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## Between declaration and action – an analysis of the results of research on circular behaviours taken up by the households and perceived benefits from them

**Abstract:** The main aim of the paper is to analyse and evaluate the possible relation between taking up of the circular behaviours by the households' members and perceiving the benefits. The paper presents the results of the research conducted among Polish households on the territory of two voivodships: Podkarpackie and Małopolskie. In the article the authors present the result of the statistical analysis of the frequency of undertaking those behaviours in the households and perception of the benefits. To indicate the possible dependences the Chi2 Test of Independence and The U Mann-Whitney Test were used. Obtained results indicate that undertaking circular behaviours may have an influence on the perceived benefits of varying magnitude. It could be important due to the establishment of support activities aiming at increasing the overall level of circularity among the households (as an economic sector). The originality of the research consists the methodology used and novel questionnaire prepared by one of the authors. The questionnaire joins 9R's circularity concept (normally used in circularity assessments in business companies) with typically households' behaviours. This article is the sixth one in the publication series devoted to circular economy and sustainable development matters.

**Keywords:** circular economy; households benefits; statistical analysis; quality of life

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## INTRODUCTION

The present paper is the sixth one in the publication series devoted to circular economy and sustainable development matters. In this paper the major attention will be focused on perceived benefits from undertaking circular behaviours by the households.

In previous articles (Szczygieł, 2020a, 2020b, 2021a and Szczygieł, Kowalska, 2021b) the concept of circular behaviours was presented and characterised. These behaviours could be defined as those that in which the main attention is on decreasing the need of resources by reducing the demand for products and shifting to meeting the need (Szczygieł, 2021a). Due to the fact that the present article is part of the publication series, there is a need to characterise the potential benefits perceived by the households' members from undertaking circular behaviours.

Reaching the benefits from a certain type of behaviour is widely described in economic history (Jevons, 1911; Fisher, 1918/2007; Blaug, 1994). The benefits could be considered in different contexts (Table 1).

*Table 1.* Examples of benefits from circular economy implementation

Aspect	Circular benefits
Environmental	<ul style="list-style-type: none"> <li>– protection against ozone depletion, acidification, eutrophication, abiotic depletion or fossil fuel abiotic depletion,</li> <li>– raw materials reduction,</li> <li>– water savings,</li> <li>– eco-efficiency (increase of profitability and environmental performance)</li> <li>– greenhouse gas emission reduction,</li> <li>– mitigation of climate change,</li> <li>– bio-energy production.</li> </ul>
Social	<ul style="list-style-type: none"> <li>– improvement of water and food products,</li> <li>– healthcare savings,</li> <li>– increasing the social responsibility among communities,</li> <li>– increasing the level of collaboration.</li> </ul>
Economic	<ul style="list-style-type: none"> <li>– economic growth,</li> <li>– increased market share and value generation,</li> <li>– economic and energy efficiency,</li> <li>– collaboration between companies,</li> <li>– improving the products and savings on production costs,</li> <li>– economic benefits in supply chains,</li> <li>– enhancing the business competitiveness,</li> <li>– reduction of emission's cost,</li> <li>– reduction of climate changes' cost,</li> <li>– additional jobs,</li> <li>– trade balance effects,</li> <li>– advantages for families*.</li> </ul>

Source: own elaboration based on: (Bressanelli et al., 2020; Cavallo, Cencioni, 2017; Cusenza et al, 2019; Davidescu et al., 2020; Ddiba et al., 2018; Minunno et al., 2020; Sehnem et al., 2019; Wijkman, Skånberg, 2017)

In Table 1, the last-mentioned benefit from an economic perspective relates to benefits for families. They will be the subject of the analysis presented in this article. Under this broad term there are many different advantages, the closed catalogue of which is difficult to compile. For single consumer, taking up circular behaviours is related with the level of their easiness and effectivity (Zrałek & Burgiel, 2020). Thus, the achieved benefits will depend on the circular actions taken up by the households' members.

## METHOD OF RESEARCH

The main purpose of this study is to examine the existence of the relationship between taking up circular behaviours by the households and the perceived benefits of them.

In previous article (Szczygieł, 2021a) the statements concerning the households members' circular behaviours were presented in detail. The respondents were asked to assess the frequency of undertaking 37 various behaviours (the scale contained 5 verbal statements referring to the frequency of undertaken behaviours: *Never, Rarely, Sometimes, Often, Always*). The analysed behaviours have been labelled with numbers corresponding to the circularity levels according to the 9R's concept (Kirchner, Reike, Hekkerts, 2017; Manickam, Duraisamy, 2019; Czikkely et al., 2018), while the second number indicates the number of the analysed behaviour (e.g. R2\_5. *I use foil packaging several times*, denotes the second level of circularity "Recycle," while 5 denotes the fifth ranked behaviour analysed). As the benefits, the following statements were accepted: (1) *Saving resources – I don't need many things*, (2) *I use less electricity*, (3) *I use less gas*, (4) *I use less running water*, (5) *I generate less waste*, (6) *Financial savings – I spend much less on grocery shopping*, (7) *Financial savings – I spend much less on purchasing electronic and technical equipment*, (8) *Better mental well-being*, (9) *Better health and fitness*, (10) *I eat more vegetables and fruits*, (11) *I have control over the quality of prepared meals*, (12) *I'm doing something for the world*. The listed benefits have been catalogued on the basis of the literature review (Borrello et al., 2017; Cavallo, Cencioni, 2017; Camacho-Otero et al., 2018; European Commission, 2018; Rada et al., 2018) and the authors' own observations.

The main thesis assumed in the present article is the following: *Households which have taken up circular behaviours, experienced the real benefits of them.*

On this basis, four hypotheses were accepted for testing:

*H1* – Through circular behaviours households use less running water and electricity.

*H2* – The economic management of buying food and other products generates less waste.

*H3* – Taking up circular behaviours in the daily life of the household helps save money.

*H4* – People taking up circular behaviours in their households feel – that they are doing something good for the world.

To verify these hypotheses the Chi2 Test of Independence and the U Mann-Whitney Test were used ( $\alpha=0.05, p<\alpha$ ). The data used in the article came from the original research conducted by the author within the internal grant of Pedagogical University of Krakow (no. BN.610–64/PBU/2020) entitled: "Circular behaviours in households and the quality of life of their inhabitants." The research was conducted in December 2020 on the territory of Małopolskie and Podkarpackie Voivodeship (N=400 households), which was dictated by the scope of the project. The survey was commissioned to a professional research company. The sampling was stratified according to three factors (three stratas: province, gender, age).

The sample was selected in a way that is representative of the population structure in both voivodeships. 245 respondents came from Małopolska and 155 came from Podkarpackie. Surveyed people came mostly from urban areas (251 respondents) rather than from villages (149 respondents). There were 208 women and 192 men. The research was conducted by the outsourced research entity on the base of the author's own methodology (using a survey questionnaire; the CAWI technique). The main scope of the research project concerned the undertaking of circular behaviours by the households and the influence on their quality of life. The statistical analysis was done with using STATISTICA 13.3.

The benefits from undertaking circular behaviours by household members in Poland  
 The perception of the benefits was assessed by the respondents with using *Yes* or *No* categories. They were asked whether they observe any of the 12 benefits of their actions (Table 2).

*Table 2.* Frequency of perception of benefits from undertaking of circular behaviours (in %)

The benefits of circular behaviours	Yes	No
1. Saving resources – I don't need many things.	52.25	47.75
2. I use less electricity.	57.50	42.50
3. I use less gas.	43.25	56.75
4. I use less running water.	62.75	37.25
5. I generate less waste.	57.50	42.50
6. Financial savings – I spend much less on grocery shopping.	40.75	59.25
7. Financial savings – I spend much less on purchasing electronic and technical equipment.	35.25	64.75
8. Better mental well-being.	36.75	63.25
9. Better health and fitness.	37.00	63.00
10. I eat more vegetables and fruits.	43.00	57.00
11. I have control over the quality of prepared meals.	44.75	55.25
12. I'm doing something for the world.	41.75	58.25

Source: authors' own work

Comparing the two groups, it can be seen that four benefits were indicated as being perceived more frequently by the respondents. It concerns *saving the resources* (1), *using less electricity* (2) and *running water* (4), as well as, *generation of less waste* (5). In eight cases the number of respondents who did not notice the benefits was higher than these of them who see the benefits. These results are connected with the frequency of taking up circular behaviours. In other words, it is supposed to be perceived as a benefit if the household member has undertaken them. Table 3 presents the mean value of the circular behaviours in relation to the appropriate benefit (min = 1.0, max = 5.0).

*Table 3.* Mean value of the frequency of circular behaviours

Perception of the benefits of circular behaviours	Mean value of circular behaviours	
	Yes	No
1. Saving resources – I don't need many things.	3.49	3.18
2. I use less electricity.	3.46	3.18
3. I use less gas.	3.45	3.26
4. I use less running water.	3.44	3.19
5. I generate less waste.	3.47	3.17
6. Financial savings – I spend much less on grocery shopping.	3.52	3.22
7. Financial savings – I spend much less on purchasing electronic and technical equipment.	3.48	3.27
8. Better mental well-being.	3.49	3.26
9. Better health and fitness.	3.49	3.26
10. I eat more vegetables and fruits.	3.47	3.25
11. I have control over the quality of prepared meals.	3.49	3.23
12. I'm doing something for the world.	3.49	3.24

Source: authors' own work

The mean value of circular behaviours is higher in the group of respondents who perceived the benefits than among the respondents who did not declare them, and the differences between these two groups are highly statistically significant ( $p=0.000036$ ;  $p<0.05$ ).

Using less running water and less electricity is the consequence of taking specific behaviours. Due to the research, it was assumed that seven of them could be related with saving the electricity (R8\_21. *When choosing electronic and technical equipment, I am guided by its energy class*; R9\_28. *I turn off the light when I'm not in the room*; R9\_29. *I disconnect devices from the contact when I do not use them (e.g. remove the phone charger after charging the phone)*; R9\_30. *I do not use the standby function in electrical appliances*; R9\_33. *I use rechargeable batteries*; R9\_34. *I dry the laundry in the open air*; R9\_36. *I use renewable energy resources*) and two – with saving the water (R8\_22. *I use water sparingly*; R8\_23. *I do the laundry when I have enough to load the entire washing machine*). Table 4 presents the result of verification of the first hypothesis (H1 – *Through circular behaviours households use less running water and electricity*).

Table 4. The result of Chi2 Independent Test for H1

Circular behaviours	p-value
R8_21. When choosing electronic and technical equipment, I am guided by its energy class	0.00041***
R8_22. I use water sparingly	0.00000***
R8_23. I do the laundry when I have enough to load the entire washing machine	0.00008***
R9_28. I turn off the light when I'm not in the room	0.00000***
R9_29. I disconnect devices from the contact when I do not use them (e.g. remove the phone charger after charging the phone)	0.00000***
R9_30. I do not use the standby function in electrical appliances	0.00308***
R9_33. I use rechargeable batteries	0.22927
R9_34. I dry the laundry in the open air	0.00003***
R9_36. I use renewable energy resources.	0.01976*

Note: when  $p<0.05$  – statistical significance (\*);  $p<0.01$  – high statistical significance (\*\*);  $p<0.001$  – very high statistical significance (\*\*\*)

Source: authors' own work

Saving the electricity and water could be related directly with specific behaviours (mentioned above), it could also be assumed that overall circular habits could influence saving these resources. To verify this relation the mean value of circular behaviours could be used. Due to the fact that this variable is not normally distributed, the U Mann-Whitney Test was used. The dependence was statistically significant – if the households' members have taken up circular behaviours more often, the households use less electricity ( $p=0.00000***$ ). Similar is true for using less water ( $p=0.000004***$ ).

Every year households generate a lot of waste, yet a lot of them can be avoided by the rational way of buying and economic management of purchased products. The main circular behaviour related directly with generation of less wastes is buying the products that can be recycled (R2\_8. *When shopping, I choose recyclable products*). It is very important as not every material can be recycled which causes the problem of environmental

pollution. Economic management of food is related to purchase planning. First of all, in order to generate less food waste, households should prepare a shopping list and only buy the products listed (R9\_32. *When shopping, I only buy the products that I have on my list*). Secondly, they should focus on buying an adequate number of food products in relation to household consumption (R9\_31. *I buy an adequate amount of food products in relation to the consumption capacity of my household*), so that nothing is wasted. Preparing food themselves at home and for work or school is a way of generating less waste (R8\_26. *I prepare food myself at home and for work/school*). One of the benefits of this solution is that meals can be packed in reusable boxes and they are not additionally packed by restaurants in disposable bags. What is more, aiming to generate less waste households can sort their garbage into various fractions (R1\_1. *I sort garbage into a wet and dry fraction*; R1\_2. *I sort garbage into glass, metal and plastic, paper, bio, mixed*) or removing the elements from the products before throwing them away (R2\_3. *Before throwing things away, I remove the components that I think may be useful*). All that behaviours could be supported by using the same products several times (for different purpose) (R2\_4. *I use the paper several times, e.g. printed on one side, I use it for scrapbook*; R2\_5. *I use foil packaging several times*). All these behaviours have a positive impact on the generation of less waste, which is evidence supporting the second hypothesis (H2): *The economic management of buying food and other products generates less waste* (Table 5).

Table 5. The result of Chi2 Independent Test for H2

Circular behaviours	p-value
R1_1. I sort garbage into a wet and dry fraction;	0.00026***
R1_2. I sort garbage into glass, metal and plastic, paper, bio, mixed	0.00012***
R2_3. Before throwing things away, I remove the components that I think may be useful	0.00040***
R2_4. I use the paper several times, e.g. printed on one side, I use it for scrapbook	0.00027***
R2_5. I use foil packaging several times	0.01299*
R2_8. When shopping, I choose recyclable products	0.00008***
R8_26. I prepare food myself at home and for work/school	0.03854*
R9_31. I buy an adequate amount of food products in relation to the consumption capacity of my household	0.00211**
R9_32. When shopping, I only buy the products that I have on my list	0.00216**

Source: authors' own work.

The results of the U Mann-Whitney Test confirmed also this hypothesis – the dependence was statistically significant – if the households' members take up circular behaviours more often, the households generate less waste ( $p=0.00000002^{***}$ ).

Circular behaviours could lead to financial savings because they are based on rational management, which in the end is cheaper for the household. It could consider two categories: *spending less on grocery shopping* and *spending less on purchasing electronic and technical equipment*. For example, thanks to economical management during shopping, like buying an adequate number of food products in relation to household consumption (R9\_31. *I buy an adequate amount of food products in relation to the consumption capacity of my household*) or buying the products only from their shopping list (avoiding compulsive decisions – R9\_32. *When shopping, I only buy the products that I have on my list*), households can spend less money, because they do not spend them on unnecessary products. Preparing food at home (R8\_26. *I prepare food myself at home*

and for work/school) is much cheaper than ordering it in a restaurant or buying ready meals in the shop. Additionally, households can spend less money on purchasing electronic and technical equipment thanks to taking care of the equipment (R6\_12. *I repair broken small electronic and technical equipment, e.g. telephone, electric kettle, iron*; R6\_13. *I repair large electronic and technical equipment (e.g. computer, TV, washing machine, fridge*; R6\_15. *I use the services for servicing the products I use*; R6\_16. *I take care of small electronic and technical equipment, thus extending its life*). A good way to saving money could be using “second-hand equipment” (R8\_19. *I use used electronic and technical equipment, e.g. a second-hand telephone, a leased laptop*). This solution is more and more popular, and nowadays nobody is surprised when the official shop sells used products (i.e. T-Mobile in Poland offers repaired iPhones). The results of the analysis are not unequivocal. The differences between the analysed groups (people who perceived the benefits and who did not) are statistically significant only in some cases (Table 6). The perception of the benefit “financial savings” between the group who buy the products from the shopping list and the second one who do not do it, is not statistically significant. It may be related to the perception of grocery shopping as a basic purchase on which no savings should be made. In the case of spending much less on purchasing electronic and technical equipment, only two circular behaviours had statistically significant impact on that benefit: *repairing large* (R6\_13) and *taking care of small electronic and technical equipment* (R6\_16). There were no differences between taking another three behaviours and perceiving the financial benefits. It could be explained by the nature of repairing the items. Many small electronic and technical equipment cannot be repaired (so-called *death gene*), as well as the costs of servicing the products could be high and sometimes – even not possible (due to terms and conditions of the guarantee agreement). Using used equipment is not so popular in Poland which could explain the no dependence between behaviour and benefit. On the other hand – purchasing the electronic equipment is treated as investment, not a cost.

Table 6. The result of Chi2 Independent Test for H3

Circular behaviours	p-value
Financial savings – I spend much less on grocery shopping	
R8_26. I prepare food myself at home and for work / school	0.00035***
R9_31. I buy an adequate amount of food products in relation to the consumption capacity of my household	0.00039***
R9_32. When shopping, I only buy the products that I have on my list	0.06706
Financial savings – I spend much less on purchasing electronic and technical equipment	
R6_12. I repair broken small electronic and technical equipment (e.g. telephone, electric kettle, iron).	0.06771
R6_13. I repair large electronic and technical equipment (e.g. computer, TV, washing machine, fridge).	0.03599*
R6_15. I use the services for servicing the products I use.	0.48498
R6_16. I take care of small electronic and technical equipment, thus extending its life.	0.00028***
R8_19. I use used electronic and technical equipment (e.g. a second-hand telephone, a leased laptop).	0.45836

Source: authors' own work

The financial savings on grocery shopping was confirmed by using the U Mann-Whitney Test ( $p=0.00000004^{***}$ ), as well as reaching the savings on purchasing electronic



and technical equipment ( $p=0.00017^{***}$ ). Both results were statistically significant. Based on this two approaches of the statistical analysis, it could be stated that the third hypothesis (H3): *Taking up circular behaviours in the daily life of the household helps save money, was only partially confirmed.*

Taking up circular behaviours by the households members could be related to a hard-to-define attitude that makes us treat our actions as having a community-wide dimension. Doing something good for the world is strictly subjective, so all factors are taken into account as an expression of a possible pro-social approach. In effect, in the case of 19 from 37 analysed circular behaviours the dependence was observed between its undertaking and perceived of the mention benefit (*H4 – People taking up circular behaviours in their households feel that they are doing something good for the world*) (Table 7).

Table 7. The result of Chi2 Independent Test for H4

Circular behaviours	p-value
R1_2. I sort garbage into glass, metal and plastic, paper, bio, mixed.	0.00022***
R2_4. I use the paper several times (e.g. printed on one side, I use it for scrapbook).	0.00056***
R2_5. I use foil packaging several times.	0.02185*
R2_6. I use a reusable bag when shopping.	0.00687**
R2_7. I use paper and recyclable packaging.	0.00031***
R2_8. When shopping, I choose recyclable products.	0.00263**
R5_11. I buy used furniture and household appliances, repair or renew them for use.	0.033*
R6_13. I repair large electronic and technical equipment (e.g. computer, TV, washing machine, fridge).	0.00071***
R6_16. I take care of small electronic and technical equipment, thus extending its life.	0.00023***
R8_17. I share with others clothes that I don't need.	0.03619*
R8_18. I give unnecessary food to the dining room or share it with my family and friends.	0.00535**
R8_21. When choosing electronic and technical equipment, I am guided by its energy class.	0.00314**
R8_22. I use water sparingly.	0.00072***
R8_23. I do the laundry when I have enough to load the entire washing machine.	0.03364*
R9_28. I turn off the light when I'm not in the room.	0.00008***
R9_29. I disconnect devices from the contact when I do not use them (e.g. remove the phone charger after charging the phone).	0.00153**
R9_30. I do not use the standby function in electrical appliances.	0.01226*
R9_34. I dry the laundry in the open air.	0.00013***
R9_35. I use solar panels or photovoltaic collectors at home.	0.00296**

Source: authors' own work

The results of the U Mann-Whitney Test confirmed also this hypothesis – the dependence was statistically significant – if the households' members take up circular behaviours more often, they feel that they are doing something good for the world ( $p=0,000001^{***}$ ).

## DISCUSSION AND CONCLUSION – THE BENEFITS FROM CIRCULAR BEHAVIOURS

The present analysis allows to state that households perceived different benefits from taking up circular behaviours. Some of these behaviours may more strongly differentiate



the sense of benefits obtained. The most important thing in experiencing benefits is to undertake said behaviours. This may seem a truism, but an analysis of the frequency of benefits shows that they are not observable globally, but in detail. Only after analysing the individual behaviours and the frequency of undertaking all behaviours in total (mean value), despite small differences in the level of this mean, the households indicate the specific benefits they feel from undertaking circular behaviours of the overall level. Detailed analysis allows to indicate statistically significant differences in two groups of households (who take up circular behaviours and who do not). This may also indicate that the so-called small steps method is applicable here, where taking small, often minor behaviours and actions can result in concrete benefits. It should not be forgotten, however, that circular behaviour is caused both by individual characteristics and dispositions and, above all, by the characteristics of the situation or context in which the person finds themselves (Gaspar, 2013; Korsunova et al., 2021). Taking up simple actions like turning off the water when brushing the teeth, turning off the unnecessary light or disconnecting devices from the contact may result in reduced demand for non-renewable raw materials. Previous research noted that the policy of savings in electricity in households is very efficient from an environmental point of view (Duarte, 2014). Similarly, the prudent actions in the area of consumption, from purchasing through the use of goods to waste management, can have a positive impact on cleanliness in the broad sense, particularly expressed in the generation of less waste. This behaviour with regard to food in particular has been confirmed in previous studies (Jungowska et al., 2021; Lehtokunnas et al., 2020; Mylan et al., 2016) It is not only the segregation of waste itself that is important here, but also all the activities carried out during the purchasing (i.e. buying an adequate amount of food products or buying the products from the list, etc.) and use process (choosing recyclable products, removing the components which may be useful, etc.). Thoughtful consumer decisions can also provide benefits in terms of financial savings. And while economic factors (e.g. price) will be the main drivers in purchasing decisions, a pro-environmental attitude can also have a positive impact. This will particularly apply to items used in the long term, which are not bought every day. On the other hand, the above average economic status favours taking up pro-ecological behaviours (Heřka et al., 2015). This may be related to the positive correlation between price and product quality. The researches confirmed, the industry and consumers agreed that better quality of products was a starting point for increased product lifespans (Laitala et al., 2021; see also: Nazlı, 2021).

Consumers' behaviour is partly determined by their lifestyle. It is this that can influence the degree of responsibility for the environment and the conditions in which we live (Lubowiecki-Vikuk et al., 2021; Lopes de Morais et al., 2021; Musova et al., 2021). Probably everyone would like to have a positive impact on the functioning of their immediate environment, but it is important not to juxtapose individual effects with global environmental needs. Unfortunately, in such a comparison it is easy to come out wrong and lose faith in the effectiveness of the efforts made. The overall effects of circular actions may not be satisfactory, only their detailed analysis can show significant differences in perceived benefits. This is why it is so important to emphasise small, individual actions which can only be correctly interpreted after detailed analysis.

The analysis of circular behaviour and its benefits should continue and be deepened. As can be seen from the discussed example of research on two voivodeships, it is necessary to address this topic nationwide and also internationally. These are the next steps,

through which it would be possible to identify the factors determining the uptake and implementation of the idea of a circular economy in households. This is an essential element for the proper identification and design of modern models of intersectoral cooperation that can ensure the success of measures taken to protect resources.

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