Environmental Science and Policy 145 (2023) 151–163

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

The end of plastic? The EU's directive on single-use plastics and its implementation in Poland

Dominika Kasznik, Zofia Łapniewska [1,*]

Institute of Economics, Finance and Management of the Jagiellonian University in Kraków, ul. prof. Stanisława Łojasiewicza 4, 30-348 Kraków, Poland

ARTICLE INFO

Keywords:
SUP directive
Disposable plastic products
Plastics manufacturers
Anti-plastic trends
Directive (EU) 2019/904
Ecological economics

ABSTRACT

We are drowning in a sea of plastic. Not only do marine animals ingest or get entangled in (micro) plastic, but it also ends up in the food chain, including in humans. This plastic comes from mainly single-use products. "Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment" introduced numerous restrictions on their production. However, its effectiveness depends on national implementations that are delayed due to, inter alia, the objections of manufacturers. In this article, we present research conducted on Polish companies producing single-use plastic products, on sellers (retail outlets and food service establishments) and consumers. The results show that all study groups agree on the need to reduce the production of disposable plastics. The most frequently indicated solution is the introduction of reusable products to the market (in line with the circular economy notion), which would still be synthetic polymers. Manufacturers emphasize that promising chemical recycling technologies are emerging for all plastic waste. In addition, both consumers and producers are increasingly focused on products made of alternative materials, as consumers (especially from large cities) are increasingly averse to plastic in general, which was also pointed out by sellers. Consumers surveyed believe that the "Plastics Directive" is needed and blame the producers of disposable plastics for the condition of the environment, while manufacturers highlight irresponsible consumer behaviour and the need for more education in this regard.

1. Introduction

It is ironic, amid the current turmoil over plastic pollution, that the first synthetic plastic (a form of nitrocellulose) was intended to provide environmental protection, by reducing demand for ivory, from which billiard balls were made, although they would occasionally explode when struck. Indeed, it has been reported that John Wesley Hyatt, who introduced it for this purpose, commented that, "in spite of their tendency to catch fire, cellulose nitrate saved the elephant" (Rhodes, 2019: 219, after Freinkel, 2011).

Over time, an uncompromising ideal was invented - a plastic characterized by unlimited and uncomplicated possibilities of production and forming, as well as lightness, durability and, above all, low economic cost. Who would have thought that this "defects-free" solution would be such a serious problem today?

Plastic has accompanied humans for over 100 years (Rhodes, 2019: 220; Geyer et al., 2017), during which there was a process of gradual dependence of many areas of life and economy on it. Today, however, the features that were once considered to be the unquestionable advantages of synthetic polymers are not that attractive anymore. The European Commission, in its proposal to limit the impact of certain plastic products on the environment, defined the broadly understood "plastic" as: widely available, permanent, susceptible to transmission by wind, current and tides, and therefore transboundary, with toxic and other hazardous effects (plastic residues are found in the organisms of marine animals and consequently end up in the food chain) (COM(2018) 340: 1–2). These features emphasize the importance of the problem of the negative impact of plastic products not only on the marine environment, but on the entire biosphere. Perishable single-use plastic products are of particular concern. According to the "Directive of the European Parliament and of the Council (EU) 2019/904 of 5 June 2019 on the reduction of the impact of certain plastic products on the environment", also known colloquially as the "Plastics Directive" (Siwkowska, 2021; Biopack, 2022), the implementation of which is the subject of the research presented in this article, a single-use plastic product is:

* Corresponding author.
E-mail address: z.lapniewska@uj.edu.pl (Z. Łapniewska).
[1] **ORCID:** 0000-0003-0002-5323

https://doi.org/10.1016/j.envsci.2023.04.005
Received 20 May 2022; Received in revised form 29 March 2023; Accepted 3 April 2023
Available online 17 April 2023
1462-9011/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

> A product that is made wholly or partly from plastic and that is not conceived, designed or placed on the market to accomplish, within its life span, multiple trips or rotations by being returned to a producer for refill or re-used for the same purpose for which it was conceived (Directive (EU) 2019/904: Art.3, Par. 2).

The issue of plastic waste has been raised many times at the European Union (EU) level. At the end of 2015, the European Commission stressed that plastics are a priority in the plan approved by it for the transition of the European Union economy to a circular economy (COM (2015) 614). In 2017, the European Commission announced that, as part of the drive to create such an economy, it will aim at a state in which all plastic packaging will be recyclable by 2030 (COM(2017) 479). In "A European Strategy for Plastics in a Circular Economy" it was noted that "too often the way plastics are currently produced, used and discarded fails to capture the economic benefits of a more 'circular' approach and harms the environment" (COM(2018) 28: 1). It was emphasized, that it is necessary for all the entities operating in the economy to cooperate in order to counteract environmental degradation. At the same time, attention was drawn to the important role of the plastics industry, and it was pointed out that introducing improvements in its functioning may contribute to the emergence of new opportunities. According to the information contained in the strategy, the vision of the new management of plastics is defined as follows:

> A smart, innovative and sustainable plastics industry, where design and production fully respect the needs of reuse, repair, and recycling, brings growth and jobs to Europe and helps cut EU's greenhouse gas emissions and dependence on imported fossil fuels. (…) In Europe, citizens, government and industry support more sustainable and safer consumption and production patterns for plastics. This provides a fertile ground for social innovation and entrepreneurship, creating a wealth of opportunities for all Europeans (COM(2018) 28: 5).

The European Strategy for Plastics in a Circular Economy identifies solutions and actions that need to be taken to achieve this vision. The "Directive (EU) 2019/904 of the European Parliament and of the Council" mentioned above is another manifestation of the desire to create this new economy (Vidal et al., 2020). This Directive attempts to save the environment from plastic waste, which results from the growing volume of production (in 2050, it is to be 4 times greater than today (Ellen MacArthur Foundation, 2016; Mai et al., 2020)), over-consumption (especially visible in NAFTA countries, Western Europe and Japan (Plastics Insight, 2017)), but also waste that is insufficiently collected and recycled (Plastics Europe, 2019: 29–31; Nøklebye et al., 2023). It recalls that there are predictions that if no action is taken, the world's oceans will have more plastic waste than fish by 2050 (Ellen MacArthur Foundation, 2016; Kerscher, 2019: 47–48). Given the indicated goals of the "2030 Agenda for Sustainable Development" (United Nations, 2015) and the needs of future generations, the right steps have to be taken before it is too late. With reference to the "Plastics Directive", these steps are aimed at reducing environmental pollution with single-use plastic products and at eliminating other negative consequences of the presence of plastic waste in the environment. Unfortunately, this Directive is not free of ill effects, as it will certainly hit companies that manufacture this type of products - which was, inter alia, the subject of our research.

The goal of this paper is to identify the potential impact of the "Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 with regard to the reduction of the impact of certain plastic products on the environment" on Polish producers of disposable plastic products, as well as to indicate trends related to the (non)use of these products by consumers, as pointed out by sellers (retail outlets and food service establishments). We focus on the process of implementing this Directive in Poland, a country that is one of the main single-use plastic products (SUPs) manufacturers in the European Union that is subject to restrictions on goods, while also on the anticipated impact this Directive may have on the present and future activities of companies and consumers. The need to conduct the study presented here resulted from noticing the research gap: the lack of research indicating the attitude of both sides – producers and consumers (as well as sellers) – to the implemented "Plastics Directive", as well as presenting the vision of changes and the adaptation to the post-implementation reality. Our mixed-method research (Jick, 1979; Creswell, 2009: 203–224; Grønmo, 2019: 394–419) included two interviews with representatives of companies producing disposable plastic goods – ZELAN company (the largest Polish producer of disposable cutlery at the time of the interview) and Bittner Packaging (the largest producer of disposable tableware with domestic capital), and we conducted two surveys – among sellers and consumers. The study of these groups was to allow us to look at the analysed subject from different points of view (Wodak and Mayer, 2016; Wilson, 2020).

The most important conclusions from the research are: the observed strong opposition of producers of disposable plastics to the implementation of the "Plastics Directive" in its intended form, as indicated by numerous actions and appeals by these companies, as well as the shock experience of its rapid implementation in 2019, short transition periods and expected negative impact on the activities of enterprises in the plastics sector in the coming years. At the same time, the spread of the Sars-CoV-2 virus and the sudden shift towards hygienic packaging and disposability led to a significant increase in the sales of products offered by the surveyed companies, despite the growing aversion to plastic by consumers observed before the pandemic. It may be presumed that the delays related to the formulation of the guidelines for the "Plastics Directive" by the European Commission and the continued lack of national laws are a "stalling game" with regard to implementing production restrictions (Poland is a country that lags behind the other EU member states when it comes to implementing most of the measures of the Directive (Copello et al., 2022: 8)). Manufacturers believe that the best solution in the face of the implementation of the Directive's restrictions is to switch to the production of reusable plastic goods, which is in line with the assumptions of the circular economy. They point to chemical recycling as "tomorrow's" technology to transform polymer waste into high-quality secondary raw material and reuse it. They are also considering manufacturing from alternative materials such as wood, pulp or WPC [wood-plastic composite] (or importing such finished products from China and introducing them into the domestic market). The surveyed sellers and customers are also already taking or planning to take measures to reduce the consumption of plastic disposable products. Sellers introduce products from alternative materials or fees for disposable products to their points of sale. Consumers more often choose reusable products, segregate waste and choose products made of materials alternative to plastic. Both groups agree that the implementation of the "Plastics Directive" is necessary. They have placed the responsibility for generating plastic waste to the greatest extent on producers (although manufacturers, on the contrary, on consumers), which is in line with the intention of the Directive. All surveyed groups agree that plastic pollution is a problem and that measures should be taken to tackle it.

This paper is divided into six parts. After this short introduction, we present the European Union plastics market by pointing to the largest producers and the highest demand for single-use plastic products by the EU countries, with particular emphasis on Poland as our research area (Section 2). In the third part, we present the assumptions of the "Plastics Directive", the process of its implementation at the European Union and Polish levels, as well as the new circumstances, i.e. the Sars-CoV-2 virus pandemic, which affected the perception of a radical reduction in the production of disposable plastic products. The fourth section is devoted to the discussion of the adopted research methods and the presentation of the research environment, and the fifth part presents the results of our empirical research. The article ends with discussion and conclusions in section six.

2. The European Union plastics industry

Data from the study "Plastics – the Facts 2021" indicates that in 2020, on a European scale (EU27 + 3 (UK/NO/CH)) of the plastics industry, there were about 52,000 enterprises, including the following: producers and processors of plastics, manufacturers of processing machines and companies recycling synthetic materials (Plastics Europe, 2021: 8). It should also be emphasized that in the total number of entities, the vast majority are small and medium-sized enterprises (Plastics Europe, 2021: 9). Together, all of these companies employ nearly 1.5 million people. In 2020, the annual turnover of the plastics industry in Europe was close to EUR 330 billion. Considering the contribution of gross value added in the scale of the entire European industry, the plastics industry ranks 8th (Plastics Europe, 2021: 9). At the same time, the demand for the raw material, in this case plastic, from which the processors produce finished products on the European scale (for EU27 + 3) in 2020 amounted to 49.1 Mt (Plastics Europe, 2021: 18–19). The highest demand was reported for Germany (23.3%, i.e. almost a quarter of the total demand), then Italy (14.1%), France (9.3%), Poland (7.5%), Spain (7.4%) and Great Britain (7.0%). The greatest demand for plastics comes from the packaging segment (40.5%) and construction (20.4%) (Plastics Europe, 2021: 20). The demand for recycled plastics, which was initially relatively low (only 6% (Zamorowska, 2019)), seems to be growing, which is encouraged by new regulations, as well as pro-recycling trends observed among consumers and producers (Antonopoulos et al., 2021; Brooks, 2021; Nelms et al., 2022). Increasing the use of recycled plastics can reduce the extraction of fossil fuels and reduce CO_2 emissions (COM(2018) 28: 3, after FEDEREC, 2017), which observations contributed to the creation of a provision in the "Plastics Directive" requiring Member States to gradually increase the use of plastics from recycled beverage bottles, as well as to increase the level of separate collection for recycling purposes (Directive (EU) 2019/904, Art. 6 and Art. 9). In 2020, of the 29.5 Mt of plastic waste collected in the EU27 + 3, only 34.6% was recycled, 42% was incinerated for energy recovery and 23.4% was landfilled (Plastics Europe, 2021: 26).

It may be assumed that the "Plastics Directive" can affect not only plastics converters, in this case producers of single-use plastic products, but also other entities operating in the plastics industry in European Union, while it is very likely that it will upset existing global export and import relations (in 2018, the share of the European Union in terms of global exports and imports of plastics was 39.9% and 36.9%, respectively (International Trade Centre, 2019; PKO BP, 2019: 3)). A downward trend is already visible in the following areas: the number of enterprises operating in the European Union plastics industry (reduction by approx. 8000 compared to 2018 in the EU28); employees (by 100, 000), generated turnover (by EUR 30 billion), as well as the contribution of this industry to the creation of gross value added in the European Union industry in general (currently, as previously mentioned, the plastics industry ranks 8th, and in 2018 it was 7th (Plastics Europe, 2019: 8–9; Plastics Europe, 2021: 8–9)). However, it is difficult to unambiguously link the indicated drops with the "Plastics Directive" due to the dynamically changing conditions of the entire environment.

The plastics industry in Poland employed over 215,000 people at the end of 2020 and generated almost PLN 85 billion (ca. EUR 18.9 billion)[2] of turnover in that year (Foundation Plastics Europe Poland, 2021: 16; GUS, 2021: 127). As in the European Union plastics industry, the leading position in Poland is also among the entities that are plastics processors. The data from 2017 shows that there are 7377 such enterprises in Poland, which are responsible for approximately 85% of the domestic turnover (PKO BP, 2019: 9; Kozera-Szałkowska, 2019: 753). The industrial segments that report the highest demand for the raw material (total demand was 3.5 Mt) are: the packaging segment (35%), which uses the most plastic for the production of foil, food trays and reusable shopping bags (Deloitte, 2019) and construction (24%) (Kozera-Szałkowska, 2019: 754). In 2017, in which the value of plastic products in Poland amounted to EUR 16.3 million, and thus the country took 5th place in European Union with almost 7% share in its market (PKO BP, 2019: 8). In addition, in recent years, a rapid development of the plastics sector in Poland has been observed and its further growth was forecast, which would be demonstrated by, among other things, a good economic situation in the plastic packaging, construction and automotive industries (Knell, 2019; Ostrowski, 2019). It is also interesting that the Polish plastics industry recorded a much faster growth rate than the Polish industry in general. In 2010–2018, there was an increase in the sales of plastic and rubber products (data given in total) by 88.5% (Ostrowski, 2019). In that decade (2008–2018) there was a 26% increase in investment in total processing, while the plastics and rubber processing segment, considered as a separate category, is credited with a 68% increase in investment (Kozera-Szałkowska, 2019: 755).

With the appearance of the first information on the "Plastics Directive", concern arose that the current good economic situation in the plastics sector in Poland and very positive forecasts for the future would be upset, and in many cases the invested capital would not be returned. Kazimierz Borkowski, Managing Director of Plastics Europe Polska, in a press release from 2019, available on the website of the Association of Plastics Producers, emphasizes that despite the continued good streak visible in the Polish plastics industry:

> [The industry] is feeling more and more pressure from both legislators and the public, which seems to be heading towards reducing the use of plastics. The SUP Directive and the provisions resulting from it are the first example of such initiatives - in a moment it may turn out that some of the afore-mentioned industry investments will not even have a chance to pay for themselves (Plastics Europe Newsroom, 2019).

The regulations of the "Plastics Directive" may harm small and medium-sized enterprises in particular, and these constitute the majority of plastics processors in Poland (Szydłowski, 2019). The EU act in its current wording is a real challenge for all companies belonging to the single-use plastic products industry in the country.

Meanwhile, littering the environment with plastic is a social problem, which is often caused by the irresponsible management of single-use products after their use by end consumers (Tonglet et al., 2004; Botetzagias et al., 2015; Roche Cerasi et al., 2021). Therefore, a question can be posed whether the new restrictive requirements, which primarily affect producers of this type of products, are just and fair. Shouldn't the solution to this problem be a mutual cooperation of all entities operating in society and the responsibility evenly shared between producers, points of sale – where disposable plastic products are available – and consumers, so as not to place the greatest restrictions only on the first group? These questions inspired us to conduct research on all of the afore-mentioned groups (Sections 4 and 5 below). However, when it comes to simply stopping the degradation of the environment with single-use plastics and ensuring a level playing field for future generations to enjoy a good life, it may turn out that the restrictive regulations contained in the "Plastics Directive" are the only way to achieve this goal.

3. "Plastics Directive" and its implementation in Poland

On May 28, 2018, the European Commission issued a proposal to the European Parliament and the (EU) Council, the justification of which was the harmful effects of plastic products on ecosystems, biodiversity and human health, while also expressing concern about the waste of materials that could be reused (COM (2018) 340). As the document emphasizes, as much as 43% of the total amount of plastic waste found on European beaches is single-use only (COM (2018) 340: 1), which makes it the most problematic in terms of marine pollution. The Commission has distinguished 10 different categories of this type of waste

[2] Indicative figure for the average exchange rate: EUR 1 = PLN 4.5.

(Directive (EU) 2019/904, Article 4–10). This division was drawn up due to the frequency of the appearance of various types of disposable plastic products on the studied beaches. Other factors that led to this state of affairs, according to the European Commission's proposal, are: "the wide availability of plastic, consumption trend for convenience, lack of incentives to ensure a proper collection and treatment of waste leading to poor management and insufficient infrastructure" (COM (2018) 340: 1). In this proposal, reference is also made to the United Nations Sustainable Development Goals of the "2030 Agenda for Sustainable Development" (United Nations, 2015), to be implemented not only at the local (European Union) level, but also at the global level (Goals 12 and 14). It was also emphasized that due to the transboundary nature of waste, the only comprehensive and effective solution to the problem would be mutual and coordinated cooperation between Member States having access to the same seas and waterways. Another problem that may arise in implementing plastic restrictions, if Member States decide to act alone, is the risk of market fragmentation, which "could lead to a variety of restrictions of market access among the Member States, barriers to the free movement of goods and to the level playing field between producers in different countries" (COM (2018) 340: 6). Therefore, it is extremely important to introduce common legal solutions at the EU level, and hence, uniform goals limiting the negative impact of plastic waste on the environment. Following this intention, the European Commission indicated the requirements to be imposed on the Member States of the European Union, which were ultimately included in the Directive as follows: restrictions on the use of SUP products, market restrictions, product design requirements, labelling requirements, extended producer responsibility, separate collection, and dissemination of knowledge (COM (2018) 340: Art. 4–10). These requirements have also been allocated to specific categories of single-use plastic products, and the proposed measures that Member States could implement to meet the targets are listed.

The proposal of the European Commission was positively received by the European Parliament and the (EU) Council, and as a result the "Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment" (Directive (EU) 2019/904) was published in the Official Journal of the European Union. This Directive, as previously proposed by the European Commission, concerns two specific groups of plastic waste: single-use plastic products and fishing gear. The subject of this article and the associated research focused on the former. According to the Directive, Member States are obliged to implement the requirements for specific categories of single-use products made of plastics. The Directive also proposes measures that may be applied by Member States on the way to achieving the goals, e.g. introducing additional payments or a deposit system (Art. 9). However, the final decision on the measures taken to transpose and implement the requirements of the Directive is an individual matter for each country, which is subject to compliance with EU food law in the field of hygiene and safety (Art. 11). In the "Plastics Directive", most of the requirements indicate various dates by which Member States and the European Commission must take action to initially begin to meet the targets, and then the dates by which countries are to achieve specific percentage or quantitative results indicating the adherence to the requirements. In addition, this legal act contains numerous specifications regarding the exact expectations of the European Union regarding the requirements. For example, the Directive stipulates that by 2025 all plastic bottles will be at least 25% from recycled materials (Art. 6, Par. 5a) and by the same year, the collection and recycling of disposable bottles is to reach 77% (Art. 9, Par. 1a).

All EU Directives need to be reflected in national legislation. Article 17 of the "Plastics Directive" indicates that "Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 3 July 2021" (Directive (EU) 2019/904, Art. 17, Par. 1). Unfortunately, the assumptions of the Directive have still not been implemented into Polish legislation (as of Mach, 2023). The Ministry of Climate and Environment reported that the detailed guidelines of the European Commission for the products listed in the Directive took a long time to come (the current version of the act comes from June 7, 2021 (Official Journal of the European Union, 2021)), which fact contributed to this delay (Ministry of Climate and Environment, 2021; Zamorowska, 2021). It is also hard not to mention the unexpected pandemic crisis, the overcoming of which has become a priority goal on a global scale. The latest report regarding the SUP Directive implementation assessment (Copello et al., 2022: 7–9) indicates that Poland, as of September 2022, was not the only European Union Member State which had failed to implement the directive on time - Finland, Czech Republic, Slovakia, Romania, Bulgaria and Croatia also have encountered some difficulties. All the afore-mentioned countries were indicated as those who have not implemented the Directive or have implemented it incorrectly. However, it is important to point out that according to the report, the transposition delay in Poland is greater than in any other European Union Member State. Still, the vast majority of European Union Member States managed to transpose, at least partially or in full, the requirements of the Directive into national legislation, which only confirms that a planned implementation of this act was possible (Grom, 2021; Copello et al., 2021).

In Poland, in the spring of 2023, when we are in the process of revising this article, there are three bills: UC73 (concerning waste management and product fee), UC81 (concerning packaging and packaging waste - extended producer responsibility) and UC98 (concerning the deposit-refund system) which implement (among others) the regulations of the "Plastics Directive". While UC81 was stuck at the opinion stage in August 2021, and U98 has not yet been passed to the Social Committee of the Council of Ministers since November 2022 (Government Legislation Centre, 2021b, 2022), the closest to the adoption is UC73, which was sent to the Sejm (the lower house of Polish parliament) in February 2023 (Government Legislation Centre, 2021a). Without the other acts, however, UC73 does not constitute a coherent whole in accordance with the regulations currently in force (Jóźwiak, 2023). Despite the fact that the "Plastics Directive" has not yet been adopted into Polish law, significant changes are already visible in the economic reality, as a result of which, single-use plastic is gradually giving way to other solutions that both producers and consumers have been preparing for, as shown by our research (Section 5). However, there was also an objection from the producers, and the first comments were submitted by the entities we examined to the European Commission's 2018 application (COM(2018) 340).

The Polish Union of Plastics Converters (*pl.* Polski Związek Przetwórców Tworzyw Sztucznych, PZPTS) in the information passed on from July 3, 2018, questioned the appropriateness of the solutions proposed by the European Commission, stressing that, while taking into account the afore-mentioned plan of the European Union concerning the transition into a circular economy (COM(2018) 28), the means to achieve the goal should be to find measures to foster the "closure" of single-use plastic products in the cycle and not to create the conditions for the emergence of more waste with a possibly bigger environmental footprint. In addition, the association emphasized that the European Union only contributes to littering of water bodies to a small extent (PZPTS, 2018a), because, as indicated by the available reports, the old continent has only a 1% share in the mass of plastic waste that is thrown into the seas and oceans each year, while Asian countries are responsible for as much as 82% (Jambeck et al., 2015; Ritchie and Roser, 2018).[3] Soon after (on September 4, 2018), the official position of the Association appeared on the PZPTS website (PZPTS, 2018b). It highlights the possible fragmentation of the European Union market, inconsistency

[3] Despite the fact that European Union countries, e.g., Germany in 2010 generated almost 0.5 kg of plastic waste per person per day (this is one of the highest results in the world), due to well-developed waste management, their impact on marine pollution and oceans is negligible (GTAI, 2018).

with the existing legislation, and non-compliance with the afore-mentioned strategy on plastics, especially due to the inappropriate approach of the European Commission to recycling presented in the "Plastics Directive". In addition, the document also highlights the lack of proven advantages (in terms of environmental benefits) of alternative materials over plastics, thus further encouraging consumers to live on a "produce-use-waste" model rather than stimulating circular solutions; the important role of packaging in preventing food waste; focusing only on the responsibility of producers for the pollution and the lack of reference to the inappropriate behaviour of consumers in the field of waste management; and finally, the excessively broad and underdeveloped proposals that do not take into account the industrial classification definition of single-use products proposed in the Directive (PZPTS, 2018b). However, these comments did not affect the decision of the European Parliament and of the Council (EU), as in mid-2019 the "Plastics Directive" came into force. On January 17, 2020, the managing director of European Plastics Converters, Alexandre Dangis sent an official letter to Thierry Breton, the Commissioner for the Internal Market, in which he raised doubts about the consistency of the "Plastics Directive" with the strategy of the "European Green Deal"[4] (European Plastics Converters, 2020a).

Robert Szyman, the director general of PZPTS, in his position of February 17, 2020, underlined that even before the emergence of the Directive, both in Poland and in the EU, restrictive regulations in the field of environmental protection were in force (PZPTS, 2020a). Entities using the environment, were, inter alia, required to pay fees for the introduction of gases or dust into the air, as well as for waste storage. Moreover, as regards the new legislation affecting in particular the Polish plastics industry, PZPTS had to face the recycling fee for plastic bags (PZPTS, 2019) and the effects of the amendment to the Waste Act (new deposit fee and new obligations to store recyclable materials and waste) (PZPTS, 2018c). In addition, from the beginning of 2021 the so-called "plastic levy" was introduced, which is in practice the EU fee of EUR 0.8 for every kilogram of non-recycled plastic. According to the declaration of the Polish Ministry of Finance, the new category of revenues of the European Union budget will not additionally burden consumers nor producers of plastics, but will be covered by the state budget (Ministry of Finance, 2021). The aim of introducing this fee was to increase the level of recycling of plastics, and thus reduce the production of disposable products. However, the rapid spread of the Sars-CoV-2 virus has shed new light on the perception of SUP products, and in particular of packaging.

The massive number of COVID-19 cases around the world and the growing demand for all "protection products" against infection have marginalized the usefulness of reusable plastic product models discussed in the European Union (Heiges and O'Neill, 2020; Parashar and Hait, 2021). The features guaranteed by single-use products made of plastics have become very attractive, and the products themselves are in demand. On April 9, 2020, a message appeared on the PZPTS website informing that companies belonging to the association had provided hospitals with very large amounts of cups, bowls, cutlery, packaging bags, food transport containers, protective visors and foil for medical curtains free of charge, and offer to start mass production of protective visors (PZPTS, 2020b). This fact reminded us that the pursuit of high hygienic standards led to the use of plastics, in particular disposable products, e.g. in medicine, which was a massive improvement in this field (Rivera et al., 2005; Sastri, 2014). Currently, the single-use feature has also been appreciated in other areas, and Chief Sanitary Inspector (*pl.* Główny Inspektorat Sanitarny, GIS) in the guidelines for the food industry recommended limiting the time unpackaged food intended for direct consumption is displayed in shops (GIS, 2020).

Referring to the extremely important role of single-use plastic products in the prevention of virus infections, representatives of European Plastics Converters in an open letter to the President and members of the European Commission of April 8, 2020, accentuated that it is very difficult to replace plastics in terms of their being single-use (European Plastics Converters, 2020b). In the letter, Renato Zelcher (President of European Plastics Converters, EuPC) and the afore-mentioned Dangis, speaking on behalf of European plastics converters, asked for the deadline for the implementation of the "Plastics Directive" to be postponed by at least one year and for the prohibitions imposed by the Directive on certain single-use plastic products to be lifted (European Plastics Converters, 2020b).

The European Commission responded to these appeals wih a statement that its "position continues to be that deadlines in EU law have to be respected" (Simon, 2020). Thus, the Directive began to be implemented by the EU Member States. It can be presumed that this delay on the part of the European Commission, which did not immediately provide detailed guidelines, was a play for time that was just taking into account the extraordinary circumstances of the pandemic. Meanwhile, the slow pace of legislative work in Poland can also be perceived as a nod towards producers, although they themselves point out rather high uncertainty and inability to act due to the lack of an established legal status. However, this does not change the fact that the UC73, UC81 and UC98 laws will eventually be implemented, and disposable plastic, according to the results of our research, will slowly disappear from our consumer environment.

4. Research methods and research environment

The rationale for conducting our research was the recognition of a research gap of the potential impact of the "Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 with regard to the reduction of the impact of certain plastic products on the environment" on entities in the single-use plastics value chain, while taking into account the responsibility for waste that, in whole or in part, enters the biosphere. The review of positions from secondary sources, presented in points 2 and 3 above, does not allow to address this gap unequivocally, so we decided to conduct primary research. We did not find any other similar studies carried out in other European Union countries, even those that are leaders in the production[3] and use of single-use plastics.

The initial and overriding aim of our study was to determine the potential impact of the "Plastics Directive" on Polish producers of disposable plastic products. For the purpose of this study, the following research questions were formulated:

Q_1: How did companies operating in the single-use plastic products industry respond to the adoption of Directive 2019/904 by the European Parliament and the Council (EU) on June 5, 2019?

Q_2: How do the companies covered by the Directive assess their situation in the face of the announced restrictions?

Q_3: What actions have companies manufacturing the plastic products covered by the Directive taken or are planning to take to comply with its requirements?

It is worthy of note that, there would be no production without the demand for products covered by the "Plastics Directive". It is reported, among others, by various points of sale and food service establishments that the end users of disposable plastic goods (i.e. consumers) are the ones who limit the use of disposable plastics (Willis et al., 2018; SEI, 2021). The ubiquitous aversion to plastic, anti-plastic trends (Holmberg and Persson, 2023), and now also the "Plastics Directive" to some extent influence their decisions. Thus, places where disposable plastic products are (or were) available, decide to replace the existing plastics with alternative materials to cope with the external pressures. This aspect is also extremely important in our study. Therefore, one more additional

[4] A package of measures presented by the European Commission on December 11, 2019, which assumes that by 2050 Europe will become the first completely climate-neutral continent. This plan can be seen as an expression of the European Union's commitment to a transition to the circular economy (COM(2019) 640).

research question was formulated:

Q4: What changes have occurred in sales and purchasing decisions made by owners of retail outlets, food service establishments and consumers in terms of products covered by the Directive?

In our study, we decided to use mixed methods (Creswell, 2009: 203–224; Grønmo, 2019: 394–419; Ladner, 2019) to better address our research needs. Mixed methods, which are a combination of qualitative and quantitative methods in social research, make it possible to access different types of data and information that helps to describe the studied phenomena in a fuller and more comprehensive way. In our research, two interviews were conducted with representatives of companies producing goods covered by the "Plastics Directive" - ZELAN and Bittner Packaging. We also conducted two surveys, targeted at sellers and consumers. To make the methodology reproducible, we provide our research tools as attachments to this article (additional materials no. 1 and 2). The interviews were partially structured, then carried out using an interview questionnaire (additional material no.1). This method allowed for some freedom in the order of questions asked, while also provided the opportunity to ask additional questions that facilitated the expansion of the respondents' statements (Kvale, 2007; McGrath et al., 2019). The interview questionnaire consisted of 15 questions that may be divided into the following groups:

- issues related to the activities and functioning of the company,
- issues of perception and opinion on the "Plastics Directive",
- issues related to the impact of the "Plastics Directive" on the respondent's company,
- issues relating to the current situation of the enterprise and its future.

The second method used to obtain results that reflected trends in larger groups was a survey. The survey method utilizing standardized questionnaires made it possible to obtain a picture of attitudes and opinions of a larger population regarding the problem of environmental pollution with plastic (Babbie, 2011: 268–312; Andres, 2012). To obtain a broader view, apart from producers, two groups of the surveyed stakeholders were additionally distinguished: sellers (retail outlets and food service establishments, which, for the purposes of this study, were jointly classified as sellers) and consumers. As the information to be provided by people belonging to these groups differed, two separate questionnaires were prepared:

- a survey questionnaire addressed to the group of sellers consisting of 17 questions: 12 single-choice questions, 1 multiple-choice question, 1 question using the Likert scale and 3 open-ended questions (qualitative element),

- a survey questionnaire addressed to the group of consumers consisting of 18 questions: 11 single-choice questions, 3 multiple-choice questions, 1 question using the Likert scale, and 3 open questions.

Both questionnaires are attached to this paper (additional material no. 2).

The "Plastics Directive" introduces 7 requirements (Directive (EU) 2019/904, Article 4–10). It is worth emphasizing, however, that the deadlines by which the Member States are to comply with the requirements vary - some entities covered by the Directive were given more time to adapt to them, others less. In accordance with the EU act discussed herein (Directive (EU) 2019/904, Article 17), restrictions on placing on the market, as well as the marking requirements, came into force first, on 3 July 2021. Pursuant to this requirement, the following 10 different disposable products made of plastic cannot be introduced into the markets of the European Union Member States: cotton buds, cutlery, plates, straws, stirrers, balloon sticks; and articles made of expanded polystyrene (EPS): containers for food, containers for drinks and cups. This requirement can be said to be the most restrictive, and additionally it assumes the shortest possible time for implementing changes.

In order to interview the companies that produce the goods subject to market restrictions, six companies were contacted, two of which were interviewed - ZELAN (Marian Olszyński as a representative) on April 18, 2020 and Bittner Packaging (Agata Mach as the co-owner) on April 30, 2020. Olszyński has been a development advisor at ZELAN for 18 years and has been associated with the plastics industry for about 50 years. ZELAN is a family company that has been operating on the Polish market of plastic products since 1977, with Antoni Zieliński as its founder and current owner (Olszyński, Interview). Bittner Packaging is also a family business that was founded in 1992 by the Bittner brothers. Currently (since 2015), the company is co-owned by one of the brothers, Andrzej Bittner, his daughter (Agata - our respondent) and his son.

As part of its basic activity, ZELAN company deals with the production of thin-walled plastic products, electroplating services and their own very modern tool department and services. However, as Olszyński emphasizes, over 70% of their overall activity is processing plastics (Olszyński, Interview). ZELAN employs over 200 people and generates approximately PLN 50 million of turnover annually (ca. EUR 11.11 million) (Olszyński, Interview). Olszyński also adds that ZELAN "is the largest Polish producer of disposable cutlery – which in today's concept – is reusable in Poland, while also being one of the largest in Europe. You can point to the annual production reaching billions of pieces" (Olszyński, Interview). The company's website informs that approx. 60–70% of the production is for export (ZELAN, 2015), and the trading partners are all European Union countries (and Great Britain), Ukraine, Russia and also currently Saudi Arabia (Olszyński, Interview).

The second company – Bittner Packaging – employs 128 people and generates PLN 35 million turnover annually (ca. EUR 7.78 million), which means that it is also a medium-sized enterprise (Mach, Interview). Its main activity is the production of dishes and cutlery made of polypropylene and polystyrene foil. Initially, the company supplied its products only to the local Polish market, but over time the activity has expanded to foreign markets (Bittner Packaging, 2018). The main foreign trade partners of the enterprise are the Member States of the European Union, and above all, the Baltic States, Hungary, the Czech Republic, Slovakia and Germany (Mach, Interview). The co-owner additionally points out that Bittner Packaging trades with a company with a similar portfolio operating in Ukraine, and also mentions Bosnia and Herzegovina, as well as Serbia as other non-EU trade partners – "these are only minor transactions, however" (Mach, Interview).

Although the interviews made it possible to get to know the perspective of producers, sellers and consumers were also an additional source of information on the issue under analysis. For the first poll, using convenience sampling (Battaglia, 2008), at the end of March 2020, a link to the survey questionnaire prepared in Google Forms was sent to friends, people who work or recently worked in retail outlets or eateries, shops and restaurants known to researchers and furthermore, to family and friends with a request of sending the link with the questionnaire to people representing our target group. The survey was also posted on Facebook. The process of collecting responses took seven days (23.03.2020–29.03.2020) and 44 completed questionnaires were collected. According to the data from the basic record, the vast majority of survey respondents were women (81.8%). 68.2% of the respondents were in the 18–26 age group, 20.4% of the respondents were aged 27–45%, and 11.4% of the answers came from employees of 46–65 years of age. In this study, the data on the place where a respondent works (the type of place and the size of the city in which the retail outlet or food service establishment is located) were as important for us as the criteria of gender and age. The greatest number of responses came from local / neighbourhood retail outlets (36.4%), others from chains operating on international markets (25%), chains operating on the home market (20.5%), schools / universities (4.5%) and others (13.6%). The vast majority of respondents (70.5%) indicated that they work in a food service establishment, which is important from the point of view of observing the attitude of consumers to single-use plastic products,

especially to those subject to market restrictions. The remaining 29.5% of people are employees of grocery stores, supermarkets, specialty stores and "other" places. The majority, namely 52.3% of respondents, are employees of shops / eateries located in a city with more than 500,000 inhabitants. 18.2% of the respondents are employed in cities with up to 50,000 residents. 11.4% of people indicated that their workplace is located in a city of between 50,000 and 150,000 inhabitants and the same number indicated a smaller settlement. Only 6.8% of respondents work in a shop or restaurant in a city between 150,000 – 500,000 inhabitants.

The second survey – the opinion of consumers – was designed to find out their views on the limitation of the availability of disposable plastics. Convenience sampling was also used here (Battaglia, 2008) and e-mails with the request to fill in a survey questionnaire in Google Forms and share it with others were sent to family and friends. Additionally, the link to the research was posted on two student groups on Facebook. The process of collecting responses lasted 5 days (22.03.2020–26.03.2020) and during this time we managed to collect 85 completed questionnaires. The group of respondents was also dominated by women (77.6%). The most numerous group in the survey were people aged 18–25 (41.2%), and the next largest group were people aged 27–45 (28.2%). A total of 16.5% of the respondents were under 18 years of age, while 14.1% belonged to the 46–65 years of age group. In terms of the place of residence, most of the surveyed consumers live in large cities with more than 500,000 inhabitants (41.2%) and in villages (40%), whereas the next responses came from people living in medium-sized cities with 150,000–500,000 inhabitants (9.4%), 50,000–150,000 inhabitants (1.2%) and small towns up to 50,000 (8.2%). More than half of the respondents declared that they had secondary school education (56.5%), 23.5% higher education, 16.5% primary education, and 3.5% vocational education. The diversity of the group of respondents presented here is an undeniable advantage of the survey, despite the limitations of the convenience sampling method (Andrade, 2020).

5. Research results: Polish producers of disposable plastic products, sellers and consumers facing the changes

5.1. Response of single-use plastics producers to the implementation of the SUP Directive

In the search for an answer to the first research question Q1: How did companies operating in the single-use plastic products industry respond to the adoption of Directive 2019/904 by the European Parliament and the Council (EU) on June 5, 2019? - it can be observed that for both ZELAN and Bittner Packaging, the Directive came as a shock. The co-owner of Bittner Packaging adds:

> We took over this company in June 2015, and our development plan and all activities that we carried out until May 2018 assumed the modernization of production under the existing model, within the product portfolio at that time, which, as it turned out, today 90% is subject to market restrictions (Mach, Interview).

Both respondents also reiterate a previous argument about the marginal contribution of the European Union towards generating plastic waste:

> The European Union strives to be a precursor and it was this desire that prompted it to introduce regulations. Already in the pre-pandemic time, countries such as the USA, Russia and Mexico confirmed that they would also apply this type of legal solutions. However, the largest producer of plastic waste is Asia, so if no law is introduced there regarding this problem, there will be no tangible effect (Mach, Interview).

Despite signals from the European Commission regarding restrictions on the production of disposable plastics sent as early as 2015, which we write about in the Introduction, respondents were surprised by such a quick implementation of the "Plastics Directive" and, above all, such a short time set for producers to adapt to it. Due to the lack of any official information on the national implementation of the "Plastics Directive" at the time of the interviews, company representatives were asked directly about the actual implementation of the Directive in Poland. It turned out that, as of 2020, the national implementation had not yet started. There were two consultation meetings (Mach, Interview), but at the time of the interviews the following was said: "there is no national action, which is very much to be expected, because the processing industry in the country is massive" (Olszyński, Interview). The main accusations made by representatives of enterprises against the Directive are as follows: excessively short periods for adaptation (Olszyński, Interview) and the lack of a transition period to adapt to the new reality (Mach, Interview). The changes would apply to over 7,000 Polish entities, mainly small and medium-sized enterprises, employing about 215,000 people (Foundation Plastics Europe Poland, 2021: 16). According to Marian Olszyński, it is estimated that even about 20% of these companies may already be affected by the Directive in some way (Olszyński, Interview). Agata Mach adds that PZPTS attempted to estimate how many people in the industry could lose their jobs – "It is about 17000 people" (Mach, Interview). To sum up, is the "Plastics Directive" a dark scenario for small and medium-sized enterprises? "Indeed, for some enterprises, the Directive can be lethal, especially for companies dealing in the production of non-basic products, in other cases, when the product is 'useful for life', this plastic can be replaced in some way" (Olszyński, Interview).

5.2. Self-diagnosis of the situation of producers of disposable plastics

A continuation of the discussed issue is the second question (Q2): How do the companies covered by the Directive assess their situation in the face of the announced restrictions? The attempt to answer this question is connected with the preliminary conclusion that the condition of this sector was very good compared to the entirety of the industrial sector (on both the Polish and European Union markets). A significant increase in sales and good forecasts for the future made entrepreneurs willing to invest in its further development. Olszyński highlights that when he came to ZELAN (18 years earlier), the value of sales amounted to several million, now it is about PLN 50 million (ca. EUR 11.11 million), and the portfolio of products offered has also significantly expanded: "We were always focusing on automation and robotization of production. (.) Our direction is to do everything at a very high technological level, based on the most modern world solutions, as well as our own technological thought" (Olszyński, Interview). Recently, ZELAN has invested in, among other things, highly innovative technological processes based on patents. For this purpose, over PLN 20 million debt (ca. EUR 4.44 million) was acquired under the EU POIR program,[5][6] (Olszyński, Interview). Olszyński assesses the situation of ZELAN as stable, but adds that:

> Significant investment costs are a heavy burden. (.) [investment] will start to pay off, but at the moment, on the one hand, there is the Directive and the need for product and technological changes, and on

[5] Operational Program Smart Growth 2014–2020 (*pl.* Program Operacyjny Inteligentny Rozwój, POIR), is financed from the EU Regional Development Fund. Under this program, ZELAN may ultimately receive an EU subsidy of up to 45% of net expenditure. The Polish Agency for Enterprise Development extended the company's ability to implement this project until September 2023: "We have gained additional time to conform with the requirements of the EU Directive" (Olszyński, Interview).

[6] According to the "List of projects implemented under the Smart Growth Program 2014–2020", the title of ZELAN project is as follows: "Launching a new design line of cutlery with a toothpick using packaging technology with an angular label" (POIR, 2020).

the other hand, the current situation. these are difficulties which are not a driving force for a company like us (Olszyński, Interview).

In March 2020, ZELAN experienced a 9% drop in sales compared to the previous year, but as the company's representative points out: "We are glad that we only have a slight decrease" (Olszyński, Interview). The owner of Bittner Packaging believes that a lot depends on the company's condition and its ability to adapt to changes, yet she stresses that: "There are many companies in Poland that may not be able to cope. We do not know ourselves if we will" (Mach, Interview). Her company also focused on automation. Investments were made in modern machines (injection moulding machines, thermoforming machines, extruders) for each of the departments, a warehouse was rented and various improvements were made at one of the company's locations. Interestingly, as part of one of the projects, the company was awarded a subsidy from the European Union, which assumed the project would be maintained for 3 years. "We would have to keep the production of what is [under the Directive] restricted two years after the introduction of the Directive. Ultimately, we gave up on this project" (Mach, Interview). Meanwhile, our respondent continues, some of the company's loans, leases and projects will be repaid by 2025, and the company will have no income from them (Mach, Interview). Additionally, Bittner Packaging's credit opportunities have been partially exhausted, and the prospects for investing in alternative products are somewhat limited: "In fact, in a year we can be half the size we are today", and the emergence of the Directive directly translates into the company's turnover: "Since May 2018, we have noticed a decline in interest in our products in favour of imports from China, which we also run" (Mach, Interview). The statements above indicate the uncertainty and rather high concerns related to the long-term survival of the enterprises. Failure to adjust the national law to the adopted Directive does not facilitate planning for enterprises, although they are aware that the full implementation of the guidelines of the "Plastics Directive" will be necessary.

5.3. Actions taken by SUP producers on the way to the Directive compliance

The diagnosis presented above leads to the third research question (Q3): What actions have companies manufacturing the plastic products covered by the Directive taken or are planning to take to comply with its requirements? To adapt to the new requirements and at the same time ensure the company's survival, the following measures have been taken at Bittner Packaging:

> We will definitely increase the share of trade at the expense of production. We will import more products [pulp or wood] from China. Additionally, we are now investing in catering and food containers. We are also introducing a new line of reusable cutlery made of similar [to pulp] materials or made of WPC material to make such products using our injection technologies (Mach, Interview).

The owner of Bittner Packaging, however, emphasizes that these products are much more expensive: "If a restaurant does not care so much about the ecological image, but more about economic issues, it still chooses these plastic items [cutlery]" and notes that in the long run, "We think about various solutions which I cannot talk about at the moment, because this is the design phase of various innovations. Necessity is the mother of invention, and the Directive certainly motivates the industry to look for alternatives" (Mach, Interview). ZELAN's model will also change – the company mainly focuses on multiple use:

> We had to change our investment intentions, i.e., not billions of items anymore, but the production of hundreds of millions in the formula of multiples. We want to give the customer a product in which this multiple will be a limitation, thanks to which the overall mass [of waste] will be reduced several dozen times. We consider the existing part of production and new products in multiple terms,[7][8] (Olszyński, Interview).

In addition, the company focuses on greater diversification of the offered products, thus expanding the portfolio that previously consisted mainly of cutlery: "We produce, for example, thin-walled single-use coffee cups and thin-walled reusable beer mugs" (Olszyński, Interview). The company's representative emphasizes that they will not completely forgo disposable cutlery: "This is the EU Directive. There are countries that will not submit to it"[9] and adds that the current situation of the spread of Sars-CoV-2 allowed the company to return to the production of single-use sets[10]: "The demand for them has now increased due to the need to increase the hygiene of consumption. These are highly hygienically packed sets, which are burned in an incineration plant after consumption" (Olszyński, Interview). At the same time, ZELAN started the production of folding cutlery for food packages[11] (Olszyński, Interview). In the context of hygiene, the owner of Bittner Packaging emphasizes his point by saying: "Recently we have written an article based on US research that the spread of COVID-19 was very rapid at the outset in corporations where the cups were washed but not scalded. For this reason, it was recommended to use disposable products" (Mach, Interviews). Additionally, she highlights the following: "We have a law that if a food service establishment does not have a steam dishwasher, it cannot use any reusable products" (Mach, Interview), indicating that "isolating properties are the main features of polymers and it is difficult to [in this respect] find an alternative material to plastic" (Mach, Interview). In this regard, the representative of ZELAN company adds that: "This Directive choked us a lot, and now [in the age of the pandemic] it is like 'a blessing in disguise'" (Olszyński, Interview). Both companies saw a significant increase in interest in cutlery sets packed in sanitary conditions: "These orders now consist of tens, hundreds or even millions of such sets" (Olszyński, Interview), while at Bittner Packaging: "We have recently increased sales of these products by 300%" (Mach, Interview). As the respondents say, companies are taking steps towards the reusability of their products (in line with the principles of the

[7] A reference to the problem reported by PZPTS in September 2018, i.e., a vague definition of disposable products. At that time, PZPTS suggested that this concept be clarified: "Considering single-use plastic products (cups, containers for food and drinks, wrappers, cutlery, plates, straws, drink mixers) as those that would not meet the requirement of passing 20 complete cycles in a dishwasher under operating conditions, technical performance of tests and calibrations of devices defined in the NF EN 12875–1: 2005 standard" (PZPTS, 2018b).

[8] The European consulting and advisory firm Ramboll won the tender of the European Commission and was selected to redefine some of the concepts of the Directive (Olszyński, Interview). However, it seems that this firm did little in this matter. A representative of ZELAN provided us with a document from April 14, 2020, containing PZPTS comments on the study supporting the development of implementing acts and guidelines under the Directive, in which PZPTS members continue to pay attention to the need to precisely distinguish disposable from reusable products in the features of the product design (Olszyński, Interview).

[9] The company's trading partners from outside the European Union are Russia, Saudi Arabia and Ukraine (Olszyński, Interview).

[10] According to the information on the company's website, such a set may include: "cutlery individually packed without any additives or a more complex set with additional food products" (ZELAN, 2019).

[11] "Food packages are believed to reduce food waste, which today is at an estimated 30%" (Olszyński, Interview).

circular economy), while on the other hand, they are investing in new material technologies, including composites. At the same time, noticing the moment of a gigantic increase in interest in disposable products, they will try to gain as much as possible from it, although they are aware that it will not last long.

5.4. Anti-plastic trends or hygiene? Changes in the demand for disposable plastic products

The fourth and final research question (Q4), namely: What changes have occurred in sales and purchasing decisions made by owners of retail outlets, food service establishments and consumers in terms of products covered by the Directive? - was intended to broaden the accumulated knowledge on changes in the sector, on the perception of single-use plastic products and the choices made by stakeholders. However, our interlocutors also had some observations on this subject. Olszyński drew attention to the fact that: "When the Directive was announced, and then when the Directive came into force, large retail chains wanted to have products with a green leaf for races" (Olszyński, Interview), while Mach stressed that "When going to restaurants, consumers more often wonder whether they will get a plastic plate or not, or whether to take a straw or not", while at the same time noted that "This ecological trend is more identified with large cities" (Mach, Interview). However, we wanted to put our question directly to people working in retail outlets and food service establishments who were asked to specify which of the single-use plastic products (respondents could choose between all categories of single-use plastic products covered by the Directive, and not only 6 specific products subject to "market restrictions") are available at their workplace (additional material no.2, questionnaire 1). In addition, sellers were also asked if they noticed any changes or received comments related to plastic products from consumers, and if any decisions were made at the point of sale or food service to reduce environmental pollution with plastic. In 65.9% of places (for N = 44) there were products belonging to the group of "cutlery, plates, stirrers and straws", subject to restrictions in terms of market circulation. "Light plastic shopping bags" and "cups for beverages" were available in 61.4% of places. A total of 56.8% of places offer their customers "food containers". In 27.3% of places you can get "containers for drinks with a capacity of up to 3 litres", and in 22.7% – "packets and wrappers". The remaining products that were not available in at least 10 places were considered of marginal importance (the question was in multiple choice form). More than half of the respondents (59.1%) to this survey observed changes in customer behaviour with regard to disposable plastic products (Table 1).

Apart from the comments (Table 1, answer 2), our respondents also indicated[12] that their "customers have their own packaging, bags, cups" (22.7% of responses) and "customers don't want straws or lids" (13.6% of responses). The group of food service establishments and stores that has implemented or is planning to implement some changes includes almost all places where employees encountered comments about plastic products from customers (94.7% for N = 19) and an additional 48% of places where they did not encounter any comments from them (for N = 25). The respondents, when asked what changes were introduced in their workplace, replied that, first of all, it is "offering customers alternative materials to plastic" and "introducing a fee for plastic products".[13] It is worth emphasizing at this point that 68.2% of all places (for N = 44) where some changes have already been introduced or are planned to reduce the amount of plastic used, are primarily chain restaurants located mainly in cities with more than 500,000 inhabitants, and thus it can be assumed that the ecological trend actually occurs more often in large cities (as indicated by Mach in the interview). This observation, however, requires further in-depth comparative research.

Table 1
Aversion to plastic in food service establishments and retail outlets.

	Yes	No
1. Have you noticed any changes in customer behaviour with regard to disposable plastic products?	59.1%	40.9%
2. As an employee of a retail outlet / food service establishment, have you encountered any comments from customers referring to the problem of disposable plastic products?	73.1%	26.9%
3. Has the shop / food service establishment you work for introduced any changes regarding the use of and trading in disposable plastic products within the last year or is planning to do so?	68.2%	31.8%

N = 44 for question 1 and 3; for question 2 N = 26.

The respondents of the second questionnaire (additional material no. 2, questionnaire 2) - i.e. consumers - were asked if they had introduced any changes to their lives aimed at reducing the amount of plastic used, and if so, what those changes were. As many as 82.4% (N = 85) of our respondents declared that they undertook activities aimed at minimizing their own participation in environmental pollution in terms of plastic. However, among the products most frequently purchased by the surveyed consumers are (multiple choice question): hygiene products such as sanitary napkins, tampons, tampon applicators, wet wipes (60% of responses, N = 85), beverage containers up to three litres (47.1% of responses), cotton buds (42.4% of responses), and other items that are restricted in terms of trade, namely, lightweight plastic carrier bags (29.4% of responses) and food containers (21.2% of responses). The remaining answer options were selected sporadically. At the same time, the most frequently indicated changes that consumers introduced into their lives are as follows: "preferential choice of reusable models" (49.4%), "waste segregation" (15.3%) and "selection of alternative materials" (15.3%).[14] 67.1% of respondents also declare that they noticed some changes in the use of plastics among their relatives. Ultimately, 88.6% of retailers and 100% of consumers perceive plastic pollution as a problem. The results presented above allow for an answer to the research question in terms of the change of the sellers' offer, as well as the choices made by consumers.

5.5. Responsibility for waste and perception of the Directive

Referring to the subject of the entire article, we decided to further explore the issues that bother us about the perception of the "Plastics Directive" and responsibility for waste, which are discussed in Sections 2 and 3 of this article. Both sellers and consumers were asked whether they thought that the changes introduced by the "Plastics Directive"[15] are necessary; and which side, in their opinion, should bear the responsibility for plastic waste. A total of 88.6% (N = 44) of employees of food service establishments and retail outlets and 92.9% (N = 85) of consumers believe that the changes assumed by the "Plastics Directive" must be introduced. The respondents to both questionnaires, when asked who should be responsible for the generated plastic waste, gave the following answers (Table 2):

[12] Stylized responses based on the respondents' own statements (open question).

[13] It should be emphasized that pursuant to Art. 40a. 1 of the Act of June 13, 2013, relating to the management of packaging and packaging waste (Journal of Laws of the Republic of Poland, 2013), some entrepreneurs are legally obliged to collect the so-called recycling fee from customers who buy "thicker" plastic shopping bags.

[14] Stylized responses based on the respondents' own statements (open question).

[15] Most likely, the respondents of the survey do not know exactly what the assumptions of the "Plastics Directive" are, and the individual requirements included in the survey do not in any way specify the correct interpretation, therefore the question was only of illustrative nature.

Table 2
Who should be responsible for dealing with plastic waste?.

	Producers	Consumers	Salespeople	I have no opinion
Survey 1 respondents: salespeople (N = 44)	47.7%	29.6%	9.1%	13.6%
Survey 2 respondents: consumers (N = 85)	50.6%	24.7%	14.1%	10.6%

Most of the surveyed sellers and consumers believe that the responsibility for the generated waste should lie primarily with the producers,[16] which is in line with the intention of the "Plastics Directive". Moreover, representatives of the companies interviewed say that: "[The Directive] does not exacerbate circular issues. Under the EPR [Extended Producer Responsibility] it wants to dump all responsibility for a plastic product on the manufacturer - from start to finish" (Olszyński, Interview). Mach adds: "Part of the fee resulting from the EPR is to be allocated to consumer educational activities to teach people how to deal with this plastic. In this way, this end user - the consumer - is targeted" (Mach, Interview). The ZELAN representative summarizes the Directive as follows: "It should start with education, otherwise it's putting the cart before the horse. The problem is not the use, but the abandonment of what should be next: collection, segregation and re-use of plastic" (Olszyński, Interview). Of course, the Directive also envisages a significant increase in the level of recycled plastics in the Member States[17] and utilizing recycled material in beverage bottles.[18] However, with regard to products subject to market restrictions, the EU legal act even forces Polish (and European Union) consumers to choose alternative material solutions (we do not expect that the demand for disposable products will suddenly drop), and thus bolsters the emergence of waste generation instead of pursuing the objectives of the circular economy. At the same time, it is worth emphasizing that the survey shows that Polish consumers are paying more and more attention to their decisions regarding the purchase and management of disposable products made of plastics. This is a clear signal that the potential of all actors to cooperate with one another has not yet been properly used.

To sum up, investments had been made in further development of the business both at ZELAN and Bittner Packaging prior to the introduction of the Directive. Such actions were most likely influenced by very strong sales results and optimistic, forward-looking forecasts for the plastics industry. The advent of the "Plastics Directive" was a shock for the converters it covers, not only due to the good economic situation in the industry, but mainly due to the fact that the European Union Member States only make a small contribution to the production of plastic waste released into the environment. Since the first mention of the Directive appeared, in both interviewed companies there has been a decrease in sales of single-use plastic products manufactured as part of the company's core business. In addition, the information collected through the questionnaire surveys clearly demonstrated the "aversion" visible among consumers towards plastic disposable products, and also indicated that both in restaurants and retail outlets where such products were available (or still are available) alternative solutions are becoming more and more popular. On the other hand, there has been a significant increase in interest in disposable cutlery sets packed in sanitary conditions during the coronavirus pandemic. The requirement to move away from some disposable plastics (in the European Union) prompted entrepreneurs to look for new solutions, including the following: producing products from alternative materials, increasing trade (products imported from China) at the expense of in-house production, expanding product range, as well as replacing the disposable model with reusables (certified multiple use). These changes indicate that the companies surveyed are currently trying to significantly diversify their product portfolio step by step away from identifying their activities only with the concept of disposable plastics. At the same time, disposable plastic cutlery is a basic product, and additionally, as shown by a survey conducted in a group of sellers, "cutlery, plates, drink stirrers and straws" were available in the largest number of food service establishments and retail outlets, the employees of which were representatives of the surveyed group. Thus, they can be considered common and extremely necessary. When it comes to cutlery, which is a common element in the offer of both interviewed firms ZELAN and Bittner Packaging, consumers have become accustomed to plastic, disposable knives, forks and spoons, which are a convenient and economical solution. Only relatively recently have alternative materials become more popular and the market is not yet saturated with them, thus companies whose core business is to some extent based on the production of disposable plastic cutlery have a chance to introduce new products on the market and succeed. Although there are some opportunities for the surveyed companies (and the sector in general), the expected impact of the "Plastics Directive" on Polish producers of disposable plastic products was described by our respondents as negative. In addition, the lack of support from the government, consultations pointing only to the desire to collect the highest possible amount of state budgetary revenues, as well as the pressure of time intensify the unfortunate situation of some processors, who since July 2021 have been forced to limit the sale of some of their products (a majority of them in the case of ZELAN and Bittner Packaging) in the European Union. Additionally, there is noticeable pressure associated with shifting the responsibility for littering the environment with plastic mainly to manufacturers - such an approach is visible in the Directive, and such conclusions can also be drawn from the surveys conducted among sellers and consumers.

6. Discussion and conclusions

The first issue that arose during interviews with representatives of companies producing the products covered by the Directive is the undeniably higher cost of alternatives to disposable plastic. Cutlery ilustrates this issue most plainly: reusable plastic cutlery would be much heavier and more bulky, and thus more expensive (both for the producer and for the end consumer). Likewise, the cost of cutlery made of pulp, or the previously mentioned WPC material, will be higher. Thus, all ecological solutions (not only in the field of cutlery) will significantly increase prices, and ultimately new products, that are not "cheap replacements" anymore, will cease to exist. It would be interesting to conduct such a profitability study in the future, as well as to simulate the market demand for the afore-mentioned ecological substitutes.

The second issue worth investigating, which directly arises from the first issue raised, is the questioning by our respondents of the environmental benefits of changed products. As the representative of ZELAN company states:

> Now there is a shift away from biodegradable and bio-compostable materials, as it turns out that they contain microplastics that can be even more harmful to human organisms. In addition, it will be a nightmare for recyclers - for example, there will be polystyrene, and inside, wood fibres, corn fragments, starch (Olszyński, Interview).

The co-owner of Bittner Packaging adds that products made of, for

[16] Manufacturers, on the other hand, believe that the greatest contributor to the generation of the mass of waste going to the environment is inappropriate management by consumers. "If people do not stop throwing waste wherever it falls, then even introducing restrictions in the field of market circulation will not have any measurable effect" (Mach, Interview). Therefore, it can be concluded that the most effective way to combat environmental pollution with plastic would be the mutual cooperation of all actors.

[17] By 2025, the amount of collected single-use plastic waste is to be equal to 77% of the total amount of products placed on the market (90% by 2029) (Directive (UE) 2019/904, Art.9, Par. 1).

[18] By 2025, beverage bottles are to contain at least 25% of recycled material (plastic), and by 2030 it should be at least 30% (Directive (UE) 2019/904, Art.6, Par. 5).

example, pulp are not a better alternative to plastic:

> First of all, they are produced very far away - no one in Europe produces anything from this material because we do not have access to this amount of sugar cane here. The finished product is transported by ships or trains from Asia, so the carbon footprint is huge. Huge amounts of water are used to produce pulp, and it is also available in natural and white colour. White colour is preferred by consumers, and to obtain such a colour, chemicals must be used, which first go to the water and then to the soil (Mach, Interview).

Mach also points out that replacing plastic with other - one could say - "classic" materials, such as: paper, glass, aluminium, is also by no means an ecological solution. "The carbon footprint, the amount of water, the amount of energy are several times higher than for plastic products" (Mach, Interview). That is why, during the interview, she deliberately underlined that nowadays in many places we are dealing with an ecological trend, and not necessarily with ecological awareness. According to her, the right choice of material is the one that is the most environmentally efficient. "It is a polymer because we use the Earth's resources - energy and water - the least. We do not poison it, we do not use any detergents or chemical additives" (Mach, Interview). Interestingly, the information prepared by Trucost for the American Chemistry Council shows that the environmental cost of replacing consumer goods packaging with alternative materials to plastic would be almost 4 times higher, as the environmental cost of plastic is USD 139 billion, while the environmental cost of alternative materials is USD 533 billion (Lord, 2016: 7). It might be interesting to study the expected environmental impact of the "Plastics Directive" - considering material substitutes for the restricted products, as well as alternatives to beverage cups and food containers with restricted use.

Our respondents declared that the pursuit of a circular economy is the best solution for all entities, as well as for the environment. In order to achieve the objectives of the circular economy, it is necessary to strengthen the recycling that in EU27 +UK/NO/CH countries reaches an average level of around 25% (Plastics Europe, 2019: 31; Matthews et al., 2021). In Poland alone, it is about 28% (Plastics Europe, 2019: 31). The co-owner of Bittner Packaging indicates that on the market "there is a huge demand for regranulates, although so far recycling in Poland is a completely unprofitable industry" (Mach,Interview). Mach also points out that the main problem is the variety of plastics and the resulting separation problems in mechanical recycling (Mach, Interview). However, as it turns out, the problematic need for complete segregation will eventually be eliminated:

> Now, the largest concerns producing plastics are thinking about implementing chemical recycling on a mass-industrial scale as soon as possible. It is a total novelty that will enable the transformation of polymer waste into high-quality secondary raw materials with a partially reconstructed plastic monostructure (Olszyński, Interview).

Mach adds that it is "chemical recycling that will solve the problem of the need to separate different types of polymers for the purposes of mechanical recycling" (Mach, Interview). In this regard further detailed research on both the technological possibilities offered (as well as their economic and environmental costs) and the use of recycled materials (not only regranulates) are necessary to demonstrate the full potential of recycling in a circular economy.

Finally, when conducting our research on the production, sale and consumption of disposable plastic products in Poland, we did not find similar studies in other European Union countries, some of which are even larger producers and consumers of goods made of synthetic polymers than Poland. Observation of the further implementation of the "Plastics Directive" in a comparative perspective would certainly enrich the knowledge of the entire European Union plastics market and help in formulating the appropriate recommendations, so that the final decisions are better received by the producers themselves and their stakeholders.

To conclude, the overriding purpose of this article was to identify the potential impact of the "Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 with regard to the reduction of the impact of certain plastic products on the environment" on Polish producers of disposable plastic products. When we conducted the research in the spring of 2020, which is more than half a year after the adoption of the "Plastics Directive", we thought that the national legislation and guidelines of the European Commission would be prepared, which would allow us to address the existing changes more objectively. Meanwhile, not only in 2020, but also in 2023, when we are in the process of revising this article, and the Directive should already be in force in the Member States, the work on its national implementation still continues. Hence the conclusion – that delays are deliberate actions to shelve the implementation of the market restrictions set out in the Directive due to special circumstances, i.e., the spread of the Sars-CoV-2 virus and the related hygienic needs met by disposable plastic products. In addition, the presented empirical research allowed us to, on the one hand, make a diagnosis of the condition of Polish companies manufacturing products that will eventually be banned in the European Union in the near future on the eve of the announced changes (a significant increase in sales at the beginning of the pandemic, investment in the development of enterprises, but at the same time uncertainty about the future), while on the other hand, to determine the expected impact of the "Plastics Directive" on their activities (clearly perceived negatively by our respondents). By expanding our research environment to include sellers (food service establishments and retail outlets) and consumers, we were able to look at the studied phenomenon from different points of view, while also demonstrate that trends of aversion towards disposable plastics persist and both groups take conscious actions to limit the use of such products or eliminate them from sale / use altogether. All the surveyed groups (producers-sellers-consumers) focus on alternative materials (wood, pulp, WPC) and the reusability of manufactured and used products, which seems to be the desired direction, which is also in line with the assumptions of the circular economy. Will the changes included in the Directive be enough to stop us from drowning in a sea of plastic? Is not this just the beginning of a discussion on the harmfulness of production, which also encompasses alternative products to disposable plastics? These issues will come back to us in the coming years and will certainly be worth investigating.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article. The linguistic proofreading and open access was financed by the Excellence Initiative - Research University at the Faculty of Management and Social Communication of the Jagiellonian University in Krakow, Poland.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Acknowledgements

We would like to thank Agata Mach (co-owner of Bittner Packaging) and Marian Olszyński (representative of ZELAN) for interviews and providing comprehensive information on the sector of plastic producers in Poland, and Stefan Łapniewski for his assistance in editing the final version.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2023.04.005.

References

Andrade, C., 2020. The inconvenient truth about convenience and purposive samples. Indian J. Psychol. Med. 43 (1), 86–88. https://doi.org/10.1177/0253717620977000.

Andres, L., 2012. Designing and Doing Survey Research. Sage, London.

Antonopoulos, I., Faraca, G., Tonini, D., 2021. Recycling of post-consumer plastic packaging waste in the EU: recovery rates, material flows, and barriers. Waste Manag. 126, 694–705. https://doi.org/10.1016/j.wasman.2021.04.002.

Babbie, E. 2011. The Basics of Social Research, fifth ed. Wadsworth, Belmont.

Battaglia, M., 2008. Convenience sampling. In: Lavrakas, P.J. (Ed.), Encyclopedia of Survey Research Methods. Sage, London, pp. 148–149.

Biopack, 2022. Plastics Directive. ⟨https://biopack.com.pl/en/dyrektywa_plastikowa,31⟩ (accessed 31 March 2022).

Bittner Packaging, 2018. O firmie. ⟨http://www.bittner.waw.pl/pl-PL/Home/AboutUs⟩ (accessed 26 April 2020).

Botetzagias, I., Dima, A.F., Malesios, C., 2015. Extending the theory of planned behavior in the context of recycling: the role of moral norms and of demographic predictors. Resour. Conserv. Recycl. 95, 58–67. https://doi.org/10.1016/j.resconrec.2014.12.004.

Brooks, B., 2021. Recycled plastics market becoming more liquid and globalized as demand soars. S&P Global Commodity Insights. 11 March. ⟨https://www.spglobal.com/commodity-insights/en/market-insights/blogs/petrochemicals/031121-recycled-plastics-global-market-commoditization-standards-pricing⟩ (accessed 15 March 2022).

COM(2015) 614, 2015. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Closing the loop - an EU action plan for the Circular Economy. European Commission, 2 December. ⟨https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0614&from=PL⟩ (accessed 26 March 2023).

COM(2017) 479, 2017. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank. Investing in a smart, innovative and sustainable Industry - a renewed EU Industrial Policy Strategy. European Commission, 13 September. ⟨https://eur-lex.europa.eu/resource.html?uri=cellar:c8b9aac5–9861-11e7-b92d-01aa75ed71a1.0001.02/DOC_1&format=PDF⟩ (accessed 26 March 2023).

COM(2018) 28, 2018. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European Strategy for Plastics in a Circular Economy. European Commission, 16 January. ⟨https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A28%3AFIN⟩ (accessed 26 March 2023).

COM(2018) 340, 2018. Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment. European Commission, 28 May. ⟨https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52018PC0340⟩ (accessed 22 March 2023).

COM(2019) 640, 2019. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal. European Commission, 11 December. ⟨https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN⟩ (accessed 27 March 2023).

Copello, L., Haut, G., Maillot, J., Mongodin, F., 2021. Moving on From Single-Use Plastics: how is Europe doing? Assessment of European countries' transposition of the Single Use Plastics Directive. Rethink Plastic alliance, July. ⟨https://rethinkplasticalliance.eu/wp-content/uploads/2021/06/SUP-Assessment-Design-final.pdf⟩ (accessed 30 March 2022).

Copello, L., Haut, G., Mongodin, F., 2022. Single Use Plastics Directive Implementation Assessment Report, Rethink Plastic alliance, September. ⟨https://rethinkplasticalliance.eu/wp-content/uploads/2022/09/SUP-Implemetation-Assessment-Report.pdf⟩ (accessed 22 March 2023).

Creswell, J.W., 2009. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage, London.

Deloitte. 2019. Informacje prasowe: Sektor opakowań to branża, która w pierwszej kolejności będzie musiała znaleźć sposób na skuteczny recykling odpadów z plastiku. Deloitte, 22 January. ⟨https://www2.deloitte.com/pl/pl/pages/press-releases/articles/sektor-pakowan-skuteczny-recykling-produktow-z-plastiku.html⟩ (accessed 28 March 2020).

Directive (EU) 2019/904, 2019. Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance). The Official Journal of the European Union, 12 June. ⟨https://eur-lex.europa.eu/eli/dir/2019/904/oj⟩ (accessed 26 March 2023).

Ellen MacArthur Foundation, 2016. The New Plastics Economy — Rethinking the future of plastics. World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company. ⟨http://www.ellenmacarthurfoundation.org/publications⟩ (accessed 16 March 2022).

European Plastics Converters, 2020b. EuPC advocates for a postponement of the SUP Directive implementation in view of the COVID-19 crisis. Open letter, 8 April. ⟨https://www.plasticsconverters.eu/post/eupc-advocates-for-a-postponement-of-the-sup-directive-implementation-in-view-of-the-covid-19-crisis⟩ (accessed 7 May 2021).

European Plastics Converters, 2020a. Are the Green Deal and the Single-Use Plastics Directive a contradiction in Europe? Press Release, 21 January. ⟨https://www.plasticsconverters.eu/post/are-the-green-deal-and-the-single-use-plastics-directive-a-contradiction-in-europe⟩ (accessed 3 April 2020).

FEDEREC, 2017. Évaluation environnementale du recyclage en France selon la méthodologie de l'analyse de cycle de vie. Les entrepreneurs au cœur de l'économie circulaire, April. ⟨https://presse.ademe.fr/wp-content/uploads/2017/05/FEDEREC_ACV-du-Recyclage-en-France-VF.pdf⟩(accessed 11 April 2022).

Foundation Plastics Europe Poland, 2021. Branża tworzyw sztucznych w pandemii: Raport Fundacji PlasticsEurope Polska 2020/2021. Fundacja PlasticsEurope Polska, Warszawa. ⟨https://plasticseurope.org/pl/knowledge-hub/branza-tworzyw-sztucznych-w-pandemii/⟩ (accessed 13 April 2022).

Freinkel, S., 2011. A Brief History of Plastic's Conquest of the World. Cheap plastic has unleashed a flood of consumer goods. Scientific American, 29 May. ⟨https://www.scientificamerican.com/article/a-brief-history-of-plastic-world-conquest/⟩ (accessed 25 March 2023).

Geyer, R., Jambeck, J.R., Law, K.L., 2017. Production, use, and fate of all plastics ever made. Sci. Adv. 3 (7), 1700782. https://doi.org/10.1126/sciadv.1700782.

GIS, 2020. Q&A dotyczące żywności i koronawirusa. Główny Inspektorat Sanitarny, 25 June. ⟨https://www.gov.pl/web/gis/qa-dotyczace-zywnosci-i-koronawirusa–aktualizacja-25-czerwca-2020-r⟩ (accessed 13 April 2022).

Government Legislation Centre, 2021a. Projekt ustawy o zmianie ustawy o obowiązkach przedsiębiorców w zakresie gospodarowania niektórymi odpadami oraz o opłacie produktowej oraz niektórych innych ustaw. Numer z wykazu: UC73. ⟨https://legislacja.rcl.gov.pl/projekt/12345305/⟩ (accessed 5 January 2022).

Government Legislation Centre, 2021b. Projekt ustawy o zmianie ustawy o gospodarce opakowaniami i odpadami opakowaniowymi oraz niektórych innych ustaw. Numer z wykazu: UC81. ⟨https://legislacja.rcl.gov.pl/projekt/12349805⟩ (accessed 5 January 2022).

Government Legislation Centre, 2022. Projekt ustawy o zmianie ustawy o gospodarce opakowaniami i odpadami opakowaniowymi oraz ustawy o odpadach. Numer z wykazu: UC98. ⟨https://legislacja.rcl.gov.pl/projekt/12356003⟩ (accessed 23 March 2022).

Grom, A., 2021. Dyrektywa SUP w Polsce - na poważnie, czy z przymrużeniem oka? Biznes czeka na ramy prawne. Teraz środowisko, 9 November. ⟨https://www.teraz-srodowisko.pl/aktualnosci/Dyrektywa-SUP-w-Polsce-Anna-Grom-Interseroh-ROP-recyklat-11044.html⟩ (accessed 16 March 2022).

Grønmo, S., 2019. Social Research Methods: Qualitative, Quantitative and Mixed Methods Approaches. Sage, London.

GTAI, 2018. The Plastic Industry in Germany: Issue 2018/2019. Germany Trade & Invest. ⟨https://www.gtai.de/resource/blob/64132/90bb4f93ab4a2780476d37d1c0a678c1/industry-overview-plastics-industry-in-germany-en-data.pdf⟩ (accessed 11 April 2022).

GUS, 2021. Statistical Yearbook of Industry – Poland. Statistics Poland, Warsaw. ⟨https://stat.gov.pl/download/gfx/portalinformacyjny/pl/defaultaktualnosci/5515/5/15/1/rocznik_statystyczny_przemyslu_2021.pdf⟩ (accessed 30 March 2022).

Heiges, J., O'Neill, K., 2020. COVID-19 has resurrected single-use plastics – are they back to stay? The Conversation, 14 July. ⟨https://theconversation.com/covid-19-has-resurrected-single-use-plastics-are-they-back-to-stay-140328⟩ (accessed 16 March 2022).

Holmberg, K., Persson, S., 2023. Keep plastics on a tight leash: Swedish public opinion on plastic policies. Environ. Sci. Policy 141, 109–116. https://doi.org/10.1016/j.envsci.2023.01.005.

International Trade Centre, 2019. Data according to the Harmonized System (HS) developed by the World Customs Organization under number 39 and published on the website of the International Trade Center. ⟨https://www.trademap.org/⟩ (accessed 15 March 2022).

Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R., Law, K.L., 2015. Plastic waste inputs from land into the ocean. Science 347 (6223), 768–771. https://doi.org/10.1126/science.1260352.

Jick, T.D., 1979. Mixing qualitative and quantitative methods: triangulation in action. Admin. Sci. Quart. 24 (4), 602–611.

Journal of Laws of the Republic of Poland, 2013. Ustawa z dnia 13 czerwca 2013 r. o gospodarce opakowaniami i odpadami opakowaniowymi (Dz.U. 2013 poz. 888). Journal of Laws of the Republic of Poland, 13 June. ⟨https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20130000888⟩ (accessed 29 March 2023).

Jóźwiak, Z. 2023. Krajowe wdrożenie dyrektywy plastikowej dotknie firmy i samorządy. prawo.pl, 14 February. ⟨https://www.prawo.pl/samorzad/ustawa-o-ograniczeniu-plastiku-wplynela-do-sejmu,519810.html⟩ (accessed 24 March 2023).

Kerscher, U., 2019. Towards a sustainable future? The EU policies concerning plastics and their didactical potential for primary and secondary teaching. Discourse Commun. Sustain. Educ. 1, 47–62. https://doi.org/10.2478/DCSE-2019-0005.

Knell, T., 2019. Plastic industry Poland: Justified anticipation of the growth of production. MachinenMarkt International, 23 May. ⟨https://www.maschinenmarkt.international/poland-justified-anticipation-of-the-growth-of-production-a-830708/⟩ (accessed 12 April 2022).

Kozera-Szałkowska, A., 2019. Polymer market – production, consumption, waste management. Polimery 64, 751–758. https://doi.org/10.14314/polimery.2019.11.3.

Kvale, S., 2007. Doing Interviews. Sage, London. ⟨https://dx.doi.org/10.4135/9781849208963⟩.

Ladner, S., 2019. Mixed Methods: A Short Guide to Applied Mixed Methods Research. Sam Ladner.

Lord, R., 2016. Plastics and Sustainability: A Valuation of Environmental Benefits, Costs and Opportunities for Continuous Improvement. Trucost, London.
Mach, A., 2020. Co-owner of Bittner Packaging. Interview, 30 April.
Mai, L., Sun, X., Xia, L., Bao, L., Liu, L., Zeng, E.Y., 2020. Global riverine plastic outflows. Environ. Sci. Technol. 54 (16), 10049–10056. https://doi.org/10.1021/acs.est.0c02273.
Matthews, C., Moran, F., Jaiswal, A.K., 2021. A review on European Union's strategy for plastics in a circular economy and its impact on food safety. J. Clean. Prod. 283, 125263 https://doi.org/10.1016/j.jclepro.2020.125263.
McGrath, C., Palmgren, P.J., Liljedahl, M., 2019. Twelve tips for conducting qualitative research interviews. Med. Teach. 41 (9), 1002–1006. https://doi.org/10.1080/0142159X.2018.1497149.
Ministry of Climate and Environment, 2021. DGO-OP.050.49.2021.MR. ⟨http://orka2.sejm.gov.pl/INT9.nsf/klucz/ATTC63HLH/%24FILE/i25537-o1.pdf⟩ (accessed 26 March 2023).
Ministry of Finance, 2021. WM3.054.1.2021. ⟨https://orka2.sejm.gov.pl/INT9.nsf/klucz/ATTBXGKCY/%24FILE/i17020-o1.pdf⟩ (accessed 26 March 2023).
Nelms, S.E., Easman, E., Anderson, N., Berg, M., Coates, S., Crosby, A., Eisfeld-Pierantonio, S., Eyles, L., Flux, T., Gilford, E., Giner, C., Hamlet, J., Hembrow, N., Hickie, J., Hopkinson, P., Jarvis, D., Kearsley, J., Millard, J., Nunn, F., Pollitt, E., Sainsbury, A., Sayer, S., Sinclair, R., Slack, A., Smith, P., Thomas, R., Tyler, J., Walker, R., Wallerstein, C., Ward, M., Brendan, J., Godley, B.J., 2022. The role of citizen science in addressing plastic pollution: challenges and opportunities. Environ. Sci. Policy 128, 14–23. https://doi.org/10.1016/j.envsci.2021.11.002.
Nøklebye, E., Adam, H.N., Roy-Basu, A., Bharat, G.K., Steindal, E.H., 2023. Plastic bans in India – Addressing the socio-economic and environmental complexities. Environ. Sci. Policy 139, 219–227. https://doi.org/10.1016/j.envsci.2022.11.005.
Official Journal of the European Union, 2021. Commission Notice - Commission guidelines on single-use plastic products in accordance with Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment (2021/C 216/01). The Official Journal of the European Union, 7 June. ⟨https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AC%3A2021%3A216%3AFULL⟩ (accessed 26 March 2023).
M. Olszyński Development advisor at ZELAN Interview April 2020 18.
Ostrowski, A., 2019. Branża tworzyw sztucznych [RAPORT]. MM Magazyn Przemysłowy, 2 July. ⟨https://www.magazynprzemyslowy.pl/artykuly/Branza-tworzyw-sztucznych-RAPORT⟩ (accessed 6 April 2020).
Parashar, N., Hait, S., 2021. Plastics in the time of COVID-19 pandemic: protector or polluter. Sci. Total Environ. 759, 144274 https://doi.org/10.1016/j.scitotenv.2020.144274.
PKO BP. 2019. Branża tworzyw sztucznych: Wzrost znaczenia polskich producentów na świecie. Departament Strategii i Analiz Międzynarodowych. Powszechna Kasa Oszczędności Bank Polski, September. ⟨https://wspieramyeksport.pl/api/public/files/1728/PKO_TWORZYWA_SZTUCZNE_2019_FINAL_PWEpdf.pdf⟩ (accessed 28 March 2020).
Plastics Europe, 2019. Plastics – the Facts 2019: An analysis of European plastics production, demand and waste data. ⟨https://plasticseurope.org/wp-content/uploads/2021/10/2019-Plastics-the-facts.pdf⟩ (accessed 15 March 2022).
Plastics Europe, 2021. Plastics - the Facts 2021: An analysis of European plastics production, demand and waste data. ⟨https://plasticseurope.org/pl/wp-content/uploads/sites/7/2021/12/AFweb-Plastics-the-facts-ING-2021.pdf⟩ (accessed 15 March 2022).
Plastics Europe Newsroom, 2019. Informacje prasowe: Przemysł tworzyw sztucznych – rozwój pod presją. Plastics Europe Newsroom, 28 May. ⟨https://legacy.plasticseurope.org/pl/newsroom/press-releases/archiwum-informacje-prasowe-2019/przemysl-tworzyw-sztucznych-rozwoj-pod-presja⟩ (accessed 12 April 2022).
Plastics Insight, 2017. Global Consumption of Plastic Materials by Region (1980 – 2015). Plastics Instight, 14 September. ⟨https://www.gap-polymers.com/en/blog-post/global-consumption-of-plastic-materials⟩ (accessed 12 April 2022).
POIR, 2020. Lista projektów realizowanych z Programu Inteligentny Rozwój 2014–2020. Program Operacyjny Inteligentny Rozwój. ⟨https://www.poir.gov.pl/strony/o-programie/projekty/lista-beneficjentow/⟩ (accessed 1 May 2020).
PZPTS, 2018a. Produkty jednorazowego użytku z tworzyw sztucznych. Aktualności, 3 July. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/395748/produkty-jednorazowego-uzytku-z-tworzyw-sztucznych⟩ (accessed 12 April 2022).
PZPTS, 2018b. Artykuły z tworzyw sztucznych jednorazowego użytku - stanowisko PZPTS do projektu dyrektywy UE. Aktualności, 4 September. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/401159/artykuly-z-tworzyw-sztucznych-jednorazowego-uzytku-stanowisko-pzpts-do⟩ (accessed 12 April 2022).
PZPTS, 2018c. Nowe przepisy wyhamują recykling. Aktualności, 9 October. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/406315/nowe-przepisy-wyhamuja-recykling⟩ (accessed 12 April 2022).
PZPTS, 2019. Opłata recyklingowa na torby z tworzywa wielorazowe. Aktualności, 17 July. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/451756/oplata-⟩ (accessed 5 January 2022).
PZPTS, 2020a. Zakaz sprzedaży i posiadania wyrobów z tworzyw sztucznych w Wałbrzychu niezgodny z Konstytucją RP i traktatami UE. Aktualności, 17 February. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/485671/zakaz-sprzedazy-i-posiadania-wyrobow-z-tworzyw-sztucznych-w-walbrzychu-niezgodny-z-konstytucja-rp-i-traktatami-ue⟩ (accessed 12 April 2022).
PZPTS, 2020b. PZPTS w walce z pandemią - podziękowania dla firm członkowskich. Aktualności, 9 April. Polski Związek Przetwórców Tworzyw Sztucznych. ⟨https://pzpts.pl/pr/497765/pzpts-w-walce-z-pandemia-podziekowania-dla-firm-czlonkowskich⟩ (accessed 12 April 2022).
Rhodes, C.J., 2019. Solving the plastic problem: from cradle to grave, to reincarnation. Sci. Prog. 102 (3), 218–248. https://doi.org/10.1177/0036850419867204.
Ritchie, H., Roser, M. 2018. Plastic Pollution. Our World in Data. ⟨https://ourworldindata.org/plastic-pollution⟩ (accessed 16 March 2022).
Rivera, A.M., Strauss, K.W., van Zundert, A., Mortier, E., 2005. The history of peripheral intravenous catheters: how little plastic tubes revolutionized medicine. Acta Anaesth. Belg. 56, 271–282.
Roche Cerasi, I., Sánchez, F.V., Gallardo, I., et al., 2021. Household plastic waste habits and attitudes: a pilot study in the city of Valencia. Waste Manag. Res. 39 (5), 679–689. https://doi.org/10.1177/0734242X21996415.
Sastri, V.R., 2014. Plastics in Medical Devices: Properties, Requirements and Applications. Elsevier, Amsterdam. https://doi.org/10.1016/C2012–0-05946–7.
SEI, 2021. Reducing Plastic Pollution: Campaigns That Work. Stockholm Environment Institute, Stockholm.
Simon, F., 2020. EU dismisses industry calls to lift ban on single-use plastics. EURACTIV.com, 15 April. ⟨https://www.euractiv.com/section/circular-economy/news/eu-dismisses-industry-calls-to-lift-ban-on-single-use-plastics/⟩ (accessed 31 March 2022).
Siwkowska, A., 2021. Implementacja dyrektywy w sprawie ograniczenia wpływu niektórych produktów z tworzyw sztucznych na środowisko. PARP, 2 August. ⟨https://www.parp.gov.pl/component/content/article/72791:implementacja-dyrektywy-w-sprawie-ograniczenia-wplywu-niektorych-produktow-z-tworzyw-sztucznych-na-srodowisko⟩ (accessed 31 March 2022).
Szydłowski, K., 2019. Klamka zapadła. Rok 2021 będzie końcem plastikowych sztućców i talerzy. Teraz środowisko, 14 June. ⟨https://www.teraz-srodowisko.pl/aktualnosci/plastik-jednorazowego-uzytku-tworzywa-sztuczne-dyrektywa-2021–7136.html⟩ (accessed 3 April 2020).
Tonglet, M., Phillips, P., Read, A.D., 2004. Using the theory of planned behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. Resour. Conserv. Recycl. 41, 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001.
United Nations, 2015. Resolution adopted by the General Assembly on 25 September 2015 [without reference to a Main Committee (A/70/L.1)] 70/1. Transforming our world: the 2030 Agenda for Sustainable Development. ⟨https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf⟩ (accessed 26 March 2023).
Vidal, M., Alomar, C., Deudero, S., Altvater, S., Sandra, M., De Raedemaecker, F., Devriese, L., Mata Lara, M. 2020. Potential Future Impacts. D2.4 AQUA-LIT project. Palma. (accessed 12 April 2022).
Willis, K., Maureaud, C., Wilcox, C., Hardesty, B.D., 2018. How successful are waste abatement campaigns and government policies at reducing plastic waste into the marine environment. Mar. Policy 96, 243–249. https://doi.org/10.1016/j.marpol.2017.11.037.
Wilson, D.C., 2020. A Guide to Good Reasoning: Cultivating Intellectual Virtues. University of Minnesota, Minneapolis. ⟨https://open.lib.umn.edu/goodreasoning/⟩.
Wodak, R., Meyer, M. (Eds.), 2016. Methods of Critical Discourse Studies, third ed. Sage, London.
Zamorowska, K., 2019. Jak Europa (nie) radzi sobie z odpadami z tworzyw sztucznych? ⟨https://www.teraz-srodowisko.pl/aktualnosci/jak-europa-radzi-sobie-z-odpadami-z-tworzyw-sztucznych-6156.html⟩ (accessed 14 April 2020).
Zamorowska, K., 2021. Polska nie zdążyła z implementacją dyrektywy SUP. Jakie będą tego konsekwencje? Teraz środowisko, 9 July. ⟨https://www.teraz-srodowisko.pl/aktualnosci/dyrektywa-sup-tworzywa-sztuczne-przepisy-krajowe-10580.html⟩ (accessed 3 January 2022).
ZELAN, 2015. O firmie. ⟨http://galwanizernia_en.zelan.pl/o-firmie/⟩ (accessed 26 April 2020).
ZELAN, 2019. Sety. ⟨http://www.zelan.pl/sety-pl.html⟩ (accessed 3 May 2020).