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SOCIAL PARTICIPATION AND LOGISTICAL ELEMENTS OF CEMETERY WASTE BIOFRACTION MANAGEMENT

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ABSTRACT: In the 21st century, waste is a growing problem and must be considered one of the essential elements of creating conditions for sustainable development. The article pays special attention to the biofraction of cemetery waste, and interviews with cemetery visitors made a possible determination of its place among other wastes produced in the cemetery. The willingness of cemetery visitors to participate in the logistics of the cemetery waste management system was also tested. The article also presents selected elements of cemetery waste management logistics. The system should consist of several subsystems. Subsystems of waste minimisation "at the source" and waste segregation, disposal, and secondary management were considered crucial. In addition to the logistics mentioned above, subsystems were proposed to include innovation in cemeteries, the biotechnology of composting/vermicomposting of the biofraction, and segregation on-site by those cleaning their graves. The cemetery biofraction represents a waste suitable for on-site management, increasing the potential for environmental, social, and economic savings. The issues under consideration are part of the problem of integrating the cemetery biofraction into the green recycling system in force in Europe. Logistics for management of other cemetery wastes (plastic, metal, glass, and paper), which require subsystems involving their long-distance transportation, should be limited at the level of purchase by cemetery users. From civic participation in the control of logistical improvements, the entire cemetery waste management system will gradually evolve.

KEYWORDS: Cemetery biofraction, participation, logistics in waste management

Introduction

The increase in human well-being is due to the development of civilisation. It applies to all fields of industrial and organisational activity, but in addition to the benefits, it entails some consequences and burdens on all planes in which man tries to organise his well-being: social, economic, and natural. A consequence of all human activity is waste. Accompanying man in the 21st century, it touches and leaves a negative footprint in all these spaces, all the more so as its volumes continue to grow. Waste management costs money, and the impact of waste, especially hazardous waste, threatens social space and leaves traces in nature.

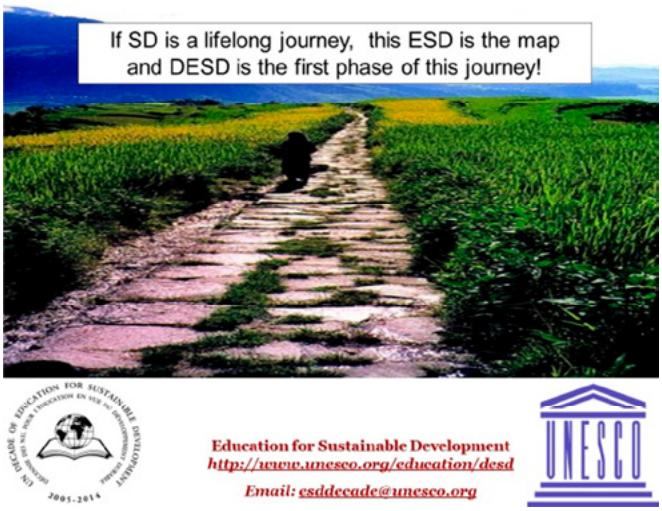
The steady increase in waste results from economic growth and the easy disposal of things less needed. Competition in sales markets also results in the proliferation of showy packaging, generally designed for single use. Consumerism and the pace of civilisation foster a growth of waste, waste of resources, and many difficult intellectual and moral choices (Tofler,1999).

It contradicts the idea of environmentalism, which considers ever-increasing material and energy conservation as one of its most essential principles. This attitude is in line with sustainable development (Figure 1), for which efforts have been made for several years to educate societies across the planet.

On the path to a sustainable Planet, continuing education is essential. In the conditions of the European continent, it was created in the form of systemic activities. So far, the Decade of Education for Sustainable Development (2005-2014) (Hejs, 2007; Kostecka, 2009), the International Year of Biodiversity (2010), and the Decade of Biodiversity (2011-2020) have been organised, and the Decade of Ecosystem Restoration (2021-2030) is ongoing.

The waste issue cannot be overlooked at any point in sustainability education efforts. When we consider the problem of sustainable waste management, it should be emphasised that activities that cause or may cause waste should be planned, designed, and conducted to:

- prevent the generation of waste,
- ensure environmentally safe use of waste, if it could not be prevented,
- provide an environmentally compliant way of dealing with waste that could not be prevented or utilized (Uchwała, 2023).



SD – sustainable development; ESD – education for sustainable development; DESD – decade of education for sustainable development

Figure 1. The role of education in creating a sustainable reality

Source: Hejs (2007).

In Polish reality, the necessity of minimising generated waste was pointed out by Kempa (2001) (Figure 2). This necessity is now emphasised in many European legal acts and also in the Polish National Waste Management Plan 2028 (Uchwała, 2023) and the amendment to the Law on Maintaining Cleanli-

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ness and Order in Communes (Act, 1996). Acceptance of measures to minimise waste requires legal reservations, a series of educational activities, and financial support for a constantly improving waste management organisation (Figure 2).

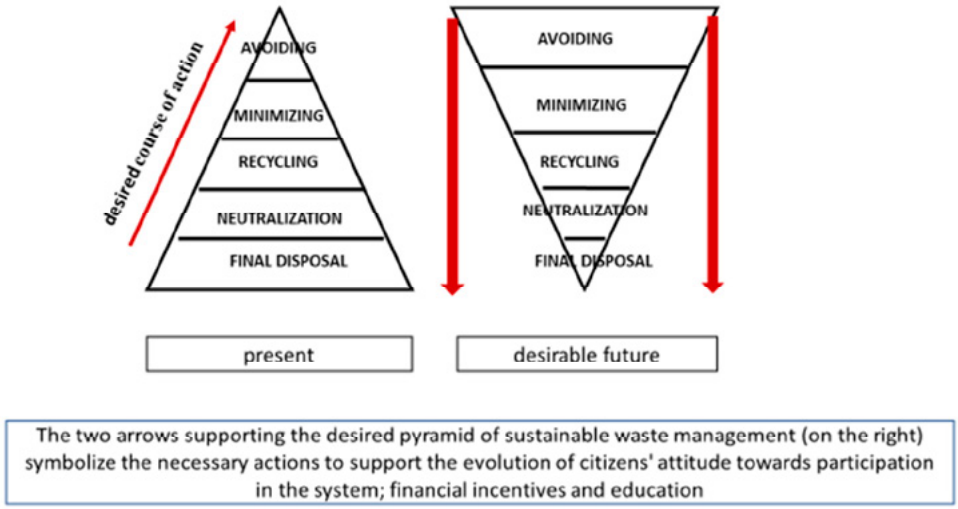

Figure 2. Actions toward sustainable waste management

Source: authors' work based on Kempa (2001).

Waste accompanies the activities of various industries, commerce, tourism, services, crafts, education, and the "social part of industry". Waste is also created in the home kitchen or the cemetery.

Among waste materials, it is worth noting those generated at cemeteries. The directions of changes in the contemporary design of cemeteries in Europe are indicated by Długozima and Rej (2014). Although compared to all municipal waste generated, cemetery waste is usually a small group (about 1%) compared to all the waste generated, they are a problem for the municipal management system often due to the systems in cemeteries to allow their segregation, the lack of the habit of segregating them by visitors and also the age-old and extensive culture of caring for the graves of the dead (Kostecka et al., 2024). Due to the usually unconsidered composition of cemetery decorations, this waste is diverse, mixed, and highly contaminated. The heterogeneity of cemetery waste is a significant impediment to its proper management. The problem of reducing the deposition of cemetery waste in landfills due to its natural or energetic use has been addressed by Hussová (2013), among others.

Part of cemetery waste is biodegradable waste (e.g., live flowers and grounds from the contents of pots, flowers from wreaths, weeds and branches from tending the area around graves).

Given the growing requirements for a green recycling system for biowaste in Europe, including that generated in cemeteries, properly compliant waste management is also becoming important. Municipal waste management (which in Poland includes cemetery waste) is implemented by municipalities. Its proper functioning, therefore, also requires the active interest of residents, in this case – cemetery visitors. Indeed, the key to success in cemetery waste management is not only the proper organisation of waste collection by the relevant municipal institutions but also the active involvement of cemetery visitors in the system. Not without significance is their knowledge and conscious use of it to reduce the generation of cemetery waste. Thus, in all elements of the problem mentioned above, public participation plays an important role, that is, the conscious participation of citizens in the system and even its co-creation, and participation can take various forms (Wójcicki, 2018).

In Poland, the historical tradition of caring for and decorating the graves of loved ones of the deceased, burning candles, and having a funeral ceremony richly decorated with flowers plays an essential role in the generation of cemetery waste. These phenomena and accepted customs also affect the quantity and quality of waste generated in cemeteries.

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The study aimed to assess the interest and knowledge of visitors to selected cemeteries about their related biowaste production. The discussion of survey results emphasised the need for cemetery waste generators to participate in the cemetery waste management system and outlined new elements of the logistics of this management.

Research Methodology

An introduction to the analysis of the waste problem was included inan interview study. Using the example of visitors to several cemeteries (Pobitno in Rzeszów, the cemetery in Łańcut, Głogów Małopolski, Boguchwała and Tyczyn – southeastern Poland), a willingness for involvement in segregation of the clean bio fraction in appropriate containers was determined. The willingness of cemetery visitors to participate in the logistics of the waste management (GO) system was also assessed. In a face-to-face interview, 150 visitors (who agreed to participate in the study) to the listed cemeteries were asked close-ended questions with the possibility of providing open-ended answers (the questions asked are provided in the tables of respondents' answers, Tables 1 and 2). The interview data obtained was analysed using a Microsoft Excel spreadsheet with calculated averages documented in percentages.

Based on the literature on the subject and our own experience, new measures have been proposed to expand the logistics of cemetery fraction management to create closed circuits.

Research results and their discussion

One hundred and fifty people interested in responding took part in interviews. They were selected randomly; the represented group was mostly women (65%). Among the interviewees, representatives of the age group of over 50 years (58%) predominated.

Presence of biofraction against other cemetery waste

The answers provided show that the waste of the five analysed cemeteries is dominated by candles, glass, and plastic (in 73% of the respondents) (questions and answers in Table 1).

It can be concluded that grave visitors are more likely to bring artificial flowers to their deceased, as they rate such waste in more significant numbers (62%) as dominant in the mass of cemetery waste they produce. Only 35% of people by stating the predominance of natural flower waste allows one to believe that this is what they buy to decorate the grave, and then the vast majority (58%) segregate their waste (Table 1). Those who took part in the survey generally segregate the waste they produce (58-69% do so).

Table 1. Presence of biofraction versus other cemetery waste through the eyes of surveyed cemetery visitors. Responses in %

Research assumption	Natural flower waste	Artificial flower waste	Weeds and ground sweepings	Candle waste, glass, and plastic	Other, what?
Your cemetery waste is predominantly*; **.	35	62	35	73	-
What do you segregate at the cemetery*?	58	62	62	69	leaves
Do you take any cemetery waste home*?	35	35	-	8	-
If so, why? How do you accomplish this? **	Waste of natural flowers for compost, artificial flowers for reeds, candles washed and reused				

* more than one answer could be selected; ** during the interview, they were asked why the indicated waste was prevalent, how it was transported home (compiled from survey results).

Respondents sometimes take their cemetery waste home. It applies to natural flower waste, which they compost in their gardens. It can usually be done by those who visit the cemetery by car. Less often, those who use public transportation do so. Some respondents take home artificial waste

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flowers, as well as candles, glass, and plastic lanterns. They explain this by recycling these materials, refreshing artificial flowers and reusing glass lanterns after washing or cleaning them. Respondents do this mainly for economic reasons. Some of those asked also melt the leftover paraffin or wax from the lanterns as time for this is available, e.g., for the elderly. Transporting such waste home is again undertaken mainly by those who visit the cemetery by car. Those who use public transportation do so less often (Table 1).

Assessment of the potential for participation in the segregation of clean biofraction of cemetery waste

The majority of those questioned (73%) believe that proper segregation of the bio fraction in cemetery waste is possible and necessary (92%); 69% will devote their time to join in this activity when they find containers prepared for this purpose (Table 2). More than half (54%) of those taking part in the survey find time to deepen their knowledge of recycling the biofraction, including cemetery waste.

Table 2. Participation in segregation of clean biofraction of cemetery waste. Responses in %

Research Assumptions	Questions to verify the validity of the assumption made	Yes	No	I have no opinion
Respondent will join segregation of bio fraction of cemetery waste	– Is proper segregation of the bio fraction in cemetery waste possible?	73	12	15
	– Is proper segregation of the bio fraction in cemetery waste needed?	92	-	8
	– Will you take the time to join in this activity when you find the appropriate containers prepared for it?	69	12	19
	– Do you find time to deepen your knowledge of biofraction recycling, including cemetery recycling?	54	46	-
Survey respondent supports innovations in the organization of his cemetery	– Do you support the organization of earthworm composters in your cemetery area?	54	19	27
	– Will you accept an additional voluntary fee for this purpose?	30	58	12
Respondent will participate in the organization of biofraction recycling in its cemetery area	– Will you get involved in the existence of the above initiative?	27	65	8
	– Will you come to the information meeting?	23	65	12
	– Will you commit to preparing a suitable flyer?	15	70	15
	– Will you talk about the severity of the problem with other people?	42	58	-

Compiled from survey results.

Support for the innovative idea – the organisation of earthworm composters in the area of their cemetery was declared by 54% of respondents, and 19% were against it. However, an additional fee for this purpose would be voluntarily borne by only 30% of people, and disapproval was indicated by 58%.

No system will function properly without the involvement of its participants. However, only 27% of those questioned declared involvement in the above initiative, and 65% said they were not involved. The same (65%) did not want to participate in an information meeting. Only 15% of respondents wanted to be involved in preparing a relevant leaflet (70% answered no). Slightly more, but less than half (42%) would talk about the seriousness of the problem with other people (58% said they would not) (Table 2).

Participation is a multidimensional phenomenon relating to various social, economic, and political areas. It can concern individual preferences related to the daily choices of the individual, participation in the social life of the community, as well as the involvement of individuals in the activities of the structures and institutions of the democratic state (Wójcicki, 2018).

As shown, the respondents join the segregation of the biofraction of cemetery waste; many are interested in deepening their knowledge of biofraction recycling, including cemetery waste. Respondents, although they support the innovative organisational measure of including a box of earthworms in the organisation of waste management at their cemetery, just as many, however, will not voluntarily accept an additional fee for this purpose.

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The interview results indicate that most respondents (58-70%) will not get involved and, therefore, will not participate in organizing biofraction recycling in their cemetery area. Poland has been placed in the group of European "*flawed democracies*" in the *Democracy Index* (DI), which has been published since 2006 by The Economist Intelligence Unit. Significant weaknesses, including governance efficiency and citizen involvement in politics, characterise flawed democracies. Improving the state of participation is unlikely without raising the level of political culture and political participation. A low level of political culture negatively affects the state of public participation (civil dialogue). Polish political culture scored low in the ranking discussed above. It undoubtedly translates into the level of social participation (Jasiecki, 2015). Few modern societies in developed countries accept the need to organise life together. People tend to join systems already in place and prepared, although they do so reluctantly. Meanwhile, it would be appropriate to consider the decline of the security of human life on the planet, not only in the socio-political context, when this is due, for example, to a senseless system of multiple solutions (Figure 3). The threat is also in the realm of the natural environment (Rockström et al., 2009; Ripple et al., 2020). Therefore, civic involvement in solving problems from different life spaces is now becoming necessary.

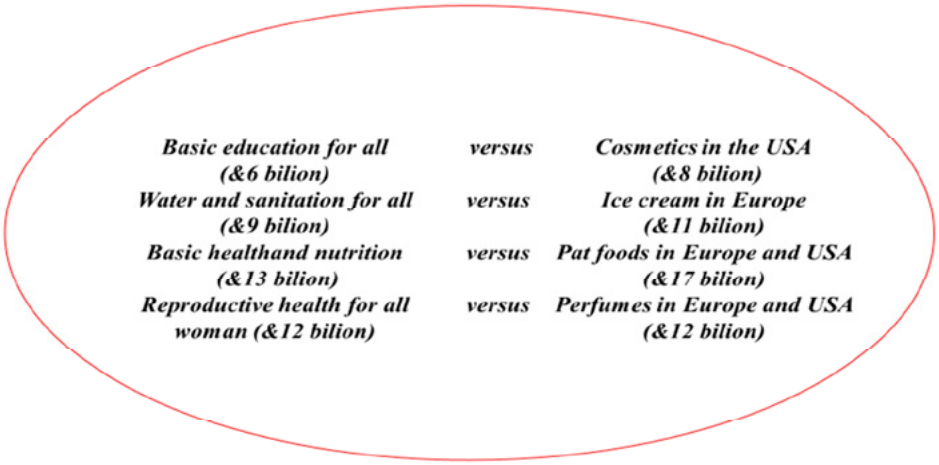

Figure 3. Putting priorities into perspective: A senseless system of financing many issues
Source: UNEP and UNESCO (2008).

All levels of society need to be reorganised in the face of the shrinking resources of the natural, social, and economic environment of people's lives. It seems that only small, consolidated social groups can discuss and solve the problems noted as necessary, precisely those with the small, local groups of people plagued. The participation of those interested in well-being can lead to the proper use of local endogenous resources by reducing the planet-destroying water and carbon footprint.

Elements of logistics of bio fraction management in cemetery waste

Waste management includes the management of substances or objects that the holder disposes of, intends to dispose of, or is obliged to dispose of, that is, their collection, transportation, processing, supervision, disposal, and circulation. It is now a very forward-looking field, which includes material recycling, energy recovery, and production of liquid and solid fuels. All this should be done using the latest technologies, advances in science and technology, and organisational innovations.

Cemetery waste belongs to municipal waste, accounting for about 1% of this waste group (Jaworska-Szott & Marcinkowski, 2014). According to the Ordinance of the Minister of Climate of January 2, 2020, on the catalogue of waste according to the source of its origin, cemetery waste is included in group "20" as municipal waste, including fractions collected selectively. The various codes classify waste in detail, dividing it into specific groups and subgroups. Cemetery waste has code 20 02 – from gardens and parks (including cemeteries). Among them, the share of biodegradable waste can be estimated at 30-40% (Uniwersytet Rzeszowski, n.d.).

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Waste logistics involves the creation of logistics chains that connect waste generation sites to waste disposal or processing and reuse sites. This process should be carried out in an orderly and comprehensive manner.

The various elements (subsystems) should be organised appropriately and cooperate with each other to prevent and minimise waste and achieve the results of activities in implementing sustainable development strategies. In the case of logistic systems used in waste management, among other things, there is a subsystem for waste disposal (segregation, movement, storage, processing, provision of recyclable materials) and reuse (within the company or by other business entities) (Gajdzik, 2009). Logistics systems used in waste management are based on dynamic models of environmental protection and are designed to prevent adverse environmental impacts of both waste and waste management enterprises.

It has long been known that a sustainable waste management system should begin at the waste generator, with the daily implementation of a mindset to avoid and minimise waste. Elements of education for cemetery users should be incorporated into the logistics of the cemetery waste avoidance subsystem. At the cemetery entrance or bus stops near them, billboards, LED boards, and other media could be installed, on which questions would be presented to encourage exploration of the problem, e.g., is it a good idea to buy plastic flowers? Does only a multitude of decorations on a grave indicate remembrance of the deceased? Other content justifying the need to participate in the subsystem of waste avoidance and segregation at the source can also be included. One can also try to convey important information in the form of leaflets available to interested parties at the entrance to the cemetery.

When the waste avoidance subsystem is not working, the logistics of the convenience subsystem for collecting and segregating waste already generated should be improved. The principles of waste segregation in cemeteries are shown in the following table (Table 3).

Table 3. Waste segregation rules for cemeteries

Biodegradable waste	Glass	Metals and plastics	Paper	Waste remaining after segregation
Grass and leaves Branches Natural cut flowers Potted flowers without pots Natural wreaths without artificial flowers or sashes	Glass candles without paraffin Jars Vases bottles	Packaging films Plastic and metal components of candles Plastic rim components Plastic pots without soil	Paper Cardboard cardboard	Paraffin candles and refills Ceramic flower pots Wreaths and flowers permanently attached to plastics and metal Earth and sand

Source: own compilation.

Waste collection methods are essential. It is crucial for biosolids, as it should guarantee the prevention and minimisation of odours generated. The odorisation of the environment is a nuisance caused by pollution. Waste can be collected in separate trash enclosures with containers or in containers, which should be safe for users, durable, and easy to keep clean. They should also ensure that noise is reduced during shunting and that the lids are easy to open and close and leak-proof (Ledoba & Oleszczuk, 2002). For biofraction, they should be emptied and disposed of frequently.

The provisions of the Law on Maintaining Cleanliness and Order in Municipalities contain norms for collecting municipal waste from unoccupied properties, such as cemeteries. However, each municipality independently determines the form of collection and municipal waste collection systems on its territory, taking into account its capabilities and the most favourable solution for residents (Saj, 2016).

A logistical approach allows the organisation of individual processes, streamlining management and increasing individual activities' environmental and economic effects. It is vital, for example, when wreaths are not prepared from a homogeneous material, so theoretically, preparing its waste for recycling requires many steps that make it difficult to reuse its components. Currently, cemetery visitors usually do not think about what kind of wreath they will order and buy if necessary. When it is a wreath made of numerous and diverse components, the immediate consequence of its purchase will be the complex structure of its waste, making segregation difficult. Furthermore, here again, it is worth returning to the logistics of subsystem one = waste avoidance. If, in the participatory attitude

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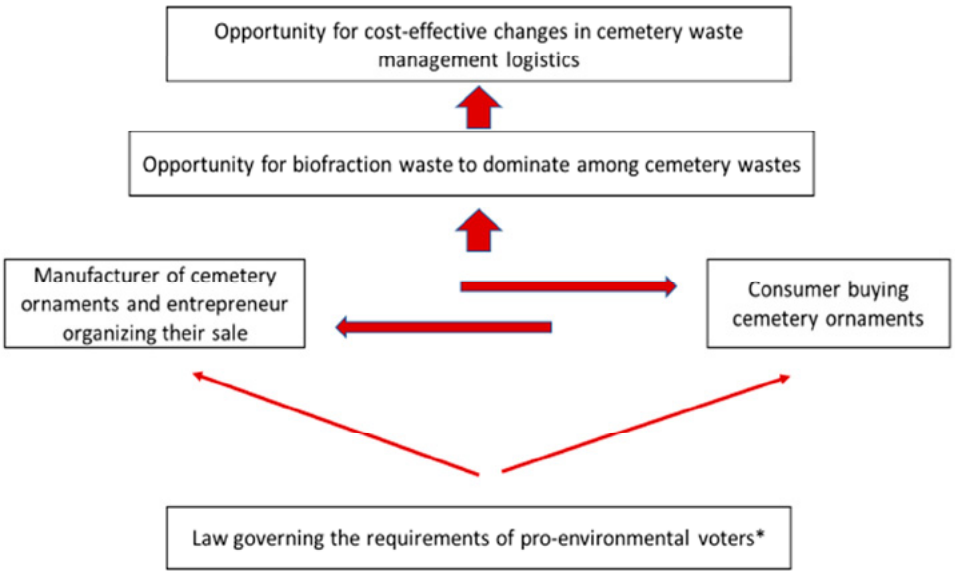
of the cemetery visitors, it was possible to forge and consolidate the conviction of the desire to influence the size of the bio fraction of cemetery waste with a simultaneous reduction of the plastic fraction, the waste of cut flowers, potted flowers and natural flowers from wreaths could begin to prevail and it would become economically and socially viable to modify the logistical subsystem of bio fraction collection in the direction of preparing it for on-site disposal in technologically modern composters or vermireactors.

Once the conviction of the importance of such a solution is in place and the preferences of cemetery visitors change, the logistics of waste transport would be simplified by excluding the bio fraction. This could be introduced into the on-site disposal subsystem.

The logistical system of waste management is a logistical subsystem of the entire cemetery. There are, therefore, interactions between waste management and the creation of efficient burial runs, the operation of the chapel, and the cemetery crematorium, if present.

At the core of developing a logistical system for cemetery waste management is also the analysis of the organisation of the supply and sale of cemetery ornaments. The economic, social, and natural aspects of the work of the people creating the supply of cemetery ornaments should be considered here. Their education on the consequences of bringing excess plastic to the cemetery is also essential to the cemetery waste reduction subsystem. The cemetery visitor, the ornament manufacturer, and the cemetery ornament supply entrepreneur are in a close relationship of dependence on acquisition opportunities and economic consequences. It is a complex issue that should be based on regulations (Figure 4).



* results from a long-term ecosystem restoration strategy.

Figure 4. Diagram of the relationship of critical elements of change in the development of cemetery biofraction management (own elaboration)

For now, cemetery waste logistics has not been analysed in many studies and is developing slowly. New ideas are emerging that may not seem legitimate to some cemetery operating companies or arouse the interest of others. A Life Cycle Analysis (LCA) of the system (study of input, processing, and output streams) can help analyse individual systems' positive consequences and burdens. For example, Blengini (2008) showed that the existing organic waste management system in the Asti area of northern Italy, based on composting, is more pro-environmental than landfilling of biosolids.

LCA can identify waste sites, categories, quantities, and their environmental impact depending on disposal and management methods. The results of the analysis can be used to develop functional, instrumental, and institutional assumptions for the waste management system. The functional dimension makes it possible to locate waste management as a complex set of activities in the entire activity of the city cleaning enterprise. Thus, it is recognised that one of the functions of the enterprise is the rational use and disposal of waste. Another assumption of the system is the instrumental

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approach. The system uses instruments of planning, control, and steering. The next set of consequences of the system approach will result from the location of the logistical system of cemetery waste management in the organisational structure of the waste management enterprise. The system then requires the identification of cells responsible for cemetery waste management. The developed WM system, in terms of logistics, shows an increased number of interactions with the environment (cooperation with external companies involved in waste disposal and reuse) and increasing structural complexity (logistic systems of suppliers and customers integrated with the logistic system of the enterprise) (Gajdzik, 2009).

The Waste Minimization Assessment (*WMA*) procedure can also be helpful in rationalising waste management. As the name suggests, its premise is to reduce the amount of waste at the site. This reduction can occur through changes in the products brought to the cemetery, made from environmentally acceptable starting material accepted by cemetery visitors and brought for them, pro-environmental technologies followed, and operational and organisational practices used. Ongoing education should result in only buying such cemetery decorations that canbe segregated.

Integrating composting/vermicomposting technology of cemetery waste biofraction into GO "on-site" logistics

As mentioned, in developing a procedure for minimising cemetery waste, many effective educational measures would need to be taken to improve the minimisation of cemetery ornament purchases by cemetery visitors. As the interview for this work showed, there is much to be done here. Concerning the cemetery bio fraction, the easiest thing to do is undertake green recycling on-site (thus shortening or eliminating the chain of transporting this waste to the disposal company). The possibility of modifying this part of the WM logistic chain should be noted, and its activities should be invested with time and money. The process of preliminary treatment of plant waste from large cemeteries basically does not exist. It will consist of removing plastics from bio-waste plant mass. Observations show that during growing seasons, the mass of bio-waste increases by 70%, and its main source is grass from mown parts of cemeteries and weeds from gravestones. A similar situation occurs with the management of bio-waste from local lawns. In fact, bio-waste containers and bags do not effectively solve this problem (Długozima, 2011). Making composters/vermicomposters and using them in practice in cemeteries requires basic education. The resulting compost could also be used on-site to produce seedlings of ornamental plants for cemetery purposes, which may contribute to the creation of new jobs.

It is also worth showing opportunities to change the form of care for graves (Kasprzak, 2023). Promoting the purchase of live flowers (for vases, pots, or wreaths) will increase their share in the waste generated, eliminating artificial flowers. The creation of composting/vermicomposting (Kostecka et al., 2018) facilities in cemeteries can further create new jobs. Composting and vermicomposting can be carried out in modern composting containers or vermireactors. They should be sheltered from wind and excessive sunlight – preferably surrounded by tree canopies if possible. The scope of the emerging enterprises could include organising such on-site green recycling hubs, taking care of their smooth operation, and implementing ideas for the disposal of valuable products – compost or vermicompost.

Conclusion

The hallmark of systems thinking in waste management logistics is carefully considering the issue and clarifying the role of individual system elements (subsystems) and the relationships between them. Numerous information and decision-making processes accompany it. Thus, the systems approach requires thinking holistically about the problem of generating, segregating, disposing, and reusing the waste generated. The systems approach points to the integrity of environmental, technological, economic, and social problems (the issue of environmental awareness).

Participation is a multidimensional phenomenon relating to various areas of social and economic life. It can concern individual preferences related to the daily choices of the individual, participation in the social life of the community, and the involvement of individuals in the activities of the structures and institutions of a democratic state. Reducing the number of cemetery decorations does not necessarily mean less interest in the graves of deceased loved ones. We have them in our memory; we

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do not need to bid for them externally, as this involves the production of waste that destroys the environment. Participation in promoting the avoidance of ornaments made of plastic and other artificial materials in favour of purchasing live flowers in various forms will increase the share of their waste in the bio fraction generated at the cemetery. Such an outcome can encourage changing cemetery waste logistics toward expanding the on-site bio-recycling subsystem.

Biodegradable waste now deserves to be called "21st-century gold". Introduced into green recycling, it offers a chance to replenish soil organic matter.

Organic matter is one of the essential components of soil. Its content is one of the most critical factors determining soil fertility and affecting soil biodiversity, plant growth, yield height, and quality. It is crucial for improving soil properties and the soil's role in the homeostasis of the entire planet (including the fixation (sequestration) of carbon from the atmosphere). Increasing the organic matter content of the soil is also a crucial part of creating regenerative agriculture, which is now relevant as a trend in agriculture and climate change mitigation policy. Lighter soils are impoverished in organic matter. Given the need to care for human health due to producing quality food, we must constantly take care of the soil and provide the benefits of increasing soil organic matter. Thus, alternative sources of organic waste, potentially useful for green recycling and biofertilizer production, are being sought. Therefore, the biofraction of cemetery waste should be given special care.

Segregation and recycling of the biofraction of cemetery waste are essential for several reasons. First, this results in less waste going to landfills, reducing greenhouse gas emissions and the risk of groundwater contamination. Second, segregating and recycling the biofraction of this part of municipal waste makes it possible to convert it into fertiliser (biogas, biofuel, bioplastic, if warranted). Using bio-waste in the fertiliser production process increases the chance of improving the balance of organic matter in the soil, which is one of the conditions for soil fertility.

Third, the economic aspect of cemetery waste biofraction recycling must be taken into account for the municipality bearing the costs of maintaining cemeteries and the residents. In the case of the municipality, the more waste that is recycled, the more fees will be reduced for the management of cemetery waste, which is currently sent to landfills, and landfill fees will increase in the coming years. If fertiliser is obtained from biodegradable waste, it can be used to reclaim green spaces, parks, and ecologically degraded areas. For residents, the economic dimension is the aspect of savings obtained by the municipality as the entity that maintains cemeteries. Lower costs of maintaining cemeteries mean lower fees paid by residents for providing burial places, from which the municipality covers a significant part of the maintenance of cemeteries.

In the coming years, local government units in Poland will face a steady increase in the efficiency of local systems for segregation, collection, and processing of municipal waste, including bio-waste. This is due to the policy adopted in the European Union, which has led to the achievement of specific levels of municipal waste recycling. This policy is confirmed in the NAP 2028 (Uchwała, 2023) and the amendment to the Law on Maintaining Cleanliness and Order in the Municipality (Act, 1996). Objectives for improving municipal waste management, including biodegradable waste, include:

- implementing the Waste Prevention Program (WPP) and reducing the amount of waste generated,
- increasing public awareness and knowledge of WPP, including food WPP,
- increasing organic recycling by promoting residents' composting of bio-waste "at source",
- ensuring selective collection of bio-waste from residents and caterers.

It is also worthwhile to undertake discussions and activities to stimulate public participation, especially in the context of activities for the careful segregation of the bio fraction, as more and more discussions are emerging about the nuisance that cemetery waste and existing ways of organising cemeteries represent.

Using appropriate procedures (e.g., LCA or *WMA* analysis*)*, one can attempt to calculate the costs of the old and new cemetery biofraction management logistics system. It is a complex operation with many elements that are still difficult to see and calculate. However, even when the economic result is not the most favourable, the calculation should still introduce an analysis of social and ecological costs. What counts in the Decade of Ecosystem Restoration (2021-2030) is a long-term strategy for restoring the bond between man and nature.

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The contribution of the authors

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PARTYCYPACJA SPOŁECZNA I ELEMENTY LOGISTYKI ZARZĄDZANIA BIOFRAKCJĄ ODPADÓW CMENTARNYCH

STRESZCZENIE: W XXI wieku odpady stanowią rosnący problem i muszą być rozważane jako jeden z podstawowych elementów tworzenia uwarunkowań zrównoważonego rozwoju. W artykule szczególną uwagę poświęcono biofrakcji cmentarnej. Wywiady z użytkownikami cmentarzy pozwoliły ustalić jej miejsce wśród innych produkowanych na cmentarzu odpadów. Sprawdzano także gotowość użytkowników cmentarzy do partycypacji w logistyce systemu zagospodarowania odpadów cmentarnych.

W artykule przedstawiono także wybrane elementy logistyki gospodarowania odpadami cmentarnymi. System powinien składać się z kilku podsystemów. Za kluczowy uznano podsystem minimalizacji odpadów „u źródła", oraz podsystemy segregowania, unieszkodliwiania i wtórnego zagospodarowywania odpadów. Do wspomnianych podsystemów logistyki zaproponowano dołączenie innowacyjnej na cmentarzach, biotechnologii kompostowania / wermikompostowania biofrakcji, wysegregowanej na miejscu powstawania przez sprzątających swoje grobowce. Biofrakcja cmentarna stanowi odpad nadający się do zagospodarowania na miejscu powstawania, co zwiększałoby potencjał oszczędności ekologicznych, społecznych i ekonomicznych. Rozważane zagadnienia wpisują się w problematykę włączania cmentarnej biofrakcji do obowiązującego w Europie systemu zielonego recyklingu. Pozostałe odpady cmentarne (z plastiku, metali, szkła i papieru), logistyka gospodarowania którymi wymaga podsystemów obejmujących ich transport na dalekie odległości, powinny zostać ograniczone na poziomie zakupów przez użytkujących cmentarze. Powinno to stopniowo ewoluować i wynikać z obywatelskiej partycypacji w kontroli możliwości usprawnienia logistyki całego systemu gospodarowania odpadami cmentarnymi.

SŁOWA KLUCZOWE: Biofrakcja cmentarna, partycypacja, logistyka w gospodarce odpadami

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