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Reverse logistics as an important element of the functioning of households in Poland – assessment of the facts

Logistyka zwrotna jako ważny element funkcjonowania gospodarstw domowych w Polsce – ocena stanu faktycznego

Abstract. In the era of growing consumerism, the generation of various types of waste has become a standard from which it is difficult to break free. This, combined with the ever faster shrinkage of natural resources, forces us to search for effective ways of recovering used and unwanted resources from Polish households. This state of affairs becomes a direction that determines activities for a large number of entities operating within various logistic chains. The changing market and legal environment forces producers, but also Polish farms to look for savings, which in turn translates into a more rational policy of these entities. In connection with the above, Polish families are also changing their approach to the issues related to the waste generated within them. Therefore, it seems reasonable to implement logistic strategies in Polish farms related to the optimal use of resources, including those that are no longer needed. The article examines the level of awareness in Polish households on issues related to waste recovery and the knowledge of basic issues related to the implementation of ecologic concepts in households.

Key words: reverse logistics, Polish households, waste, reverse logistics chain, pro-ecological awareness

Synopsis. W dobie narastającego konsumpcjonizmu wytwarzanie różnego rodzaju odpadów stało się trudnym do wyeliminowania zjawiskiem. Trudność ta, w połączeniu z coraz szybszym kurczeniem się zasobów naturalnych, zmusza do poszukiwania skutecznych sposobów odzyskiwania zużytych i niechcianych zasobów, co dotyczy również polskich gospodarstw domowych. Taki stan rzeczy staje się kierunkiem determinującym działania dużej liczby podmiotów działających w różnych łańcuchach logistycznych. Zmieniający się rynek i otoczenie prawne zmusza producentów, ale także polskie gospodarstwa, do poszukiwania oszczędności, co z kolei przekłada się na bardziej racjonalną politykę tych podmiotów. W związku z powyższym polskie rodziny zmieniają także podejście do kwestii związanych z wytwarzanymi odpadami. Dlatego zasadne wydaje się wdrażanie strategii logistycznych w polskich gospodarstwach rolnych, związanych z optymalnym wykorzystaniem zasobów. Artykuł analizuje poziom świadomości polskich gospodarstw

domowych w zakresie zagadnień związanych z odzyskiem odpadów oraz znajomość podstawowych zagadnień związanych z wdrażaniem koncepcji ekologicznych gospodarstwach domowych.

Słowa kluczowe: logistyka zwrotna, polskie gospodarstwa domowe, odpady, łańcuch logistyki zwrotnej, świadomość proekologiczna

Introduction

For many years now, one of the basic objects of interest in modern logistics is a systemic approach to effectively solving problems related to waste management. Entrepreneurs and scientists are constantly looking for new ways to minimize the loss of all kinds of resources. In connection with the above, the so-called Reverse logistics, which in its area of interest covers all management processes related to the flows of waste and related information from the places where they arise to the places of their proper destination [Budzik-Nowodzińska 2013]. It should be noted that the indicated area has definitions that are ambiguous in their message, having both common features and those that differentiate them. The correct definition of the indicated area should start with the explanation of the slogan ecologistics, which was created by combining two terms: ecology and logistics. Ecology studies the interrelationships between the natural environment and living organisms. Importantly, waste is also of interest to ecology. In this respect, it is particularly important to determine the negative impact of individual wastes on the condition of the natural environment. However, under the slogan logistics, it has an interdisciplinary character, and therefore has many definitions. Simply put, logistics should be seen as an integrated flow system of material flows in the form of raw materials, finished products and waste. What is extremely important, these streams are usually accompanied by the flow of information, which serves to optimize the transformation of physical goods.

Ecologistics, also known as recycling logistics, consists in managing the processes of moving damaged, incorrectly delivered, used, redundant products, classified as excess inventory and used disposable packaging. This management aims to recover materials that are no longer needed as much as possible, and then to reuse them in production or logistics processes, while minimizing the amount of waste that goes to the landfill [Andrzejczyk 2012b].

In its structure, recovery logistics includes the process of planning, implementing and controlling the effective and economically effective flow of raw materials, semi-finished products and finished products along with the related information flows from the place of consumption to the place of origin, for the purpose of recovery or proper management [Rogers and Tibben-Lembke 1998]. The definition of reverse logistics is almost the same as the definition of reverse logistics, otherwise known as reverse logistics.

Reverse Logistics covers all operations related to the reuse of end-of-life products and materials. Reverse logistics is a process that consists in moving end-of-life goods from the place of withdrawal to the place of reprocessing in order to obtain a specific added value or in the absence of such a possibility of proper disposal [Srivastava 2008].

The last term that should be defined is recycling (recirculation), which means taking measures to reuse waste as a starting material, or as a secondary raw material in industrial processes. According to the legal definition in Poland given in the Waste Act, recycling is understood as “recovery in which waste is reprocessed into products, materials or substances used for the original purpose or other purposes; this includes the reprocessing of organic material (organic recycling) but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling [Obwieszczenie Marszałka..., Ustawa z dnia 14 maja 2020 r...].

Note that the topic of reverse logistics in Poland seems to be still relevant because in the country an increase in the amount of waste generated in Polish households can be observed. According to the data of the Central Statistical Office, a statistical Pole produces/produces annually 325 kilograms of municipal waste. It should be noted that despite the increase in the amount of generated waste, we are still not leaders in this field. Poles are still below the European average in the area of waste generation. In 2018, the production of 12,485 thousand tonnes of municipal waste was recorded. This means an increase in production by 4.3% compared to the previous year. There was also an increase in the amount of municipal waste generated per capita from 311 kilograms in 2017 to 325 kilograms in 2018 [GUS 2020].

The largest amount of waste in Poland per capita, as much as 394 kilograms, was recorded in 2018 in the Dolnośląskie Voivodeship. This result was significantly influenced by the largest city in the region, Wrocław, which generated 531 kilograms of municipal waste per capita. On the other hand, the lowest value in the discussed scope was achieved in the Świętokrzyskie Voivodeship, where only 201 kilograms of municipal waste per capita was generated during one year [GUS 2020].

Compared to other European Union countries, Poland is much less efficient in terms of waste production than other member states. Based on the data from 2017, it can be clearly read that the average amount of municipal waste generated per capita of the European Union in 2017 was 486 kilograms, which is 161 kilograms more than the Polish processing capacity. Most of the waste was generated by countries that are characterized by high prosperity, among others, such countries as: Denmark – 781 kilograms, Germany – 633 kilograms, Luxembourg – 607 kilograms. It should also be emphasized that, apart from the countries mentioned above, also countries with a lower development potential struggle with overproduction of waste. These are, for example, countries with a large volume of tourists, including: Cyprus – 637 kilograms and Malta – 604 kilograms [Eurostat 2020].

It should be noted that not only European Union countries generate large amounts of waste. Countries outside the European Union are also struggling with the same problem. Large amounts of municipal waste were generated, among others, by: Norway – 748 kilograms, Switzerland – 704 kilograms, Iceland – 656 kilograms per capita. In connection with the above, it can be concluded that Poland has one of the lowest indicators related to waste generation per capita among European countries [Eurostat 2020]. Which does not mean that, as a country, it deals with waste in the manner desired by its socio-economic and economic environment.

In accordance with the assumptions of the European Union’s policy in the field of waste management, each country within the intra-community structures should maximize

the use of all kinds of resources, while minimizing their waste. Therefore, in 2017, 30% of the total amount of municipal waste generated in the European Union subjected to material recycling, 29% thermally neutralized, 23% neutralized by landfilling, 17% composted. Despite the fact that the problem of municipal waste is an issue that requires an appropriate solution, it should be noted that Polish pro-ecological awareness, both in the society and among its authorities, is still growing. Still, all Poles have a lot of catching up to do in this respect [Andrzejczyk 2009].

Analyzing 2018, only 26% of waste was recycled in Poland, and as much as 42% was landfilled. This means that 7.1 million tonnes of municipal waste collected in 2018 was allocated for recovery. The 3.3 million tonnes (26%) of which was designed for recycling, 2.8 million tonnes (23%) for thermal transformation with energy recovery, 1.0 was directed to biological processing processes (compositing or fermentation) million tonnes (8%) [GUS 2020]. In 2018, a total of 5.4 million tonnes were directed to the disposal processes, of which 5.2 million tonnes (approx. 42% of municipal waste generated) were designated for landfilling, and the remaining 0.2 million tonnes (approx. 2% of production) for disposal by incineration without energy recovery.

Comparing the above, it can be seen that the amount of municipal waste collected selectively in Poland is growing year by year. In 2005, separate collection accounted for only 3% of the collected municipal waste (295,000 tonnes) [Andrzejczyk 2009], while in 2018, over 3.6 million tonnes were collected selectively, which was 29% generated municipal waste [GUS 2020]. Therefore, it seems important to examine the influence of households on the functioning of reverse logistics and what determines pro-ecological behavior in these entities.

Therefore, the main aim of the article is to examine the level of awareness in the field of the production and recovery of waste generated in Polish households, as well as the level of households' awareness of the use of ecology in them. An additional aim of the presented article is to identify the phenomenon related to the lack of pro-ecological attitudes in Polish households and the reasons for this.

The article was created on the basis of an analysis of formal and legal documents, a critical review of the literature on the subject and normative acts in force in the described area, as well as on the basis of observations and surveys carried out in Polish households, divided into households living in rural, urban and urban-rural areas.

Households' place in the logistics reverse chain

In Poland, in 2018, the amount of waste collected separately was 94 kilograms per capita. Mixed municipal waste dominates among the waste generated. In 2018, their quantity was 8.9 million tonnes, i.e. 71% all generated municipal waste. In 2018, in Polish cities, 106 kilograms per capita were selectively collected, while in rural areas 76 kilograms per capita [GUS 2020]. When analyzing the data from the Central Statistical Office, it can be clearly stated that Poles segregate waste more and more willingly every year. It manifests itself in the growing set of segregated products. Table 1 presents the basic data on separate collection of municipal waste in 2017–2018. Based on the table below, it is noted that the amount of separately collected waste is growing for each group included in it.

Despite the fact that in Poland less municipal waste is generated per capita than in most European countries, it should be noted that in Poland it is still at a low level.

Table 1. Amount of separately collected municipal waste in 2017–2018

Tabela 1. Wielkość zbieranego selektywnie odpadu komunalnego w latach 2017–2018

Type of waste	Amount of waste collected per capita [kilograms]		Increase [%]
	2017	2018	
Biodegradable waste	23	26	88,46
Mixed packaging waste	14	15	93,33
Bulky waste	11	14	78,57
Glass	12	13	92,31
Plastics	8	9	88,89
Paper and cardboard	6	7	85,71

Source: own study based on [GUS 2020].

According to the data of the Central Statistical Office, in 2019 the amount of municipal waste obtained in relation to the previous year increased by 2%. In 2019, on average, 332 kilograms of collected waste per capita was collected. It means that in the previous year the average Pole generated 7 kilograms more waste than in the previous year. What is extremely important, in 2019 12.8 million tonnes of municipal waste was collected, which means an increase by 2.1% compared to 2018. Of which 10.8 million tonnes of waste were collected from households, which constituted 84.5% of all municipal waste generated in Poland [GUS 2020].

In 2019, there were 2190 separate collection points for municipal waste in Poland. The municipal waste collection service was provided by 1352 enterprises. Despite the growing environmental awareness in Poland, at the end of 2019, there were still 278 municipal landfills in operation in the country, the total area of which was almost 1700 hectares. The positive in this respect is the fact that over 92% of them are equipped with degassing installations, as a result of which it was possible to burn gas in these landfills in the amount of about 91,153 thousand megajoules of thermal energy and approx. 112,914 thousand kilowatt-hours of electricity. In accordance with the assumptions of the waste policy, 16 landfills with a total area of approximately 52.8 hectares were closed in Poland in 2019. Which still does not exhaust the assumptions of this policy [GUS 2020].

The formation of the so-called wild landfills raises much concern. In 2019, 11,371 illegal landfills were liquidated in Poland, of which approx. 26,000 were collected in total tonnes of municipal waste. At the beginning of 2020, the existence of nearly 2,000 illegal dumps has already been recorded [GUS 2020].

The reallocation of resources contained in municipal waste requires the coordination of many areas. In the processes carried out in households, as well as in enterprises, not only desired products are created, but also those that the inhabitants of these households do not want, they are waste. Importantly, waste is divided into various types and fractions. Most of the waste generated by households is municipal waste. Which does not mean that municipal waste constitutes 100% of the waste generated by these entities, because Polish households also produce hazardous waste, electronic waste, and animal waste. Nevertheless, municipal waste constitutes the overwhelming majority [Andrzejczyk 2012a].

According to the authors, the basic social unit which is the family can be compared to a system consisting of many subsystems, which can be ideally described using the model illustrated, which presents the basic subsystems functioning in typical Polish households. Their construction can also be compared to the construction of models functioning within economic entities, but also logistic subsystems functioning within the state administration (Figure 1) [Andrzejczyk 2012b].

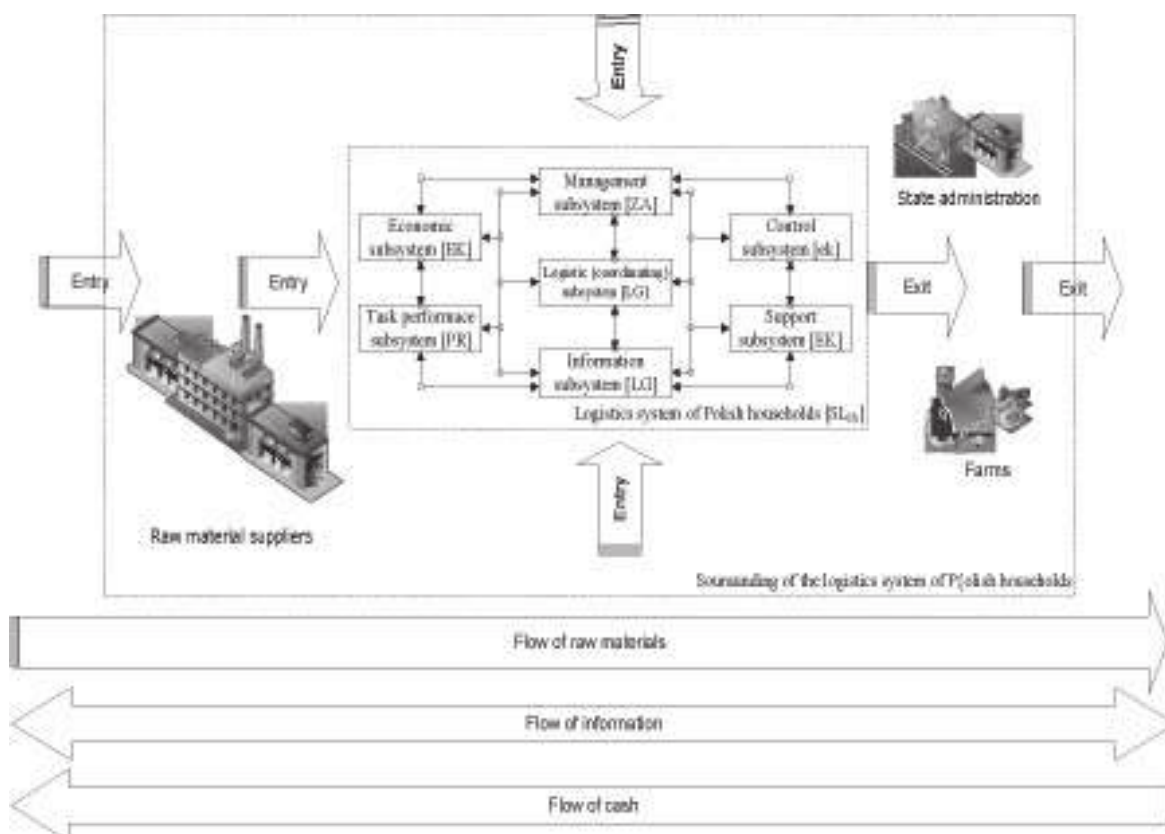


Fig. 1 Logistic chain in the aspect of household functioning

Rys. 1 Łańcuch logistyczny w aspekcie funkcjonowania gospodarstw domowych

Source: own study.

Logistic processes take place in every family, as in every commune, town, village or enterprise. This means that each of the above-mentioned entities manages various types of flows. This, on the other hand, indicates that it can be assumed that households perform logistic process management. Which, in turn, generates the crystallization of subsystems, including logistics, from the abovementioned farms. Going further between the individual subsystems, there are many relationships that are often very complex and require the cooperation of many people and entities. Therefore, more and more often one can find expressions that indicate that in order to be able to efficiently manage the whole family at all, a systemic approach becomes necessary, which in turn leads to the formation of an often informal logistics subsystem. Such a system, thanks to the coordination of physi-

cal and information flows, it facilitates the efficient functioning of the system created by households [Andrzejczyk 2012b].

This means that also households in most cases function as independent links, which are only loosely linked to logistic chains. Due to this state of affairs, households as individual entities have a limited ability to control the physical flow of raw materials and final products [Kuboń 2008, Wajszczyk 2001]. Nevertheless, consumption often depends on these farms, and this translates into production volume. The 21st century is clearly associated with the statement that one of the basic factors influencing the achievement of revenues by enterprises is logistics with all its management tools, flow of raw materials and related information [Ficoń 2001]. The same applies to modern families, which in the era of constantly emerging crises are forced to seek optimal benefits. The search for them is not necessarily related to the need to gain an advantage over the neighbor, but to the need to maintain a certain life status.

From Figure 1 it can be concluded that the logistic subsystem of households has a lot to do with the functioning of economic entities. It has a subsystem of management, information flow and raw materials. Each household is connected with its surroundings in the form of other families, enterprises and public administration facilities. The relations between the aforementioned units depend on the efficiency of logistic chains. Due to the above, it seems necessary to use logistic tools to optimize these tasks.

While observing the situation of Polish households, the cost of living has been increasing recently. Therefore, these entities are running out of funds. The protracted coronavirus pandemic is not improving the situation. In addition, public administration bodies forced to tighten their belts, constantly increase fees in the form of various tributes. Such levies include fees related to the disposal of municipal waste. These fees are charged according to different criteria and have different rates. What is extremely important, they also depend on the method of waste collection, and in particular on whether they are segregated or not. As can be concluded, the level of obtained waste in a selective manner seems at least unsatisfactory. So the question arises: how to achieve a situation in which the issues related to waste collection would be as effective as possible for both the entities collecting this waste and their producers?

When talking about efficiency, one should start with the correct definition of the indicated concept. The dominant concept in management theory is the concept of organizational effectiveness, also known as the effectiveness of the system, which is understood as the company's ability to adapt to changes in the environment on an ongoing basis and to use its resources productively to achieve the planned goals [Szymańska 2010].

The above-mentioned approach, in conjunction with the use of ecological tools, may have a positive effect in Polish households, which may translate into effective achievement of the goals indicated by Polish households. "Ecologistics is also known as recycling logistics, otherwise also reverse logistics" [Andrzejczyk 2009]. Ecological logistics, also known as recycling logistics, consists in managing the processes of moving damaged, incorrectly delivered, used, redundant products, classified as excess inventories and used disposable packaging. This management aims to recover materials that are no longer needed as much as possible, and then to reuse them in production or logistic processes, while minimizing the amount of waste that goes to the landfill [Sadowski 2009].

Functioning of Polish households and ecological awareness – state assessment

When analyzing the statistics related to municipal waste in Poland, one can get the wrong impression that it is good. This is due to the fact that we produce less waste than most European countries. Unfortunately, the collected waste, unlike the countries of the European Union, in most cases is unsorted, and what is worse, the collected waste is sent to landfills instead of reprocessing, thus occupying unproductive space, often polluting the natural environment, while making life difficult for Polish households, for example by generating an unbearable odor. This situation is reflected in the statistics of the Central Statistical Office, which states that the collected municipal waste in 2019 was directed to the following processes [GUS data, 2020]:

- Recovery – 7087.0 thousand tonnes (55.6%), including:
 - recycling – 3192.1 thousand tonnes (25.0%),
 - biological processing processes (composting or fermentation) – 1153.2 thousand tonnes (9.0%),
 - thermal transformation with energy recovery – 2741.8 thousand tonnes (21.5%).
- Disposal of 5665.7 thousand tonnes (44.4%), including:
 - thermal transformation without energy recovery – 178.6 thousand tonnes (1.4%),
 - storage – 5487.2 thousand tonnes (43.0%).

Therefore, the question arises why as much as 43% of municipal waste was landfilled. Why are these resources unused and what prevents their reuse. Therefore, research was carried out in Polish households on issues related to the discussed topic. The study included 100 families from such provinces as: Dolnośląskie, Wielkopolskie, Śląskie and Opolskie. The research was conducted in the period from 31 August to 20 September 2020. A questionnaire and an interview questionnaire was used in the study. Based on the collected results, an analysis was carried out on the basis of which the following study was prepared.

As already mentioned, the purpose of this article is to determine the current level of knowledge in Polish households on the application of the concept of ecology in the process of efficient resource management of these entities. The research aimed to determine the current potential of using logistic concepts and related concepts, with particular emphasis on ecological concepts. Based on the logistic concepts presented above, the adopted objective is to examine the level of awareness of production and recovery of waste generated in Polish households, as well as the level of these households' awareness of the use of ecologistics by them. The goal was achieved using the method of analysis and criticism of the literature and logical inference based on the results of research carried out on a sample of Polish households, which were divided according to the criterion of place of residence in terms of urban and rural area, as well as the type of building inhabited and the type of ownership of a residential facility (Figures 2 and 3.). The Figures 2 and 3 show the basic dependencies related to the functioning of Polish households. It is about the way of living and the form of ownership. Detached houses dominate in rural areas, while in cities, apartments whose owners form housing communities and cooperatives predominate. These creations support the owners in keeping the buildings in proper condition. It should be noted that a large proportion of flats in urban areas is rented. These flats are also part of housing communities or cooperatives.

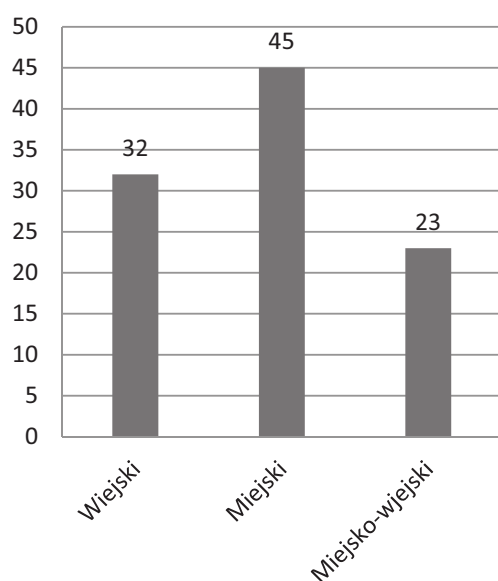


Figure 2. Area where households are located

Rysunek 2. Obszar w których gospodarstwa domowe mają swoją siedzibę

Source: own study.

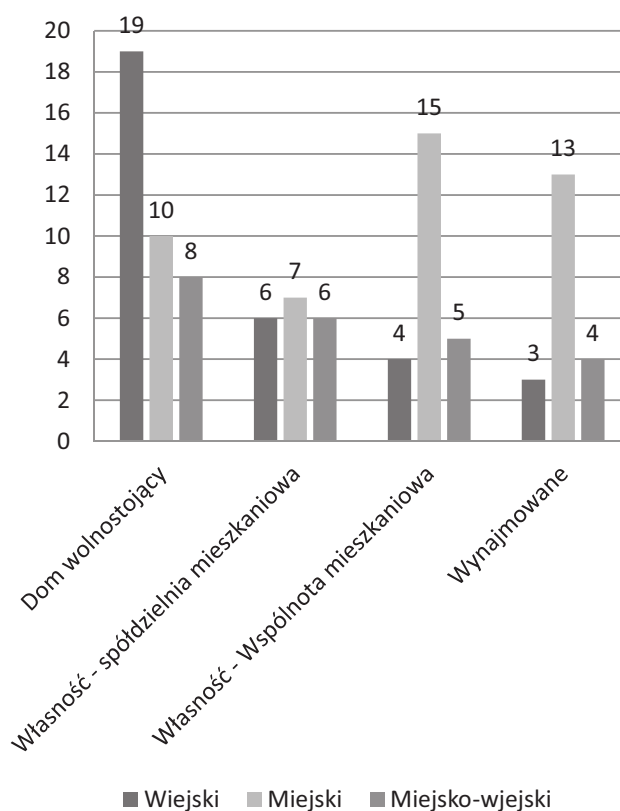


Figure 3. Type of house/flat ownership and related interdependencies

Rysunek 3. Rodzaj własności domu/mieszkania oraz współzależności z tym związane

Source: own study.

It should be noted that among the Polish households that were surveyed, as many as 52% believe that they do not use any logistic tools in managing their farms. Even more households do not use the tools available in the ecological concept (cf. Figure 4 of Figure 5). During the research, the authors checked the general awareness of ecologistics. The aim of the study was to determine whether households have knowledge of these issues at all. The entire study should be treated as a pilot and as the beginning of further research on the possibility of implementing the indicated concepts in Polish households.

On the basis of the conducted research and interviews, it can be observed that urban households much more often use logistic and ecologicistic solutions than those based in the countryside (see Table 2 and 3). This situation is most often due to the fact that small urban households have better access to education, both at the post-primary and tertiary level. These households also interact with facilities that have a well-developed logistics infrastructure, which is often difficult in the countryside.

Moreover, a large proportion of the respondents, who had no knowledge of ecologistics before the survey, showed great interest in the surveyed areas, asking what both concepts were all about.

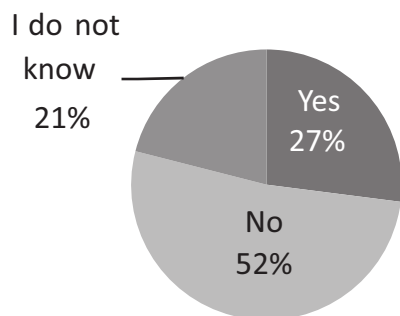


Figure 4. Share of households using logistic tools

Rysunek 4. Udział gospodarstw domowych, w których stosuje się narzędzia logistyczne

Źródło: own study.

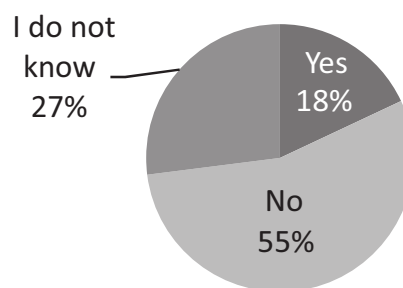


Fig. 5. Share of households using ecological tools.

Rys. 5. Udział gospodarstw domowych, w których stosuje się narzędzia ekologiczne

Source: own study.

Table 2. Share of households using logistic tools [%]

Tabela 2. Udział gospodarstw domowych, w których stosuje się narzędzia logistyczne [%]

Do you use logistic tools in your household?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	6	15	6	27
No	17	22	13	52
I do not know	9	8	4	21
Total	32	45	23	100

Source: own study.

Table 3. Share of households using ecological tools [%]

Tabela 3. Udział gospodarstw domowych, w których stosuje się narzędzia ekologiczne [%]

Do you use ecological tools in your household?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	4	10	4	18
No	18	24	13	55
I do not know	10	11	6	27
Total	32	45	23	100

Source: own study.

Analyzing the tables above, it can also be noticed that Polish households are not very keen on looking at ecology and while the tools of logistics itself are already used, those that allow to protect the natural environment to a much lesser extent. This will be even more visible in the results presented below. This situation results from low awareness, both in terms of logistics and ecologistics. Additionally, some of the respondents do not correctly recognize the keywords in the surveyed area, it is particularly visible in rural areas.

To the question asked: does the household generate municipal waste? almost half of the respondents answered yes (Figure 6). Based on the interviews conducted, it can also be concluded that Poles distinguish municipal waste from other waste, they are also aware that among the products they produce, they have also those that should be classified as non-municipal waste, including hazardous waste (Figure 7).

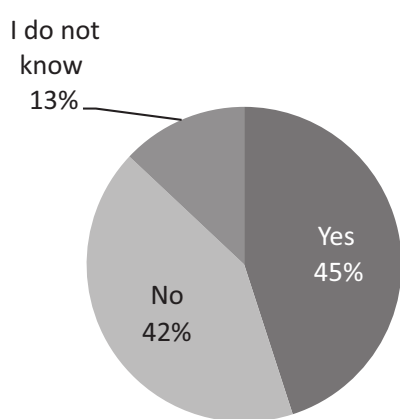


Figure 6. Share of agricultural households producing municipal waste

Rysunek 6. Udział gospodarstw domowych, w których powstają odpady komunalne

Source: own study.

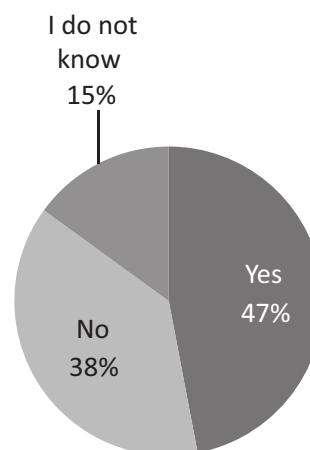


Figure 7. Share of households generating non-municipal waste, including hazardous waste

Rysunek 6. Udział gospodarstw domowych, w których powstają odpady komunalne

Source: own study.

Based on the Figures 6 and 7 and Tables 4 and 5, it can be noticed that Polish households do not avoid the related issues, as less than 15% of the respondents were completely unfamiliar with the subject. It should be noted here that the larger the farm, the greater the knowledge of issues related to the area in question.

Table 4. Share of households generating municipal waste [%]

Tabela 4. Udział gospodarstw domowych, w których powstają odpady komunalne[%]

Does your household generate municipal waste?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	10	25	10	45
No	18	14	10	42
I do not know	4	6	3	13
Total	32	45	23	100

Source: own study.

Analyzing the data from the table above, one can assume that many Polish households do not generate municipal waste. In fact, such a situation does not occur, because practically everyone produces municipal waste. In connection with the received responses, the respondents were asked why they did not produce municipal waste. It turns out that many of them assumed that they do not produce the indicated type of waste because they define this type of waste simply as waste without specifying their qualifications. Such a situation

is particularly visible in rural areas. In addition, it turned out that in rural areas, despite the prohibitions and the risk of penalties, there is still the phenomenon of burning waste in stoves or on the property. Interestingly, there is still consent to such behavior. Of course, these are not the only reasons for this, as there are individual cases of waste removal and disposal in prohibited places, e.g. in forests.

Table 5. Share of farm households generating hazardous waste [%]

Tabela 5. Udział gospodarstw domowych, w których powstają odpady niebezpieczne [%]

Does your household generate waste other than municipal waste, including hazardous waste?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	7	8	8	23
No	19	33	10	67
I do not know	6	4	5	15
Total	32	45	23	100

Source: own study.

What is extremely important, the number of households with selective waste collection is nearly 70% (Figure 8), unfortunately only 30% of households that comply with all the related rules (Figure 9).

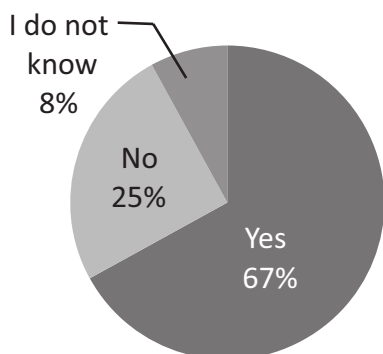


Figure 8. Share of households with selective municipal waste collection

Rysunek 8. Udział gospodarstw domowych, w których prowadzi się selektywną zbiórkę odpadów komunalnych

Source: own study.

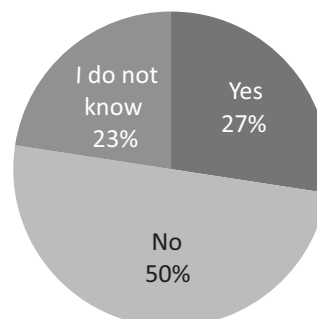


Figure 9. Share of households respecting the principles of selective municipal waste collection

Rysunek 9. Udział gospodarstw domowych, w których przestrzega się zasad selektywnej zbiórki odpadów komunalnych

Source: own study.

The range of harmfulness of the produced waste is still growing (Tables 5 and 6). It can also be noticed that in urban areas there are many more irregularities with separate waste collection than in rural areas 9 (Tables 6 and 7).

It should be emphasized that despite the fact that there are relevant regulations on waste collection and European Union directives, Polish households do not comply with

Table 6. Share of households with selective municipal waste collection [%]

Tabela 6. Udział gospodarstw domowych, w których prowadzi się selektywną zbiórkę odpadów komunalnych [%]

Is separate waste collection carried out in your household?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	20	32	15	67
No	10	10	5	25
I do not know	2	3	3	8
Total	32	45	23	100

Source: own study.

Table 7. Share of households respecting the principles of selective municipal waste collection [%]

Tabela 7. Udział gospodarstw domowych, w których przestrzega się zasad selektywnej zbiórki odpadów komunalnych [%]

Does your household comply with all the rules related to separate waste collection?	Area of residence in which the surveyed households are located			
	rural	urban	urban and rural	total
Yes	3	6	8	17
No	9	13	9	31
I do not know	6	5	3	14
Total	18	24	20	62

Source: own study.

the related standards in a proper manner. Importantly, some respondents avoided answering this question, especially inhabitants of urban areas. This situation may be due to the fact that non-compliance with these standards is not subject to high penalties, and the collection of municipal waste is usually not much more expensive than selective waste. The lack of adequate motivation is particularly evident in the case of households that are interdependent on all types of housing associations and housing cooperatives. This is due to the fact that in the case of members of communities and cooperatives, it is very difficult to detect cases of non-segregation of waste, which makes it difficult to impose a fine on people who do not segregate waste. On the other hand, households living in detached houses are easy to trace and it is much easier to prove the fact of non-compliance with the principles of selective waste collection, therefore the imposition of penalties for offenses in this respect is much simpler (Tables 8 and 9).

In addition, many respondents pointed to the lack of time to conduct selective collection of municipal waste, which, combined with the lack of motivation and the general claim that this system does not work properly, means that selective waste management simply does not work, which is confirmed, for example, in the view of overfilled containers with waste and the lack of appropriate waste selection. This, in turn, translates into a malfunction of reverse logistics both at the micro and macro level.

Table 8. Share of households respecting the principles of separate collection of municipal waste according to the apartment/house ownership criterion [%]

Tabela 8. Udział gospodarstw domowych, w których przestrzega się zasad selektywnej zbiórki odpadów komunalnych według kryterium własności mieszkania/domu [%]

Does your household comply with all the rules related to separate waste collection?	Type of ownership of the house/flat and the related interdependencies in the field of selective municipal waste collection				
	detached house	ownership – housing association	ownership – housng cooperative	rented	total
Yes	25	3	7	5	40
No	6	15	15	10	46
I do not know	6	1	2	5	14
Total	37	19	24	20	100

Source: own study.

Table 9. Reasons for non-compliance with the principles of separate collection of municipal waste according to the flat/house ownership criterion [%]

Tabela 9. Przyczyny nie przestrzegania zasad selektywnej zbiórki odpadów komunalnych według kryterium własności mieszkania/domu [%]

Why the rules of municipal waste management are not respected in the household	Type of ownership of the house/flat and the related interdependencies in the field of selective municipal waste collection				
	detached house	ownership – household association	ownership – household cooperatives	rented	total
Too little motivation	4	2	6	7	19
Too low penalties for not following the rules	4	1	4	4	13
There is no adequate system of selective collection of municipal waste	8	8	5	3	24
Wrong location of selective waste collection points	6	3	2	0	11
The inefficiency of the selective waste collection system	4	1	2	0	7
Lack of time	11	4	5	6	26
Total	37	19	24	20	100

Source: own study.

Summary

The paper presents the results of a pilot study assessing the level of awareness of the inhabitants of Polish households on the level of application of ecologistics concepts in these households in terms of the concept of waste collection and recycling.

Based on the literature analyzes and surveys conducted in one hundred different types of households, it can be concluded that Polish families show interest in the use of logistic concepts and less use of ecologicistic tools.

Based on the empirical research conducted, it is clearly visible that the inhabitants of Polish households with selective waste collection constitute the majority of the surveyed respondents. The percentage of such people is almost 70% (Figure 8). What is worrying, however, is the number of households that follow all the related rules, as it is only 30% of the answers (Figure 9). Such a situation, according to the respondents, results from: lack of time to conduct separate waste collection (26 responses), lack of an appropriate system of separate collection of municipal waste (24 responses), insufficient motivation (19 responses), too low penalties for non-compliance (13 responses). Of course, there are other reasons as well. Nevertheless, those mentioned above clearly indicate the causes of low social awareness related to the ecological conduct of everyday life.

Therefore, it is not surprising that among the Polish households that were surveyed, as many as 52% believe that they do not use any logistic tools in managing their farms. Even more households do not use the tools available in the ecologicistic concept as much as 55%. This situation is confirmed by the large number of farms that use logistic (27%) and ecologicistic (18%) tools. Which, in turn, translates into a low level of recycling and recovery of waste in Poland, which for recovery amounts to 7,087.0 thousand tonnes (55.6%), of which recycling accounts for only 3 192.1 thousand tonnes (25.0%) [GUS 2020].

In connection with the above, it should be emphasized that the level of logistics implementation in Polish households is in the initial stage. This process may be accelerated by the changes taking place in Polish legislation. However, a much greater stimulus determining Polish households more willing to use ecological tools will be the dynamically changing market with which Polish households are directly related and the situation related to the corona virus, which will autonomously force a change in the management strategy of these farms. In addition, the environment of the entities in question will pose more and more new challenges. It should be emphasized here that Polish farms will be forced to look for savings, thus they will have to minimize the waste of their resources and maximize their use. Today, every Polish family has unlimited access to resources and information, through the use of modern technologies that will enable the optimal and effective integration of Polish households with the logistics chain.

Not without significance is the ever-growing pressure of society to increase the security of future generations, which manifests itself in the rationalization of production and the flow of products in the supply chain. This is related to, for example, new epidemiological threats that force entities to remain transparent, and this in turn will force the implementation of principles consistent with ecologicistic and sustainable development. Based on the above, it can be concluded that even households should assume the implementation of the aforementioned logistic concepts in their activities. Thus, becoming responsible recipients of products both from large enterprises and small entities. This means that a single consumer, who is a component of the household, becomes an integral part of the supply chains, which affects its functioning both in terms of purchasing goods and their withdrawal from the market through the logistic feedback chain.

Summing up, on the basis of the literature review and the observations and surveys carried out, it can be clearly stated that in Poland the level of social awareness in the field of ecology is still at a low level. There is a lack of effective systems motivating the inhabitants of Polish households to comply with the principles that create pro-ecological attitudes. It can also be stated that the surveyed inhabitants make little use of logistic and

ecologicistic tools in terms of ecology. This is due to many reasons, the basic one is the lack of time and low motivation as well as the lack of appropriate legal sanctions, for example in the form of administrative penalties. In connection with the above, it is necessary to consider developing an appropriate logistic concept that will create an appropriate pro-ecological basis in the society. IT tools that will allow households to become active participants in logistics chains may prove extremely helpful in this regard. Perhaps it will be possible thanks to the so-called industrial revolution 4.0. The answer to this question will be the subject of further consideration.

References

- Andrzejczyk P., 2009: Istota i znaczenie ekologii odpadów komunalnych [The essence and importance of municipal waste ecology], *Logistyka* 5, 24–28 [in Polish].
- Andrzejczyk P., 2012a: Znaczenie logistyki zwrotnej dla zrównoważonego rozwoju region [Importance of reverse logistics for sustainable development of the region], *Prace Naukowe Uniwersytetu Ekonomicznego, Problemy rozwoju regionalnego* 244, 450–459 [in Polish].
- Andrzejczyk P., 2012b: Logistyka zwrotna jako istotny element makrologistyki poziomu lokalnego na przykładzie wybranych gmin Dolnego Śląska – cz. I [Reverse logistics as an important element of macrology at the local level on the example of selected communes of Lower Silesia – part I], *Logistyka* 4, 71–73 [in Polish].
- Andrzejczyk P., 2012c: Logistyka zwrotna jako istotny element makrologistyki poziomu lokalnego na przykładzie wybranych gmin Dolnego Śląska – cz. II [Reverse logistics as an important element of macrology at the local level on the example of selected communes of Lower Silesia – part II], *Logistyka* 5, 24–28 [in Polish].
- Eurostat, database, [electronic source] <https://ec.europa.eu/eurostat/data/database> [access: 04.08.2020].
- Budzik-Nowodzińska I., 2013: Logistyka zwrotna w gospodarce odpadami [Reverse logistics in waste management], *Logistyka* 6, 553–555 [in Polish].
- GUS, Dane statystyczne na temat gospodarki odpadami w okresie 2015–2020 [Statistical data on waste in the period 2015–2020], [electronic source] <https://stat.gov.pl/index.php> [access: 10.09.2020] [in Polish].
- Ficoń K., 2001: Logistic processes in an enterprise [Procesy logistyczne w przedsiębiorstwie], Impuls Consulting, Gdynia [in Polish].
- Kuboń M., 2008: Koszty infrastruktury logistycznej w przedsiębiorstwach rolniczych [Costs of logistic infrastructure in agricultural enterprises], *Inżynieria Rolnicza* 12, 10(108), 125–136 [in Polish].
- Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 16 kwietnia 2020 r. w sprawie ogłoszenia jednolitego tekstu ustawy o odpadach [Announcement of the Marshal of the Sejm of the Republic of Poland of April 16, 2020 on the publication of the written text on waste], *Dz.U.* 2020 poz. 797 [in Polish].
- Sadowski A., 2009: Zarys rozwoju logistyki zwrotnej [Outline of reverse logistics development], *Logistyka* 5, 12–15 [in Polish].
- Szymańska E., 2010: Efektywność przedsiębiorstw – definiowanie i pomiar [Effectiveness of enterprises – definition and measurement], *Roczniki Nauk Rolniczych, Seria G: Ekonomika Rolnictwa* 97, 2, 152–164 [in Polish].

- Rogers D.S., Tibben-Lembke R.S., 1998: Going backwards: Reverse Logistics Trends and Practices, Reverse Logistics Executive Council, Nevada.
- Srivastava S.K., 2008: Network Design for Reverse Logistics, *Omega* 36(4), 535–548.
- Ustawa z dnia 14 maja 2020 r. o zmianie niektórych ustaw w zakresie działań osłonowych w związku z rozprzestrzenianiem się wirusa SARS-CoV-2 [Act of May 14, 2020 amending certain acts in the field of protective measures in connection with the spread of SARS-CoV-2 virus], *Dz. U.* 2020 poz. 875 [in Polish].
- Wajszczuk K., 2001: Analiza łańcucha logistycznego w przedsiębiorstwie rolno-spożywczym [Analysis of the logistic chain in an agri-food enterprise], *Logistyka* 2, 553–555 [in Polish].

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