). Currently, researchers point out that technology is just a tool that can be used to improve the quality of life and should serve people, not the other way around (Gotlib & Olszewski, 2016). In the case of Dziadowicz's (2022) analysis of the readiness to implement the idea of SC on the basis of the strategic documents of 26 cities with more than 100,000 inhabitants in Poland, it was shown that in the case of Poznań, the concept appears only at the stage of operational goals and actions in the city development strategy. At the same time, in the matrix of 6 areas of activities indicated in the strategic documents (economy, mobility, society, management, environment, quality of life), this city includes the first four. The environment and quality of life of the inhabitants are omitted. Only four cities out of the analysed cities include all areas (Białystok, Bydgoszcz, Kielce and Wrocław).

According to Vishnivetskaya and Alexandrova (2019), the generation of smart cities, 'Smart City 2.0' – is a phase of city development in which the authorities play a leading role. At this stage, they are the initiators of the implementation of new technologies, as well as ideas, the use of which should positively improve the lives of citizens. Smart cities are characterised by smart governance. Authorities should pay attention to all infrastructure sectors at every stage of city management. When planning the budget and making executive decisions, representatives of the administration must not overlook any of the sectors that are important for the life of the city (Jelonek et al., 2020). The use of modern waste management methods significantly increases the aesthetics of the city. This benefits the environment, society, and the budget of the territorial unit (Jelonek & Walentek, 2022).

According to Becla and Czaja (2022), the turn of the twentieth and twenty-first centuries is characterised by rapid civilisation processes, expressed in the creation of the information society and the knowledge economy, as well as the greening and virtualisation of governance and the design of new social structures. Researchers dealing with this problem often forget that the proper development of human civilisation must combine economic, social, ecological and institutional aspects. This also applies to urban sustainability. This implies the need for a holistic, systemic and dynamic approach to them, i.e. the need to combine the three basic paths to achieving sustainability and sustainable development under the conditions of an information society, knowledge economy and wisdom. In other words, all activities should be assessed together through knowledge, sustainability, sustainability and wisdom.

The problem of waste management is very complex. It also relates to urban waste management. In developed countries in this area, we can speak of a polycentric system. It is regulated nationally and internationally (e.g. EU), but its organisation and related regulations are set locally (Ciechelska et al., 2022). By reducing the amount or nuisance of waste, actors benefit at different scales, from the individual to global organisations (Ostrom, 2012). At the same time, some

DOI: 10.34659/eis.2023.87.4.663

waste fractions are completely or partially excluded from this system (e.g. bulky waste, used clothing, food, green waste or metals). These are partly managed by informal ventures, whose organisation, modus operandi, scale or spatial extent vary. The formal system is hierarchically organised and strictly regulated by law. Informal activities are subject to local conditions and customs. For this reason, urban waste management in developed countries is a complex mosaic of activities, organisations and institutions that contribute to reducing waste and its nuisance (Ciechelska et al., 2022). On the other hand, the waste management sector receives much less attention than other urban problems, even though it is one of the most challenging elements in urban governance, and the quality of services in this area is one of the good indicators of urban governance (Nizar et al., 2018).

Waste reduction efforts are costly. As Mesjasz-Lech (2018) states, they should be undertaken primarily when targets for their level are not achieved. The above can be understood as the failure of administrative units to achieve adequate levels of municipal waste recovery and recycling, which are regulated in the Polish Act on Maintaining Order and Cleanliness in Municipalities of 1996 (Act, 2016). Thus, the financial factor is the main motivator for top-down (local government) actions. This element could also be an argument for implementing the idea of ZW in a bottom-up form. Community participation in such an action in developed countries reduces collection costs and could influence the establishment of recycling and recovery facilities (Nizar et al., 2018).

Unfortunately, among the numerous literature on the issue, there are few items indicating the economic dimension of the gain from the implementation of the concept, using specific administrative examples. Nizar et al. (2018) point to progressive cities in this area, such as San Francisco, with a population of 850,000. It achieved 77% waste acquisition after implementing the ZW concept, which is the highest in the United States. Michniewska and Grodkiewicz (2017) report that this value was 80% in 2001, making San Francisco the cleanest city in North America. This was achieved through a three-pronged approach: enforcing strict waste reduction laws, working with waste pick-up companies and working to create a culture of recycling and composting through incentives and collaboration with the public. In the case of Banda Aceh City in Indonesia, the implementation of ZW was done through incentives or sanctions on residents. This effort was to encourage or force people to do their own waste processing to possibly reduce the mass of waste sent to landfills (Nizar et al., 2018). Efforts undertaken in England to promote ZW between 2000 and 2010 helped to reduce the amount of waste generated by households by up to 29% (Phillips et al., 2011). The concept of ZW has been embraced by policymakers in the examples presented because it stimulates sustainable production and consumption, optimal recycling and resource recovery. Specialists in waste management systems recognise and apply it in different ways (Zaman, 2015).

Due to the complexity of urban waste management and the multiplicity of factors influencing the end result, there are hardly any sources in the world liter-

DOI: 10.34659/eis.2023.87.4.663

ature reporting on the gains from implementing the ZW concept in the form of financial values. However, there is no denying that this is the argument that best influences municipal authorities, regardless of the geographical location of the administrative unit. Most cities include in their strategies both executive and organisational tasks within the scope of the ZW philosophy. They concern all groups of city stakeholders who are involved in the process of generation, collection, processing and disposal of municipal waste and organising the waste management system. As can be seen from the presented activities, an important element of the ZW philosophy is to make the urban community aware of the role of appropriate pro-environmental behaviour. Unfortunately, the ZW philosophy in Poland, although widely discussed, has not been implemented on such a large scale as in cities in other countries. Although the measures taken go beyond the obligations resulting from waste management legislation, they are still limited to standard solutions (Mesjasz-Lech, 2018).

Given Poznań's current situation with regard to the organisation of waste management, steps could be taken to implement the concept of ZW within the city. The city and its subsidiaries have already implemented similar campaigns targeting residents in the case of, for example, water conservation and retention (Aqaunet, 2022; Portal Komunalny, 2022). The aforementioned campaigns were very well prepared, widely publicised and reached through various channels (public transport, visual advertisements, city and company website, local radio and TV broadcasts, leaflets, competitions in schools, etc.) a wide spectrum of residents of the city and the Poznań agglomeration. A similar campaign should be prepared in the context of waste management and the resulting savings for the average city resident. This is all the more so as, on the one hand, the "Smart City Poznań" application has already been in operation in Poznań since 2011 (Łaźniewska, 2019; Smart City Poznań, 2023). It could inform about the standards of waste handling and, for example, indicate places for transferring unnecessary items to appropriate points. On the other hand, such points and social activities in this area already take place in Poznań (e.g. Po-Dzielnia, GiveBox). Undoubtedly, the level of awareness of residents for the idea of ZW and environmental protection is also very important. The unconvinced and the doubters, through appropriate awareness-raising activities, would have the opportunity to test the functioning of the new idea experimentally, also through the economic dimension (slower increases in waste collection fees compared to other similar cities). However, this would require further action along two lines. On the one hand, convincing the city authorities to implement and realise the ZW idea, including the preparation of a professional social campaign, and on the other hand, monitoring the progress of implementation and further research within the scope of analyses of potential benefits for the city and the resident. Awareness campaigns about the threat posed by waste to the city's ecosystem should, therefore, be the basis of the ZW philosophy in the city. However, they must be complemented by concrete tools to reduce the pressure of city residents and those using its infra-

DOI: 10.34659/eis.2023.87.4.663

structure on the environment (Mesjasz-Lech, 2018). Nizar et al. (2018) indicate that ZW campaigns in waste management can be implemented in the community to raise awareness and to avoid creating excess waste.

On the other hand, the local government should prioritise and use ZW in a comprehensive strategic work plan. After implementation, an evaluation of the performance of the ZW should be carried out so that the extent of success is known (Nizar et al., 2018). This can also translate into an element of community dialogue for improving waste management in the city. This, in turn, will influence the way the city's management is organised and the economic outcomes. Representatives of the different cities analysed in Jelonek and Walentek (2022) confirmed that creating plans to reduce waste in urban spaces and enforcing the positive behaviours and practices outlined in such a plan is a win-win solution for the ecosystem, residents and city budgets. A waste management programme should focus on increasing the role of the community in handling waste, not just adding equipment to collect rubbish (Nizar et al., 2018).

The creation of a plan adapted to the needs of the city and its inhabitants has been identified as an initial step in the process of rational management of its waste. This one, in turn, can be reduced in description to three general commands: plan, apply and motivate (Jelonek & Walentek, 2022). In the work cited above, the solutions presented are also largely 100% in line with the ZW hierarchy. The main differences are evident in the final stages of management – while most cities favour incineration or landfilling of mixed waste, cleared of recyclable fractions. The current ZW hierarchy mainly focuses on excluding non-recyclable waste. Countries, on the other hand, can move towards the ZW goal by developing a National Zero Waste Strategy and by integrating and promoting the ZW initiative itself in waste management policies (in communities and industry) (Zaman, 2015). To date, national and provincial governments often only set targets for waste recovery and recycling and sometimes allow funding to be obtained for waste management. In practice, however, waste management (understood as collection, bin display, and container operation) is carried out at the local level, possibly with regional support of shared facilities (Michniewska & Grodkiewicz, 2017).

Some consider the worldview of the ZW community to be deviant in nature, and ZW publications, despite being pro-environment, are treated as "radical ideas" or considerations "on the border between environmental concern and orthodox philosophy". In the case of ZW, the rhetoric of not only moral but also mainly financial benefits can be counterbalancing (Grażul-Luft, 2022). The ZW rules communicate that the emphasis should be on resource efficiency and waste avoidance, thus eliminating the need for waste management itself. Hence, in the ZW hierarchy, recycling (which is a much more environmentally friendly form of waste management than the still very common landfilling) is ranked lowest and is assumed to be used only for the treatment of residual products whose generation could not be avoided (ZWE, 2022). The increased waste generation is due to

DOI: 10.34659/eis.2023.87.4.663

a linear material flow system, where the product will end up in a landfill anyway. It is also related to the linear economic system that currently leads the world. Meanwhile, the ZW concept is the inverse of the linear system, pointing to the circular system as the optimal system (Nizar et al., 2018). This is also an important factor in the denial of the validity of the implementation of this idea and its criticism.

ZW is more about an idea and a goal than a specific outcome we want to achieve. In the concept, there are no targets to aim for. ZW is a philosophy of continuously improving one's lifestyle so as to avoid waste. For obvious reasons, it should be seen as a challenge to ourselves and the world around us (Michniewska & Grodkiewicz, 2017). The meaning and scope of ZW is a holistic approach that considers the entire life cycle of a product, from the sourcing of raw materials to the final sale and consequent processing or disposal (Zaman, 2015). In a sense, ZW refers to a way of waste management and production planning that focuses on prevention as a counterweight to waste management in the style of an 'end-of-pipe' approach. This could bring about revolutionary changes in the approach to material flows not only in industry but also in society. The goal would be non-waste – zero waste (Michniewska & Grodkiewicz, 2017). Eliminating incinerators, landfills, and societies throwing away disposable products and creating sustainable waste management communities are ideals of ZW. We cannot expect ZW implementation to work in the short term or, for example, within a year, but we can plan for a situation that is very close to ZW in the next five or ten years (Nizar et al., 2018). On the one hand, the concept of ZW does not limit rational waste management; however, on the other hand, it requires the optimisation of our existing efforts to recover and reuse raw materials, thus aiming to create and apply new, innovative methods that minimise destructive methods such as incineration or landfilling (Michniewska & Grodkiewicz, 2017).

Regardless of the current state of diffusion of this philosophy, there is no doubt that it is not controversial per se, and it is unquestionable that its development and adoption by society as a whole as a valid method of dealing with scarce raw materials should be pursued (Michniewska & Grodkiewicz, 2017). The implementation of the ZW philosophy into the environmental strategies of cities makes it possible to create closed economic cycles in which waste is reintroduced into the system as full-value products. The effect of the introduced solutions is to reduce not only the amount of waste in general but also to increase recycling and reuse levels. It should be noted that municipal waste is characterised by properties allowing it to be processed or disposed of other than by landfilling. Unfortunately, solutions applied within the framework of the urban ZW philosophy in Poland are not as innovative as in other countries. The availability of selective waste collection points in Polish cities is not as common as in foreign cities, and the lack of understanding of the mechanisms of nature's operation and the limits of its exploitation leads to inappropriate use of available solutions or even their non-acceptance (Mesjasz-Lech, 2018).

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Dziekański et al. (2023) point out that waste is a symbol of inefficiency in any modern society and a waste of resources. To prevent further depletion, we need sustainable consumption and strategic waste management systems based on waste avoidance, material efficiency and resource recovery. And given the state and structure of the local economy and the quality of life of the local community, waste management (its structure and quantity) can be a barrier to the forward-looking development of the green economy of these cities and municipalities.

Whether the decision of the city authorities to withdraw from GOAP will prove to be correct in economic terms for the city's residents and ecologically for the environment – time will tell. Nevertheless, this may be a good time to implement and widely disseminate the ZW idea among decision-makers and the city's community. There is an opportunity to implement this idea at a very good time in the reform of the city's waste management.

The subject of the study, which has been raised and described, is a kind of contribution and a suggestion for what should, in time, be the subject of a broader study. It would address the possibility of implementing the ZW concept itself in the waste management of Poznań and of monitoring and analysing its development, its impact on its budget and that of its inhabitants and the environment.

Conclusions

The implementation of the ZW strategy, which has been extensively discussed with examples of cities and regions following its principles, brings numerous benefits. These include waste reduction, economic gain, and the development of civil society in terms of responsibility for the environment in which it lives and functions. Using these examples, it is noticeable that any city that takes steps to change its waste management and re-evaluate its standard approach to waste management benefits within just a few years, despite the initial costs incurred.

The research carried out, and the analysis of the social movements operating in the City of Poznań show that there are now grassroots initiatives related to the idea. Among the inhabitants, a group of people living according to the principles of ZW is already present. They are acutely aware of the impact they have on the environment in their daily lives. They also have the goal of changing their habits and perspectives on the generation and management of municipal waste with a strong priority on waste reduction. This gives the municipality some confidence and a solid guarantee of success for the measures potentially implemented and the commitment of the public institutions involved.

The studies carried out refer to a narrow spectrum of recipients, which was the result of their implementation at the time of the COVID-19 pandemic. Therefore, in order to obtain a broader picture of the situation, another analysis should be carried out on a much larger scale at a later date. This could be carried out by

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means of surveys conducted by the Waste Management Plant (ZZO) in Poznań, e.g. when residents sign new waste collection declarations. Increasing the effectiveness and involvement of respondents could be ensured by a proposed symbolic discount in the tariff for the above service.

The research and observations carried out allow the following conclusions to be drawn:

1. 'Zero Waste' has a real impact on waste reduction and can provide a development advantage for Poznań beyond waste management.
2. The results of the questionnaire survey testify to the existence of a certain target group of city residents expecting a change in waste management in the city, as well as grassroots initiatives (e.g. Po-Dzielnia and Uwaga śmieciarka jedzie) which, with the support of the city authorities, could be organisations coordinating the implementation of Zero Waste principles in Poznań.
3. Reducing waste using the ZW concept is economically viable and could be implemented in Poznań's conditions.
4. The organisation of waste collection guarantees the fastest results in changing and optimising the waste management system, and this can be achieved by implementing the Zero Waste principles at a favourable time for the current reorganisation of the management of this system in the city.
5. It would be advisable in the future to conduct broad social campaigns (e.g. educational and marketing) using various forms and means of communication (e.g. local media, visual advertising at bus stops, leaflets, etc.) addressed to the city's inhabitants, pointing out the benefits for citizens and the city from the implementation of the Zero Waste principles in Poznań.
6. Prospective monitoring of the effects of implementing the principles of ZW in the city through cyclic repetition of surveys (including surveys) may translate into the possibility of estimating the effect of ecological gain for the city in measurable (economic gain and savings, reduction in waste generation) as well as non-quantifiable (greater ecological awareness and shared responsibility of residents for the environment) forms.

In conclusion, the implementation of the principles of waste reduction and zero-waste living, the basis of the ZW concept in the City of Poznań, can bring tangible and intangible benefits both for its inhabitants, various businesses and the city authorities. As research shows, the city's society is already ready to embrace the above idea. In addition, transparency in waste management activities increases public confidence and involvement in the implementation of correct waste segregation. Given the current process of restructuring the city's waste management, there is a unique opportunity to implement and widely promote the concept in the city. The presented action strategy is far-sighted and provides a real opportunity to reduce waste, as well as to gain a development advantage for the city, its competitiveness for potential investors and its attractiveness for prospective residents. Through an overall optimisation of the use of raw materials, energy and labour inputs needed for waste management, Poznań

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can also be seen as a pioneering, visually and marketing "environmentally friendly" city in this area.

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DOI: 10.34659/eis.2023.87.4.663

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CZY MOŻLIWE JEST WDROŻENIE IDEI ZERO WASTE W GOSPODARCE ODPADAMI W POZNANIU?

STRESZCZENIE: Celem pracy było rozpoznanie świadomości i gotowości mieszkańców Poznania do wdrożenia idei Zero Waste (ZW) w tym mieście. Zbadano także poziom wiedzy mieszkańców odnoszący się do zagrożeń wynikających z powstawania odpadów komunalnych oraz znajomości i stopnia kierowania się zasadami ZW. Powyższe badania zrealizowano poprzez ankietyzację mieszkańców. Artykuł jest próbą odpowiedzi czy mieszkańcy dużego miasta w Polsce są gotowi do wdrożenia systemu wspierającego powyższą idę na swoim terenie. Przeprowadzone badania prezentują poziom przygotowania (gotowości) Poznaniaków oraz uwarunkowania wpływające na możliwość realizacji założeń ZW w analizowanym mieście. Zebrane wyniki po analizie statystycznej pozwoliły na wyciągniecie wniosków wskazujących na znaczną gotowość respondentów do wdrożenia idei ZW w Poznaniu. Wskazano potencjalne rozwiązania, będące wstępną koncepcją ograniczenia powstawania odpadów komunalnych za pomocą promocji ruchu ZW w mieście. Kwestia ta jest to o tyle istotna, że Poznań jest obecnie na etapie znacznego przebudowywania swej polityki komunalnej odnoszącej się do gospodarki odpadami.

SŁOWA KLUCZOWE: idea Zero Waste, odbiór społeczny, możliwość wdrożenia, miasto Poznań

DOI: 10.34659/eis.2023.87.4.663