

**SOCIAL AWARENESS OF THE CIRCULAR ECONOMY AS  
AN INTEGRAL PART OF SUSTAINABLE DEVELOPMENT.  
OBSERVATIONS FROM POLAND**

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**A b s t r a c t**

Sustained growth in the number of urban dwellers means that matters concerning the development of modern cities are not only a challenge for current residents, but a global test for the entire population. The purpose of this paper is to analyze and assess social awareness regarding sustainable development, with particular emphasis on matters concerning the circular economy. The study was conducted by means of the CAWI (Computer Assisted (Aided) Web Interviews) method on a sample of 389 respondents from Warsaw, the capital city of Poland. The results imply that although the society has a correct understanding of sustainable development and the circular economy, there is still a continuing need to support further education due to the necessity for wider and more intensive implementation of sustainable development in practice.

Keywords: eco-development, closed loop, smart city, citizens' responsibility

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## 1. INTRODUCTION

The urban environment has been studied for many years by scholars from various scientific fields. Undoubtedly, one of the factors which determine interest in urban research is the dynamically increasing number of its inhabitants (Fig. 1). In 1960, the urban population constituted just over 33% of the total population. In 1990, the volume increased to 43%, and currently accounts for over 56% [1]. According to forecasts of the United Nations, in 2050 68.4% of the population will be living in urban areas [2].

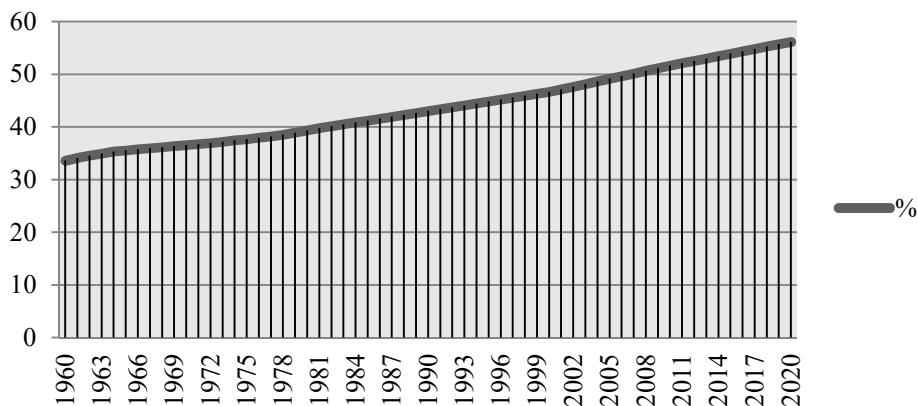


Fig. 1. Urban population (% of total population) [3]

Urban agglomerations create economic advance in various parts of the developing world, and cities act as engines of economic growth [4,5]. Urbanization affects the natural environment, economy, transport, or the quality of life of residents, and has resulted in a number of both positive and negative consequences. The scarcity of natural resources and the growing concerns over economic development at the expense of environmental degradation have resulted in a growing global interest in sustainable development. As early as 1713, Carlowitz published a book dealing with forest sciences, in which he used the example of wood to note that the available resources should be managed wisely, so that they do not become scarce [6]. Since that time, a wide variety of definitions of sustainability have emerged for both local, regional, and global scales [7]. In 1987, the report - Our Common Future, also known as the Brundtland Report, proposed the currently most popular definition, which assumes that "sustainable development is that which, while meeting the needs of contemporary societies, will not at the same time limit the development opportunities of future generations" [8]. It assumes a parallel development of the economy, society and the environment [9,10,11,12]. Currently, postulates with regard to the transformation of socio-economic advance towards sustainable development are

becoming more and more urgent, as human activity continues to move beyond the capabilities of the Earth [13,14]. Smart city management requires the implementation of sustainable measures, and particular attention should be paid to issues related to the circular economy. Proper development in the long term depends on the transformation of the currently dominant linear model of resource consumption towards a circular economy (Fig. 2). The progress of these changes is determined by many factors, and success depends, among other things, on the behavior of residents themselves, which is a consequence of their views and consciousness.

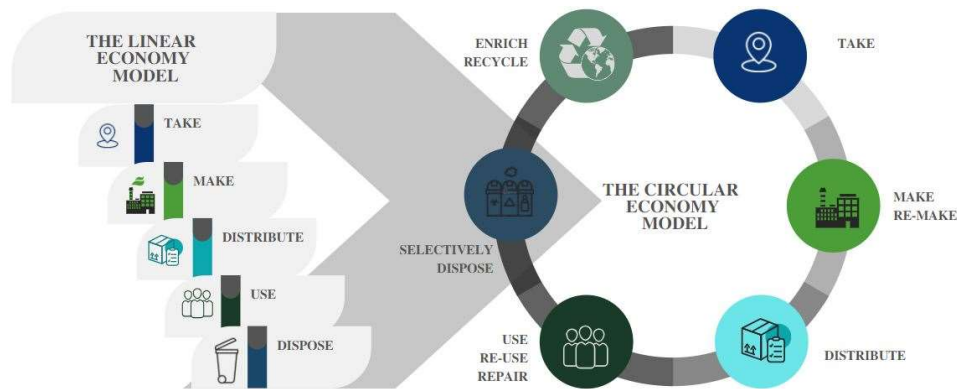


Fig. 2. Transforming a linear economy into a circular economy [15]

In light of the above, the aim of this article is to assess and analyze the social awareness of Warsaw residents regarding sustainable development, with particular emphasis on matters concerning the circular economy. The authors brought forward the following research hypotheses that serve to achieve the aim of this paper.

H1: Warsaw inhabitants have a correct understanding of the principles and concept of sustainable development, as well as of the circular economy.

H2: In spite of numerous educational campaigns, there is still a strong need to raise the society's awareness in the scope of activities aimed at disseminating issues related to the circular economy in order to implement the principles of sustainable development and the circular economy in everyday life.

## 2. THE CIRCULAR ECONOMY

The concept of a circular economy was first defined in the 1960s by the pioneer of environmental economics Professor Kenneth E. Boulding [16]. A circular economy is addressed as an economic model that aims to use resources efficiently while reducing the volume of waste and virgin resources, as well as maintaining value over the long term, using closed loops of products and materials as part of environmental protection and socio-economic benefits [17]. This model is recommended as an approach coherent with economic growth that is in harmony with sustainable environmental and economic development [18,19]. The ultimate aim of the circular economy is to generate economic growth without exerting pressure on the natural environment [20]. Both sustainable development and the circular economy reflect the vision of a smart city. Technological advances also play an extremely important role in these two concepts. Information and communication technologies (ICT) are a major tool that enables urban dwellers to meet their information and communication needs more effectively and efficiently [21]. That said, in addition to the above, achieving success and a proper functioning of cities also requires the human factor. Nowadays, there is a change in the approach to science, research and development, which is caused by a shift towards openness and transparency. This in turn leads to the involvement of citizens in a number of research endeavors [22].

The aim of circular economy, and ultimately circular cities, is to create a closed loop by transforming the flow of resources from linear to circular [23]. The literature contains studies that distinguish between eight main thematic areas related to the challenges of circular activities in cities. These include: the socio-cultural, economic and financial, information, regulatory, political, institutional, environmental and technical area [24]. Currently, cities are responsible for the consumption of 60-80% of natural resources worldwide. They account for 75% of greenhouse gas emissions and 50% of global waste [25]. About 40% of carbon dioxide emissions which contribute to climate change are caused by buildings and construction, which play a key role in the clean energy transition [26]. Progressive urbanization makes cities an ideal environment for implementing the idea of circular economy, thus marking the beginning for the concept of circular cities. The closed-loop concept is beginning to be implemented in the process of designing policies covering urban development, infrastructure reorganization and energy policy [27]. The cities that have already started to introduce this idea include Amsterdam [28], Barcelona [29], Berlin [30], Malmö [31] or Glasgow [32]. Cities of the future that are looking to support high-level circulation should use production and local resources in the most effective way, while maintaining circulation through various channels [33]. Circular city strategies can contribute to achieving the Sustainable Development Goals (SDGs) of the United Nations

Agenda 2030 for Sustainable Development, in particular SDG11 (on safe, inclusive, resilient, and sustainable) and SDG12 (on sustainable cities and consumption) [34,35].

### **3. METHODS AND RESEARCH AREA**

In this publication, CAWI (Computer Assisted (Aided) Web Interviews) was used as the research method. The advantage of this method is the possibility of obtaining reliable data at an optimal time and at an individual pace for the respondent, as well as anonymity [36]. A positive feature determining the choice of this method is also the possibility of applying the so-called sensitive questions [37]. In addition, this method is particularly useful under conditions of limited respondent availability which in this case is the pandemic situation in the country. The research focused on a relatively narrow topic and was conducted during an ongoing pandemic. These two facts certainly influenced the number of respondents who took part in the survey. The sample included 389 Warsaw residents and was conducted between March and April 2021. As the capital of Poland, and the country's largest economic and service center, Warsaw has been recognized as a good research field which exemplifies social attitudes and knowledge regarding issues related to sustainable development and the circular economy. The capital city of Poland seems to be an important area of research also in the context that it won the general classification of the second edition of the Arcadis Ranking of Polish Sustainable Cities [38], as well as in the area of society, which is particularly relevant to this publication and the scope of research. The sampling was random and the results were prepared in Microsoft Excel and IBM SPSS. The study was attended by 65% women and 35% men. The biggest group were people aged 18-25 (67%) and 26-35 (18%). The study did not include responses from people below the age of 18. The largest group among the respondents were people with a university education (64%) and secondary education (35%), and there were no people with primary education. More than half of the respondents are unmarried, 42% are in a relationship, and 6% are divorced. It should be pointed out that the studied sample is statistically unrepresentative, but the collected number of opinions makes it possible to draw general conclusions of a synthetic nature. The research concept consisted of a five-stage design (Fig. 3).



Fig. 3. Scheme of research design

Source: own elaboration

The core of research was a questionnaire, which consisted of 20 questions of varying complexity and detail, concerning issues related to sustainable development and the circular economy. The survey consisted of four thematic blocks:

1. understanding of concepts of sustainable development and circular economy,
2. daily practices among the society in the context of circular economy,
3. environmental awareness and responsibility,
4. future prospects for sustainable development and circular economy.

The study was supported by data from the Central Statistical Office (CSO) 2021 "Municipal waste management in the Mazowieckie Voivodeship in 2020" and data from Eurostat "Circular material use rate".

Due to the limited format of the study, the authors focused on presenting the most important results of the conducted research.

## 4. RESEARCH RESULTS

### 4.1. Understanding the concepts of sustainable development and circular economy

The first part of the survey concerned assessing the respondents' understanding of the main concepts discussed in the article. The first question examined how sustainable development was perceived by Warsaw residents. The vast majority of respondents (89%) indicated that by this they understand progress to be a combination of taking into account the needs of society and the environment. In

addition, knowledge of the circular economy was also verified. For 52% of the respondents the main association that this term evokes is the reuse of recovered raw materials by companies to produce new goods, for 22% it is the use of renewable energy, while for 21% it is the segregation of waste in households. Additionally, the respondents' awareness of the possible areas of use of the circular economy was analyzed. Also the answers to this question testify to a good level of knowledge, since as many as 72% of respondents indicated that the closed loop can be used in the entire economy, and not only apply to selected elements. The obtained results clearly indicate that the respondents correctly recognize the concepts and correctly identify the areas of their application. The good level of knowledge may be due to the fact that Warsaw is a thriving educational center and in recent years has been strongly promoting attitudes related to sustainable development and circular economy through the implementation of a number of campaigns (e.g. "Segregate your waste properly") or events (e.g. Ecopicnic or Ecodesign).

#### 4.2. Daily practices among the society in the context of sustainable development and circular economy

The second part of the survey focused on the respondents' daily lives and practices regarding the issues discussed. It is impossible to omit in this area the issue of waste segregation. It has a positive impact on energy savings, reduction of consumption of valuable resources or environmental issues (protection of soil and groundwater by limiting the emission of harmful gases and sewage, as well as reduction of hardly decomposable waste). Moreover, segregation of waste is important in terms of its recyclability and reusability. It was examined whether the respondents separate waste in their households (Fig. 4).

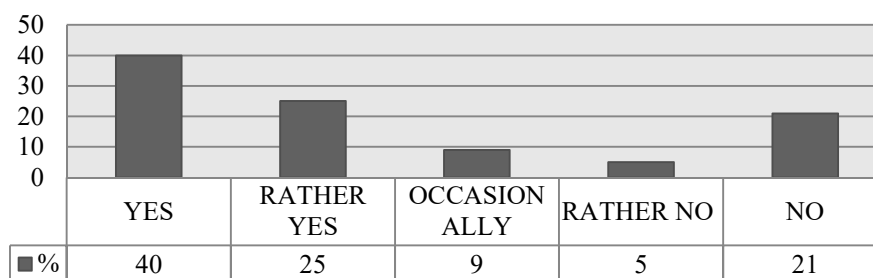


Fig. 4. Distribution of answers to the question: Do you segregate waste in your households?

Source: own study based on survey ( $N=389$ )

The results show that 40% of respondents declare that they separate waste, 25% rather do it, 9% do it occasionally, while successively 5% and 21% indicate that they rather or definitely do not do it. According to GUS data for the Mazowieckie Voivodeship, in 2020 the share of mixed waste in the total mass of collected municipal waste accounted for 63.5% [39]. The same report also shows that in 2020 as much as 87.9% of municipal waste came from households. As a result, an important element of building improvement in this area is to strive for changes in the attitudes of residents, as households are responsible for the vast majority of municipal waste. The processing of municipal waste is based on its recovery and disposal. The structure of their processing in 2020 is shown in Fig. 5.

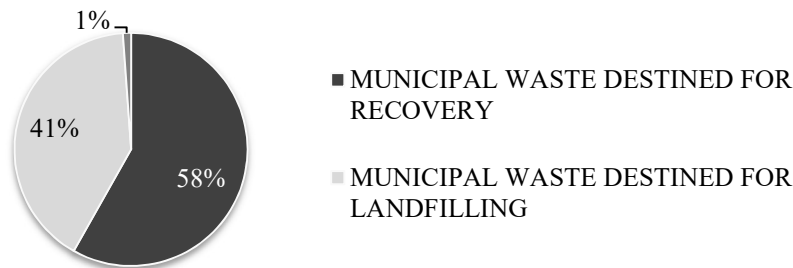


Fig. 5. Processing of municipal waste in the Mazowieckie Voivodeship in 2020 [39]

Despite numerous information campaigns implemented, a high percentage of waste for landfilling is still visible. This proves that there is still a high demand for actions aimed at increasing public awareness and, consequently, at eliminating the lack of waste segregation. In the area of waste, it is also worth paying attention to waste electronic equipment. This survey identified the main directions of action among respondents (Fig. 6).

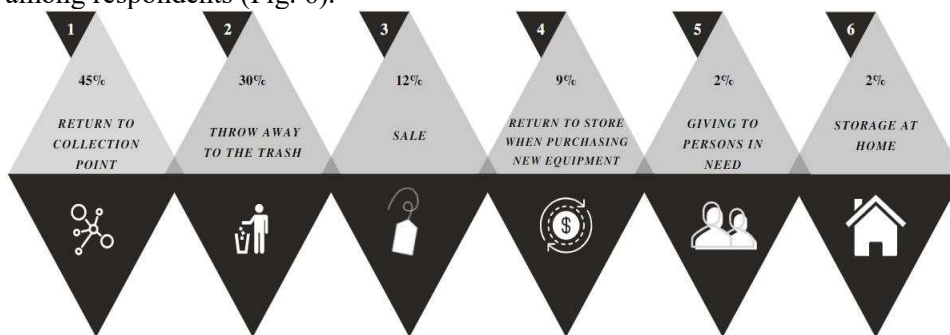


Fig. 6. Waste electrical/electronic equipment - main directions of action

Source: own study based on survey (N=389)



The largest number of respondents (45%) indicated that they return electronic equipment to collection points, which may be a positive effect of their increasing number in new locations. In Warsaw, there are many opportunities to return such waste. Among them there are Municipal Waste Selective Collection Points (so-called PSZOKs) operating on a stationary basis and their mobile supplementation (so-called MPSZOKs), as well as many other points located in every district. The map "Donate Waste" facilitates finding them, where thanks to the filtering options one can find not only electro-waste collection points but also many other initiatives compatible with the circular economy concept, e.g. canning machine and second-hand shopping places [40]. The fact that as many as 30% of the respondents declared that they throw electronic equipment into the garbage is alarming. This proves that there is still a great need for actions aimed at improving public awareness. This part of the study also verified consumer behaviour by examining whether respondents pay attention to product packaging and whether it determines their purchase decision (Fig. 7).

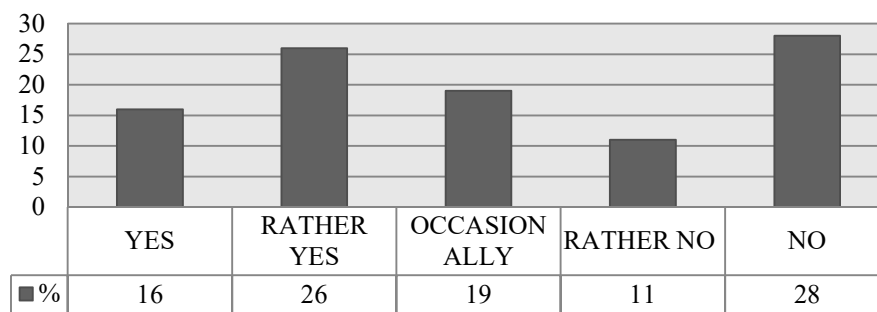


Fig. 7. Distribution of answers to the question: Do you pay attention to the product packaging and does this influence your purchase decision?

Source: own study based on survey (N=389)

Only 16% of respondents declare that packaging influences their decision to buy an article, 26% are of the opinion that it rather influences their decision, 19% pay attention to it occasionally and sequentially 11% and 28% rather or definitely do not pay attention to it.

The reasons for this behaviour were investigated and as a result the following key factors for not focusing on the product packaging when shopping were identified:

- lack of time (66%),
- poor product labelling (19%),
- higher price of recycled goods (10%),
- lack of interest in environmental issues (3%),
- small amount of recycled products (2%).

While discussing the area of everyday life it is impossible not to mention the problem of food waste. Among the respondents as many as 65% declared that this problem occurs in their household. The scale of wastage is shown in Fig. 8.

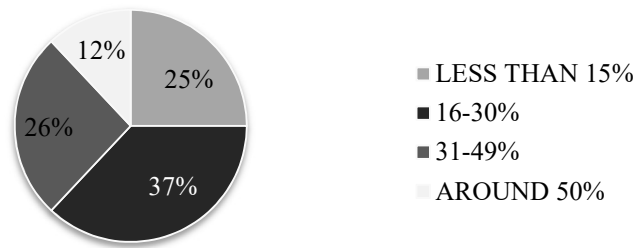


Fig. 8. Declared estimates of food wasting

Source: own study based on survey (N=389)

The highest percentage (37%) of respondents indicate that losses of food in their homes reach 16-30%, the second size is losses at the level of 31-49%, which is declared by 26% of people, while the third position is occupied by waste at the level of less than 15%, which occurs in 25% of respondents. In Poland, the PROM project is being carried out by research teams from the Institute of Environmental Protection - National Research Institute and the Warsaw University of Life Sciences. The first results of the research indicate that almost 5 million tons of food is wasted annually in Poland, of which consumers are responsible for the largest percentage of losses, since 60%, i.e. almost 3 million tons, comes from households [41]. The detailed structure of food waste in Poland is presented in Fig. 9.

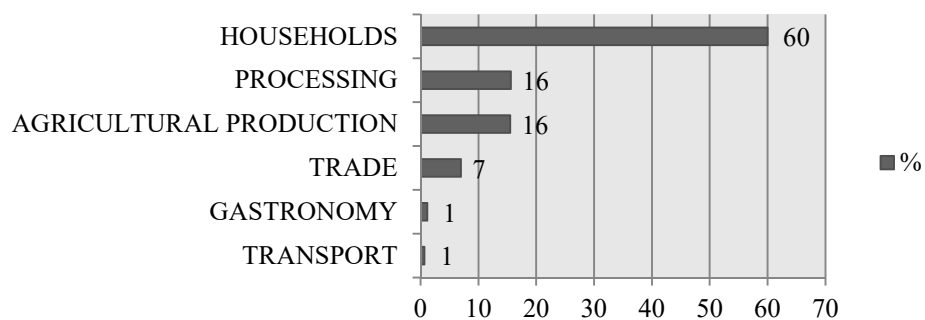


Fig. 9. The structure of food wastage in Poland [41]

The results in terms of food waste and waste generation clearly indicate the need to implement further measures to transform from a linear model of economy to a circular economy especially focusing on changes in household habits.

### 4.3. Environmental awareness and responsibility

The third part of the survey examined respondents' assessment of others' environmental awareness as well as their own knowledge of sustainability (Fig. 10 and Fig. 11).

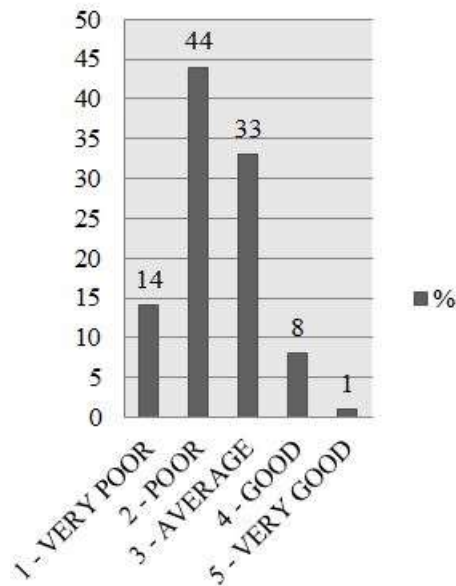


Fig. 10. Assessment of social knowledge level about environmental awareness

Source: own study based on survey (N=389)

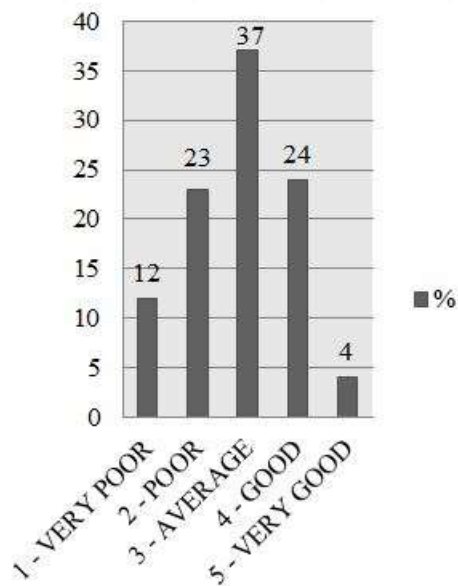


Fig. 11. Assessment one's own level of knowledge about sustainable development

The following 14% and 44% of respondents rated the level of public awareness of environmental protection as very low or low, 33% as average, 8% as good, and only 1% as very good. A little better respondents assess their own knowledge. In this case, 12% rate it very bad, 23% bad, 37% average, while successively 24% and 4% believe that they have a good or very good level of knowledge in this area.

#### 4.4. Future prospects for sustainable development and circular economy

The last part of the questionnaire explored respondents' views on the future of sustainability and the circular economy. As a result, actions that could contribute to the transformation from a linear to a circular economy were highlighted (Fig. 12).


 FINANCIAL PENALTIES	FOR EXAMPLE: FOR NOT SEPARATING WASTE
 NATIONAL CAMPAIGNS	ENVIRONMENTAL CAMPAIGNS, RAISING PUBLIC AWARENESS
 INVESTMENT IN SCIENCE	DEVELOPMENT OF NEW SOLUTIONS
 LEGAL AMENDMENTS	REGIME CHANGE, REGULATION AT INTERNATIONAL AND NATIONAL LEVEL, SUBSIDES FOR ENVIRONMENTAL SOLUTIONS, IMPOSED OBLIGATION TO USE RECYCLABLE RAW MATERIALS
 INVESTMENT IN TECHNOLOGY	DEVELOPMENT OF MODERN TECHNOLOGIES
 FINANCIAL INCENTIVES	FOR EXAMPLE: REFUNDS FOR RETURNED BOTTLES, EMPHASIS ON OPPORTUNITIES FOR SAVINGS
 EDUCATION OF THE PUBLIC	CHANGING THE WAY PEOPLE THINK
 AID TO ENTERPRISES	PROCEDURAL SUPPORT AND INCENTIVES
 CORPORATE SOCIAL RESPONSIBILITY	INTEGRATION OF ENVIRONMENTAL CONSIDERATIONS INTO COMPANY POLICIES
 THINKING IN A LONG-TERM PERSPECTIVE	AWARENESS OF FINITE RESOURCES, CONCERN FOR FUTURE GENERATIONS

Fig. 12. Actions that can contribute to transforming the economy from linear to circular  
 Source: own study based on survey (N=389)

The respondents pointed to the essential role of financial penalties for persons or enterprises acting contrary to the principles of sustainable development, for which a transparent and modern formal and legal framework is needed. On the other hand, the respondents stressed that entities should be honored for pro-environmental behavior, e.g., through financial incentives. In the future, respondents recognize the need for educational campaigns promoting knowledge about sustainable development and the circular economy, investments in modern technologies and research support in this area, broadly understood education and forward-thinking in the long-term horizon.

Proper shaping of future directions of development depends, among other things, on current control of the situation and through this appropriate adaptation of solutions. The European Union monitors circular economy in member states and calculates the circularity index of particular countries, which is the ratio of recycled materials to the national material consumption [42]. The situation of Poland in comparison with the European Union and the leaders is shown in Fig. 13.

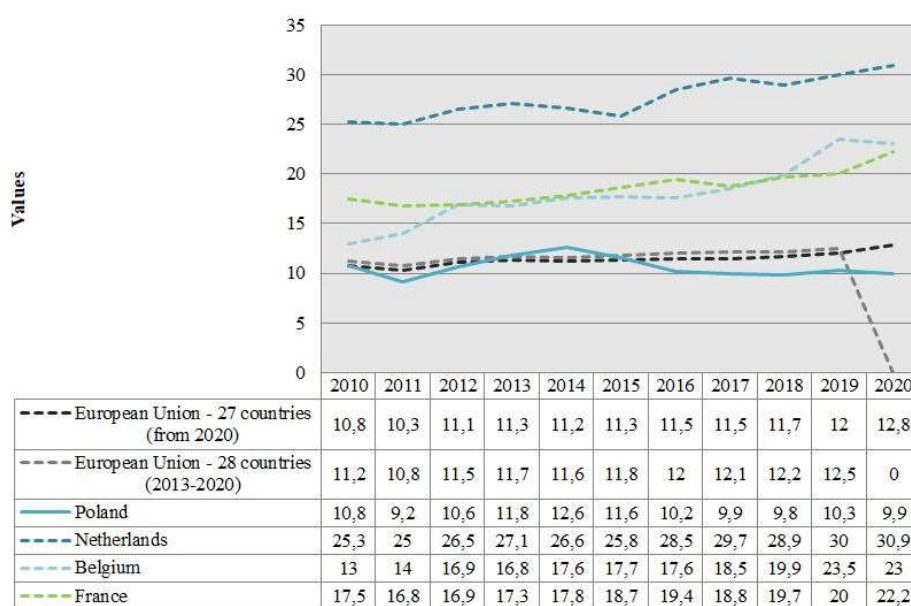


Fig. 13. Circular material use rate (Poland in comparison with EU and EU leaders) [42]

The latest data shows that the rate for Poland in 2020 is at the level of 9.9%. Leaders in this respect are the Netherlands with a rate of 30.9% in 2020, Belgium with a rate of 23% and France with almost the same result of 22.2%. Poland's result confirms that there is still space for further actions in this aspect. For the EU - 28 countries (2012-2020) no indicator value was recorded in 2020, therefore lack of data results in the indicator being presented as zero in a given year.

## DISCUSSION

Public participation has been recommended as an effective means of establishing sound sustainable development practice [43]. That said, the effectiveness and correctness of society's participation in the creation of the urban fabric depends on their awareness and level of knowledge. In light of the above research, it was found that most respondents have a proper understanding of the concept of

sustainable development and correctly identify the areas in which circular economy solutions can be applied, as well as have the appropriate associations related to it. Similar conclusions can be observed by other researchers conducting analyses in other parts of Poland (e.g. in the Małopolska Voivodeship) [44,45]. The transformation of management involves a shift towards greater co-creation of the city by all stakeholders [46]. Cities and their local government structures must now closely cooperate with citizens, companies, and other stakeholders [47,48,49]. The literature includes studies presenting approaches that assume the participation of the local community in urban management [e.g., 50,51]. Research on sustainability conducted by other scientists indicates a considerable evolution of the research field from the definition of its concept in the Brundtland Commission report to the recent elaboration of sustainable development models and indicators [52]. Furthermore, it is pertinent to note that people in general (especially young ones) support the concept of sustainable development, as evidenced by many recent studies [53,54].

It is also positive that the level of waste recycling in other European countries is steadily increasing [55]. In Poland, waste segregation is influenced by the obligation imposed on property owners to segregate municipal waste [56]. In spite of that, the results for Mazowieckie Voivodeship indicate that there is a large space for improvement in this area. As a result, it can be concluded that there is a possibility of progress in the field of society's consumer awareness. The primary determinants affecting lack of attention to product packaging during shopping were identified. Among these, lack of time and poor product labeling are the most important factors. These aspects are closely related and indicate that it would be worthwhile to improve the labeling so that the public with limited time today could more easily and quickly recognize such products. The situation could also be improved by setting up special zones in stores for recycled goods only. The results also demonstrate that some people still dispose of electronic waste into normal garbage cans. Participation in creating a closed-circuit city, or in broader terms, a smart city centered around the principles of sustainable development requires, first of all, investments in education, raising the level of social awareness through campaigns and long-term strategies. Public education and shaping habits consistent with the requirements of closed-loop processes comprise the fundamental elements allowing the transformation from theoretical to practical aspects [57]. A valuable element for the development of the circular economy is the enrichment of traditional education with new methods. One such method is the board game — "In the loop", which aims to raise awareness among players about the benefits of the circular economy [58]. The game is based on twelve elements from the list of —critical raw materials of the European Commission [59].

Food waste also turned out to be an important problem identified in the study. As many as 65% of households deal with this issue. It should be noted that it concerns most highly developed countries, where the standard of living is high [60,61,62]. To inhibit this phenomenon, it is worth promoting activities aimed at enhancing purchasing awareness - raising awareness of purchasing planning and identifying real gains in the form of savings resulting from not throwing away products [63,64,65]. The economy still loses when it comes to caring for the environment, because the price is often decisive for the purchase of a given product. Therefore, it is worth promoting the knowledge about the advantages of ecological solutions, such as sharing, in line with the idea of the economy of sharing, cooperation or co-buying. This involves sharing under-utilized resources to improve efficiency and sustainability [66]. Includes transformation of organizational and distribution models and based upon people's willingness to cooperate, help others and share their time and resources, which is reciprocated in various ways and, as a result, brings material and non-material benefits. Sharing economy refers to a number of concepts: sharing resources (including channels), cooperative trade or better and more sustainable operations, and therefore partially overlaps with the concept of the circular economy [67]. As a result, the implementation of solutions compliant with the sharing economy concept may contribute to the reduction of negative phenomena, such as waste.

Sustainable development has been strongly encouraged since the 1980s. Despite efforts to enhance the environmental situation and solve social issues, it remains necessary to design integrated methods to improve development programs, both in terms of their implementation and results [68]. The final part was intended to indicate the forecast of activities that may improve the situation in the future. The need for education and increases social awareness is still noticeable. A vital role is also played by the sector of legal regulations. Undoubtedly, the area of investment in new technological solutions and science is also very important and promising. Financial penalties and incentives will also play a key role in future development.

## CONCLUSIONS

Cities to a larger extent determine the socio-economic advance of future generations, hence undoubtedly a major role is to strive to improve the effectiveness of their functioning in the long-term perspective. The progressive degradation of the natural environment and the limited natural resources make it inevitable to set new trends for socio-economic development. Nowadays, there are many positive transformations in the implementation of regulations that aim to improve the development of urban ecosystems in a long-term perspective. Appropriate urban development is widely discussed in the scientific world, but

also among city managers and, increasingly, among citizens themselves. Such changes in the way of thinking about the city seem very promising and bode well for the future. Undoubtedly, one of the key components in enhancing the efficient functioning of modern cities is raising the level of social awareness based on the principles of sustainable development. In order for human capital to have a beneficial effect on (also urban) development, it is necessary to spread environmental awareness among the society and to educate it. As a result, the authors of this article recognize that it is valuable and highly desirable to conduct further research on these issues. It seems very useful to conduct regular measurements monitoring the state of public knowledge. As a consequence, it will be possible to properly adjust the tools to the current needs. The combination of these factors comprises a chance for success and the creation of smart cities. It would be worth considering broadening the research area to include other cities in Poland and abroad. Such research on a larger scale, both territorially and in terms of numbers, would undoubtedly provide a valuable picture of the situation in a broader perspective. To sum up, in further considerations, special attention should be paid to the fact that the city, especially one of closed circulation, represents a system of connected vessels, and its correct functioning depends on the efficient operation of elements across all areas: environmental, economic, legal, cultural and technological, as well as at all levels of management, from the stewards to the inhabitants.

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