EKONOMIA i ŚRODOWISKO

ECONOMICS AND ENVIRONMENT

Journal of the Polish Association
of Environmental and Resource Economists

No. **2 (73)** • 2020

Ekonomia i Środowisko

ISSN 0867-8898
ISSN 2300-6420 (online)

Published by: Fundacja Ekonomistów Środowiska i Zasobów Naturalnych
15-092 Białystok, ul. Sienkiewicza 22
www.fe.org.pl; e-mail: czasopismo@fe.org.pl

Publishing: Agencja Wydawnicza EkoPress
Process Manager Andrzej Poskrobko / tel. 601 311 838

Printed by: Zakład Poligraficzny ARES s.c.
Roman Józefowicz / tel. 506 177 893

www: www.ekonomiaisrodowisko.pl

ECONOMICS AND ENVIRONMENT

Journal of the Polish Association
of Environmental and Resource Economists

EKONOMIA I ŚRODOWISKO

Czasopismo Polskiego Stowarzyszenia
Ekonomistów Środowiska i Zasobów Naturalnych

THEORETICAL AND METHODOLOGICAL PROBLEMS

ENVIRONMENTAL POLICY AND MANAGEMENT

STUDIES AND MATERIALS

GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

DISCUSSION AND REVIEWS

THEORETICAL AND METHODOLOGICAL PROBLEMS

PROBLEMY TEORETYCZNE I METODYCZNE

Barbara **FURA**

METHODOLOGICAL BASIS FOR RESEARCH ON THE RELATIONSHIP BETWEEN ENVIRONMENTAL INITIATIVES AND BUSINESS COMPETITIVENESS

Barbara **Fura,** PhD (ORCID: 0000-0002-9601-6634) – *University of Rzeszów*

Correspondence address:
Ćwiklińskiej Street 2, 35-601, Rzeszów, Poland
e-mail: bfura@ur.edu.pl

ABSTRACT: This article presents a methodological basis of the project "Environmental Initiatives and Factors of Competitiveness in Companies" with reg. no. 2016/23/D/HS4/03007. The project is funded by the National Science Centre as a part of the SONATA 12 Contest. The aim of the project is to determine the relationship between environmental initiatives and the competitiveness of companies. Both primary and secondary statistical data was used for the project. This article describes the main project assumptions, research thesis, manner of acquiring the empirical data and statistical analysis of such data. The attention was also paid on difficulties and limitations which occurred when conducting the research.

KEY WORDS: environmental initiatives, factors of competitiveness, companies

 https://**doi.org**/10.34659/2020/2/12 JEL: O44, B41

Introduction

The effectiveness of scientific research is determined by proper preparation and implementation of the research project. Each research project, irrespective of the scientific problem to be solved, should consist of specific elements. Apart from the research problem, defined on the basis of the review of literature, they also include a scientific aim of the project, a concept, research theses/hypotheses, a research plan, methodology and a cost estimate. When implementing a research project, the researcher must answer the following questions: what to research, how to research and why is the problem raised by the researcher important?

It is also essential for the project to have a theoretical underpinning, and its results should fill the gap in knowledge or extend the current knowledge. Thus, the project has the chance to develop a specific scientific field and a scientific discipline. Apart from the theoretical contribution to such development, the research project should also have an application value.

The aim of this article is to present the methodological basis of the project: "Environmental Initiatives and Factors of Competitiveness in Companies" as exemplary research conducted throughout Poland into a representative sample.

Subject and main assumptions of the project

Business activities of companies bring economic growth and development which stimulate the creation of new technologies, an increase in income and improvement of the quality of life of societies (Stec et al., 2014, p. 505). Innovative, resource-saving manufacturing methods and techniques are developed, and the growth in income of societies supports the increase of demand for services provided by the natural environment (Tisdell, 2001, p. 190).

Apart from the beneficial effect on the social and economic growth and development, the quality of life, innovation level and on the development of new knowledge and technology, the broadly understood progress has also a dark side. It manifests itself in the polarisation of societies, in the phenomenon of exclusion as well as in natural environment pollution. The excessive pressure on the environment causes, inter alia, in global climatic changes, the degradation of the ozone layer, acid rains and the degradation of drinking water resources (Czaja, Becla, 2011, p. 26). In order to prevent such changes, pressure is put on business entities to limit their adverse effects on the broadly understood surroundings. The legal restrictions, norms, orders and bans issued against active business entities initially were a heavy burden for

them as they constituted, above all, an additional expense. Over time, test results have shown that although the compliance with environmental regulations pushes up additional costs, the companies may, however, decrease their costs in other areas of their activities (e.g. Saxena, Khandelwal, 2012, p. 555; Stanwick, Stanwick, 1998, p. 195-197).

Research gap, aim and thesis

With the changing attitude of companies to the issues concerning natural environment protection, there appears a question about whether a company may improve its competitiveness through undertaking activities for the benefit of natural environment protection (Riillo, 2017, p. 626-627). Such a problem has not been widely examined so far, especially in Polish literature. What is more, in the literature concerning this subject there is no consensus or clear indication about a possible mechanism which would lie at the root of such an interaction (Kudłak, 2010; Li et al., 2019).

The presented research fills the research gap by diagnosing the interaction between environmental activities of companies and their competitiveness. In the study, competitiveness was measured through its priorities/factors (Awwad et al., 2013, p. 71) including quality, delivery, flexibility and costs. Such priorities are understood as dimensions of the company production system necessary to meet the requirements of the market in which the company competes. *Quality* means a low rate of product defects, reliability of operation, compliance with standards and a low level of harmfulness/no harmfulness to the natural environment. *Delivery* is an issue connected with time. It describes how quickly the product is supplied to the client. *Flexibility* means the ability of the production system to adjust to changes in designing and planning the production volume and diversity. *Costs* represent the ability to effectively manage production costs.

The research takes into account (Leoński, 2016, p. 46-53; Schoenherr, 2012, p. 116-128) activities undertook for the benefit of environmental protection/initiatives such as pollution prevention (i1), material recycling (i2), reduction of produced waste (i3), reduction of fuel and energy consumption (i4) and reduction of water consumption (i5).

The aim of the research was to describe the relationship between environmental initiatives and factors of competitiveness in companies, taking into consideration qualitative and quantitative features of companies and the level of the social and economic development of Polish macroregions. The research results allowed to verify the research thesis:

T: The relationships between environmental initiatives and factors of competitiveness in companies are determined by the social and economic development level of the Polish macroregions and qualitative and quantitative features of the companies. This thesis is a generalization of four research hypotheses verified in the project.

The theoretical frames of the research were determined by a resource-based view of the firm (RBV) represented mainly by Barney (1991). The research considers environmental initiatives as potentially valuable, rare, inimitable and non-substitutable (VRIN) resources. The diverse effect of the influence of environmental initiatives on competitiveness priorities was substantiated based on the theory of performance frontiers (TPF) by Schmenner and Swink (1998).

Both secondary and primary statistical data had to be applied to achieve the research aim and to verify the research thesis.

Methods of acquiring and analyzing primary data

The research was nationwide. When selecting the territorial area of the research, the intention was to conduct comprehensive research which would enable international comparisons. The research covered companies from seven macroregions of Poland, i.e. southern, north-western, south-western, northern, central, eastern and Masovian Voivodeship macroregions according to the NUTS 1 division in Poland, as valid from 1.01.2018 (Regional Statistics, 2018).

The statistical population included 21 317 entities conducting business operations which as of 21.01.2018 were classified in the Emerging Markets Information Service (EMIS, 2018) in the production sector (31 according to the North American Industry Classification System – NAICS). For the above-mentioned statistical population, the minimum size of the sample was assessed to include 1 016 entities (Sample Size Calculator, 2018). The sample which was representative due to the number of companies registered in the macroregions was drawn by using an on-line generator of random numbers (Random Number Generator, 2018). The response rate was 76.8%.

The necessary primary data which came from own research was obtained on the basis of a research tool – questionnaire. Exemplary surveys using a questionnaire, survey form/interview and concerning environmental activities of companies are available, inter alia, in (Hadryjańska, 2015, p. 442-448; Rojek-Nowosielska, 2017, p. 189-195; Schoenherr, 2012, p. 126). The companies assessed their degree of involvement in environmental initiatives according to the Likert scale with values from 1 to 5, where 1 – a very low

degree of involvement, 5 – a very high degree of involvement. Similarly, the companies assessed their performance concerning the above-mentioned competitiveness priorities. *Quality* was described though variables: product characteristics, product efficiency, perceived general product quality; *delivery* was described through the assessment of its conditions concerning order placement efficiency, time of supply, conformity of products to the order; *flexibility* – through the flexibility of supply, flexibility in changing the production volume, flexibility in offer adjustment; *costs* – through direct manufacturing costs, total production costs of materials for production and costs of environmental protection.

Just like in case of environmental initiatives, the five categories of the Liker scale were also used to assess the degree of company investment in competitiveness factors (1 – a very low degree of investment, 5 – a very high degree of investment). The research was conducted mainly by applying *computer-assisted telephone interviewing* (CATI). Some companies took part in the survey by filling in on-line questionnaires (Questionnaire survey, 2018) or questionnaires in a paper version.

The empirical analysis of the primary data was based on Mann-Whitney and Kruskal-Wallis tests. The Mann-Whitney test is a non-parametric equivalent of the Student's t-test applied in case of two comparative groups, and the Kruskal-Wallis test is a non-parametric equivalent of a variance analysis applied in case of three or more groups (Aczel, 2000, p. 716-719). Unlike their parametric equivalents, the tests do not require many restrictive assumptions (Jóźwiak, Podgórski, 2012, p. 280).

The above-mentioned tests were used in the research to diagnose various degrees of involvement of companies in the above-mentioned environmental initiatives, depending on company features such as export (yes/no), ISO 14001 (yes/no), ISO 9001 (yes/no), company size, Polish Classification of Activities (PKD), territorial area of conducting activities, origin of company capital. If the Kruskal-Wallis test was significant, then a post hoc analysis was used additionally to indicate different groups (Stanisz, 2006, p. 386).

As the next step, dependencies between qualitative variables were analyzed on the basis of a chi-squared test. When making decisions in the chi-squared test, the right-tailed critical region was taken into account ($\chi^2 \geqslant \chi^2_\alpha$). Statistics χ^2_α is a critical value read from the chi-squared distribution table for the assumed significance level α and for $(r - 1)(s - 1)$ of the degrees of freedom, where r is the number of options of the first feature and s – the number of options of the second feature. The calculated value of the test statistics χ^2 is comparable to the critical value χ^2_α and if the inequality $\chi^2 \geqslant \chi^2_\alpha$ is true, for the assumed significance level α, the null hypothesis (H_0: the tested features are independent) is rejected in favour of the alternative hypothesis

(H_1: the tested features are not independent). But in case of the opposite inequality ($\chi^2 < \chi^2_\alpha$), there exist no grounds for rejecting H_0, which means that the tested features are independent (Jóźwiak, Podgórski, 2012, s. 337).

To measure the strength of the above-mentioned dependencies, Cramer's V was used. It is a normed and dimensionless quantity with values between [0,1]. If the value of Cramer's V is 0, then there is no dependence between the features, if *V=1*, the features are dependent. The closer to the unity Cramer's V is, the stronger the dependence is.

The scope of testing features on weakest scales may be extended to include the results of the correspondence analysis. Its good point is the possibility to show a clear, graphic presentation of the co-existence of variable categories. It is possible thanks to marking points which depict feature categories on one-, two- and three-dimensional coordinate systems, and as little as possible information about the actual structure of relationships is lost (Stanimir, 2008, p. 337-338).

The correspondence analysis has two variants, i.e. a simple correspondence analysis and a multiple or multivariable correspondence analysis. The simple correspondence analysis serves for visualization of relationships between two nominal features included in the form of a contingency table. The simple correspondence analysis may be expanded by the multiple correspondence analysis, which is used for the analysis of more than two nominal features (Górniak, 2000, p. 117). The correspondence analysis was applied for clarifying statistically significant dependencies between the level of involvement of companies in preventing pollution (i1) and material recycling (i2), and the financial situation of companies (good/bad situation).

It was assumed in the research that both environmental initiatives and factors of competitiveness are latent (non-observable) variables. A latent variable is a variable which has no established indirect measure procedures and is measured directly through observable indicators (Sagan, 2000, p. 53). Structural equation modelling (SEM) was used to build the model indicating the influence of environmental initiatives on factors of competitiveness in companies.

The role of the dependent variable was fulfilled by factors of competitiveness in companies, and the role of the independent variable was fulfilled by environmental initiatives (i1–i5). Before the analysis, the reliability of measurement scales which measure specific factors of competitiveness *(quality, delivery, flexibility and costs)* and environmental initiatives (i1–i5) were verified by using Cronbach's α.

Due to the lack of the multivariate normal distribution of pointer variables and the application of ordinal variables to assess the models of confirmatory factor analysis (CFA) and output structural models, the diagonally

weighted least squares (DWLS) method was applied (French, Finch, 2015, pp. 60-62). The necessary calculations were made in the R non-commercial program (*R Core Team*, 2016).

The degree of the adjustment of theoretical models to empirical data was assessed through a series of both absolute measures (e.g. statistics χ^2, root mean square error of approximation (RMSEA), (standardized) root mean square residual ((S)RMR)) and relative measures (e.g. (non) normed fit index ((N)NFI), comparative fit index (CFI)) (Januszewski, 2011, p. 240-241; Konarski, 2009, p. 345-357).

The application of the CFA allowed deciding on the structure of the resultant assessed model. However, when building structural models, it should be remembered that the starting point should always be a theory concerning the surveyed phenomenon (French, Finch, 2015, p. 60-62). It allows us to avoid errors in the model specification, which are hard to be corrected (Bedyńska, Książek, 2012, p. 162). It is the theory which is the basis for determining the variables taken into account in the model and for dependencies occurring between them.

Methods of acquiring and analyzing secondary data

Two types of secondary data were used in the research. One of them was pointer variables characterizing the social and economic situation of Polish macroregions in the year 2017. The source of data about the macroregions was public statistics (GUS, 2017; GUS, 2018a; GUS, 2018b). When surveying into the level of macroregion development, the following areas were taken into consideration (Borys, 2014, p. 14): *1.* Demography, labour market, population income, *2.* Technical infrastructure and environmental protection, *3.* Social infrastructure, *4.* Agriculture and forestry, *5.* Entrepreneurship, innovations, R&D. The areas were represented by a total of 51 features which were initially selected using in the first place the criterion of sufficient variation of features. At that stage, 19 variables whose variation level was lower than 10% were rejected. The remaining variables were put through correlation verification which was conducted on the basis of the inverse correlation matrix (Młodak et al., 2016, p. 4-5). The application of such a method resulted in a rejection of the next 7 features. Finally, a set of 25 features were obtained, and they included stimulants (21 variables) and destimulants (4 variables).

Such variables were used to determine the synthetic measure, which expresses the level of macroregion development in each of the above-mentioned areas of development. An arithmetic mean of the synthetic measures of each area gave the final measure of the level of macroregion development. The synthetic measures in the areas *1–5* were determined by using a stand-

ard method suggested by Z. Hellwig (1968) and the zero unitarization method (Kukuła, 2012). Both the methods belong to a group of multivariate methods called a multivariate comparative analysis (MCA). The MCA enables analysis of complex objects and phenomena, i.e. when many features (variables) and factors have an influence on the state and behaviour of such objects and phenomena at the same time (Bąk, 2016, p. 24).

The method proposed by Z. Hellwig includes the determination of the taxonomic distance from the standard, which is an abstract unit having the most favourable values of each of the features. Specific stages of the standard development method were included in the following points (Bąk, 2016, p. 26; Stec, 2017, p. 72-73; Malina, 2004, p. 73):

1. Creation of the observation matrix of diagnostic features.
2. Normalization (standarization) of features.
3. Determination of the abstract object (development standard).
4. Determination of a distance from the standard for each object.
5. Determination of the arithmetic mean of the Euclidean distance.
6. Determination of the synthetic measure of development.

The development measure achieves values ranging [0,1]. The closer to the unity the measure values the more closely they are to the standard the assessed object is, i.e. the higher position has the object (macro-region) in the ranking.

The zero unitarization method, just like the standard development method by Z. Hellwig, is a comparison of many objects through selected criteria. The criteria may be expressed through various quantities (Kościółek, 2015, p. 195). The aim of the zero unitarization method is to normalize the examined criteria.

Normalization of variables is based on formulas:

for stimulants:

$$z_{ij} = \frac{x_{ij} - \min_i\{x_{ij}\}}{R_j}, \tag{1}$$

for destimulants:

$$z_{ij} = \frac{\max_i\{x_{ij}\} - x_{ij}}{R_j}, \tag{2}$$

where is a range calculated from the following formula:

$$R_j = \max_i\{x_{ij}\} - \min_i\{x_{ij}\}. \tag{3}$$

The unitarization formulas ensure a varied variance and, also a constant range of normalized values of all features. The synthetic measure, according to the zero unitarization method, is calculated as an arithmetic mean of normalized values of diagnostic features. The synthetic development measure determined in this way, just like the Z. Hellwig's measure, has values ranging [0,1].

In the next stage of the procedure of the macroregion development assessment, the concordance of the results obtained using both the methods was analyzed. In order to compare the concordance of the synthetic measure values, the Pearson correlation coefficient was used and to compare the concordance of the obtained rankings, the Spearman's rank correlation coefficient was used (Bąk, 2016, p. 29).

The second type of secondary data used in the research is financial data from financial statements of the companies which are available in the EMIS base. In this way, information about liquidity, profitability, debt level and business efficiency was obtained, and then the financial situation of the companies in the years 2012-2017 was assessed. Such an assessment was made by using the E. Mączyńska discriminant function.

Just like other accessible discriminant models, such a function, thanks to the aggregation of various financial ratios which are assigned with weights expressing the role of a given variable in the synthetic resulting figure, enabled the division of the companies into entities having a good or bad financial situation (Bombiak, 2010, p. 145). The function has the following form (Mączyńska, 1994, p. 46-49):

$$ZM = 1{,}5X_1 + 0{,}08X_2 + 10{,}0X_3 + 5{,}0X_4 + 0{,}3X_5 + 0{,}1X_6\,, \qquad (4)$$

where:
X_1 – (gross profits+depreciation)/liabilities and provisions for liabilities,
X_2 – assets/liabilities and provisions for liabilities,
X_3 – gross profits/assets,
X_4 – gross profits/sales revenues,
X_5 – inventory/sales revenues,
X_6 – sales revenues/assets.

$ZM \leq 0$ means that the company is in danger of bankruptcy and $ZM \in (0,1)$ means that the company has a poor financial situation but is not in danger of bankruptcy. If $ZM \in [1,2]$ it means that the company has a good financial situation. And if $ZM > 2$, then the company is in a very good financial condition.

Conclusions

The assumed procedures of gathering and analyzing primary and secondary data allowed to create a database which was used to make reliable statistical analyzes. Ensuring the representativeness of the sample allowed to generalize the obtained results to the whole statistical population, i.e. manufacturing companies in Poland.

The research confirmed the influence of environmental initiatives on the competitiveness of companies. Such an influence depended mainly on the financial situation of the companies and on the level of macroregion development as well as on the selected features of the companies. A greater effect in terms of the influence of environmental initiatives on the improvement of the factors of competitiveness was observed in companies located in macroregions which are worse developed than in companies from macroregions which are better developed. Benefits from environmental initiatives also depended on the financial situation of the companies. Entities in a better financial situation may expect a greater effect in the form of improvement of competitiveness than entities which are in a bad situation.

The competitiveness improvement in terms of the quality of produced goods offered supply conditions, the flexibility of production and manufacturing costs are observed to a greater extent in companies operating on a larger territorial area, in companies with mostly external capital and in exporters.

This article is an example of a research project which may be useful to people preparing concepts of own research original scientific projects. However, the presented tests are not free from limitations. Firstly, to measure the degree to which the company is involved in initiatives and to determine the significance of competitiveness priorities, opinions of the companies were taken into account. For both the measures most companies assessed themselves well or very well. A small number or even lack of negative assessments casts doubt on the reliability of the assessments. Also, such a lack of poor assessments made it difficult to fully verify the advanced thesis.

Acknowledgements

This research has been supported by the National Science Center within the framework of the project No. 2016/23/D/HS4/03007 *Environmental initiatives and competitive factors of enterprises*.

References

Aczel, A.D., 2000. Statystyka w zarządzaniu. Pełny wykład. Wydawnictwo Naukowe PWN, Warszawa.

Awwad, A.S., Khattab, A.A., Anchor, J.R., 2013. Competitive Priorities and Competitive Advantage in Jordanian Manufacturing. Journal of Service Management, 6(1), 69-79, https://doi:10.4236/jssm.2013.61008.

Barney, J., 1991. Firm Resources and Sustained Competitive Advantage. Journal of Management, 17(1), 99-120, https://doi.org/10.1177/014920639101700108.

Bąk, A., 2016. Porządkowanie liniowe obiektów metodą Hellwiga i TOPSIS – analiza porównawcza. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 426, 22-31, https://doi:0.15611/pn.2016.426.02.

Bedyńska, S., Książek, M., 2012. Statystyczny drogowskaz 3. Praktyczny przewodnik wykorzystania modeli regresji oraz równań strukturalnych. SWPS, Warszawa.

Bombiak, E., 2010. Modele dyskryminacyjne jako metoda oceny sytuacji finansowej przedsiębiorstwa. Zeszyty Naukowe Akademii Podlaskiej w Siedlcach. Seria: Organizacja i Zarządzanie, 86, 141-152.

Borys, T., 2014. Wybrane problemy metodologii pomiaru nowego paradygmatu rozwoju – polskie doświadczenia. Optimum. Studia Ekonomiczne, 3(69), 3-21.

Central Statistical Office (GUS), 2017. Statistical Yearbook of Industry – Poland, Warszawa.

Central Statistical Office (GUS), 2018a. Statistical Yearbook of the Regions – Poland, Warszawa.

Central Statistical Office (GUS), 2018b. Polish Regions, Warszawa.

Czaja, S., Becla, A., 2011. Czterech jeźdźców ekologicznej zagłady we współczesnym świecie. In: Kryk, B. (Ed.), Trendy i wyzwania zrównoważonego rozwoju. Wydawnictwo Zapol, Szczecin, 35-49.

Emerging Markets Informative Service (EMIS), https://www.emis.com/php/companies/quick-screener/screener?subp= [21-01-2018].

French, B.F., Finch, W.H., 2015. Latent Variable Modeling with R. Routledge, New York-London.

Górniak, J., 2000. Zastosowanie analizy korespondencji w badaniach społecznych i marketingowych. ASK, 9, 115-134.

Hadryjańska, B., 2015. Ekologizacja procesu produkcji a kształtowanie konkurencyjności w przedsiębiorstwach przetwórstwa mleczarskiego. PTE Oddział w Poznaniu, Poznań.

Hellwig, Z., 1968. Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom rozwoju oraz zasoby i strukturę wykwalifikowanych kadr. Przegląd Statystyczny, 15(4), 307-326.

Januszewski, A., 2011. Modele równań strukturalnych w metodologii badań psychologicznych. Problematyka przyczynowości w modelach strukturalnych i dopuszczalność model. Studia z Psychologii w KUL, 17, 213-245.

Jóźwiak, J., Podgórski, J., 2012. Statystyka od podstaw. PWE, Warszawa.

Konarski, R., 2009. Modele równań strukturalnych. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa.

Kościółek, M., 2015. Wykorzystanie analizy wielowymiarowej do badania zróżnicowania potencjału innowacyjnego Polski. Metody Ilościowe w Badaniach Ekonomicznych, 16(3), 194-201.

Kudłak, R., 2010. Wpływ ochrony środowiska na konkurencyjność. Gospodarka Narodowa, 1-2, 109-125.

Kukuła, K., 2012. Propozycja budowy rankingu obiektów z wykorzystaniem cech ilościowych oraz jakościowych. Metody Ilościowe w Badaniach Ekonomicznych, 13(1), 6-13.

Leoński, W., 2016. Ekologiczne aspekty społecznej odpowiedzialności biznesu. Studia i Prace WNEiZ US, 43(1), 46-53, https://doi:10.18276/sip.2016.43/1-04.

Li, G. et al., 2019. How green technological innovation ability influences enterprise competitiveness. Technology in Society, 59, https://doi.org/10.1016/j.techsoc.2019.04.012.

Malina, A., 2004. Wielowymiarowa analiza przestrzennego zróżnicowania struktury gospodarki Polski według województw. Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

Mączyńska, E.,1994. Ocena kondycji przedsiębiorstwa (Uproszczone metody). Życie Gospodarcze, 38, 42-45.

Młodak, A., Józefowski, T., Wawrowski, Ł., 2016. Zastosowanie metod taksonomicznych w estymacji wskaźników ubóstwa. Wiadomości Statystyczne, 2(657), 1-24.

Questionnaire survey, https://goo.gl/forms/wthVpMI1DhMjcx132 [15-02-2018].

R Core Team, 2016. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org/

Random Number Generator, https://generujemy.pl/losowa_liczba [25-01-2018].

Regional Statistics, https://stat.gov.pl/statystyka-regionalna/jednostki-terytorialne/klasyfikacja-nuts/klasyfikacja-nuts-w-polsce/ [03-01-2018].

Riillo, C.A., 2017. Beyond the question "Does it pay to bee green?": How much green and when? Journal of Cleaner Production, 141(10), 626-640, https://doi.org/10.1016/j.jclepro.2016.09.039.

Rojek-Nowosielska, M., 2017. Społeczna odpowiedzialność przedsiębiorstw. Model-diagnoza-ocena. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław.

Sagan, A., 2000. Wybrane problemy identyfikacji i pomiaru struktur ukrytych. Zeszyty Naukowe Akademii Ekonomicznej w Krakowie, 54, 53-64.

Sample Size Calculator, https://www.naukowiec.org/dobor.html [20-01-2018].

Saxena, R.P., Khandelwal, P.K., 2012. Greening of industries for sustainable growth: An exploratory study on durable, non-durable and services industries. International Journal of Social Economics, 39(8), 551-586, http://dx.doi.org/10.1108/03068291211238437.

Schmenner, R.W., Swink, M.L., 1998. On the theory in operations management. Journal of Operations Management, 17(1), 97-113, https://doi.org/10.1016/S0272-6963(98)00028-X.

Schoenherr, T., 2012. The role of environmental management in sustainable business development: A multi-country investigation. International Journal of Production Economics, 140(1), 116-128, https://doi.org/10.1016/j.ijpe.2011.04.009.

Stanimir, A., 2008. Wykorzystanie analizy korespondencji w badaniach marketingowych. Zastosowania metod statystycznych w badaniach naukowych. StatSoft Polska, Kraków.

Stanisz, A., 2006. Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny, t. 1: Statystyki podstawowe. StatSoft Polska, Kraków.

Stanwick, P.A., Stanwick, S.D., 1998. The Relationship Between Corporate Social Performance, and Organizational Size, Financial Performance, and Environmental Performance: An Empirical Examination. Journal of Business Ethics, 17, 195-204.

Stec, M., 2017. Taksonomiczna analiza poziomu rozwoju społeczno-gospodarczego województw Polski. Studium przypadku – województwo podkarpackie. Wydawnictwo Uniwersytetu Rzeszowskiego, Rzeszów.

Stec, M. et al., 2014. Socio-Economic Development in the EU Member States – Concept and Classification. Engineering Economics, 25(5), 504-512, http://dx.doi.org/10.5755/j01.ee.25.5.6413.

Tisdell, C., 2001. Globalization and sustainability: environmental Kuznets curve and the WTO. Ecological Economics, 39, 185-196, https://doi.org/10.1016/S0921-8009(01)00234-8.

ENVIRONMENTAL POLICY AND MANAGEMENT

POLITYKA EKOLOGICZNA I ZARZĄDZANIE ŚRODOWISKIEM

Ryszard JANIKOWSKI

TRANSFORMATION TOWARDS A CIRCULAR ECONOMY IN THE POLISH ARMED FORCES

Ryszard **Janikowski,** Prof. (ORCID: 0000-0001-8233-2049) – *General Tadeusz Kościuszko Military University of Land Forces*

ABSTRACT: This paper is an analysis of the existing economic situation, referred to as the circular economy, of the armed forces during peacetime. This economic approach is often indicated as the target model in civilian areas and activities within the "European Defence Action Plan." The analyses carried out in this study demonstrate that some European armed forces, including the Polish one, actually realise circular economic requirements, namely creation of closed loops of material flow, slowing resources flow and using fewer materials. Some of these economic principles are typical for the military sector, such as "outdated" ammunition in civilian use. The above findings demonstrate the transformation towards a circular economy in the armed forces during peacetime.

KEY WORDS: circular economy; sustainable development; defence sectors

Introduction

During peacetime, economies of the armed forces (AF) of the Republic of Poland, NATO members, and other EU states, are currently not required to definitively base their actions on circular economy guidelines. They are, however, gradually leaving the linear economy model. For this reason, the aim of the paper is to examine the existing state of the circular economy in the armed forces. Furthermore, the necessity of this study and analyses directly stems from the *Strategy for Responsible Development*, adopted by the Polish government in 2016, and the *Priorytetowe Kierunki Badań w Resorcie Obrony Narodowej na lata 2013-2022* project (Priority Research Directions in the Ministry of National Defence for 2013-2022). This study also aims at fulfilling the goals of the European Commission as listed in "The European Defence Action Plan" (EDAP), the objectives of the European Defence Agency (EDA) and the *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Region* (COM(2015) 614 final).

Circular economy

"Circular economy is a concept aimed at rational use of resources and limiting the negative environmental impact of manufactured products, which – just as materials and raw materials – should be used in the economy for as long as possible and the production of waste should be minimised as far as possible" (https://www.gov.pl/web/srodowisko/goz, 31-07-2019). This definition has been uploaded to the website of the (Polish) Ministry of Environment. The essence of the circular economy lies in treating a product at each subsequent stage of its life as secondary raw material and not as a waste product (Kirchherr, Reike, Hekkert, 2017). The above statement is not ground-breaking, as it has been stated and published previously (Janikowski, 1999). Currently, system-based thinking is living through its renaissance (Janikowski, 2017a, 2017b). However, it has appeared before date (as illustrated by, e.g. Polski Ruch Czystszej Produkcji (The Polish Cleaner Production Movement Society), Rozszerzona Odpowiedzialność Producenta (Extended Producer Liability), Społeczna Odpowiedzialność Biznesu (Corporate Social Responsibility). However, the form used to be largely dispersed substance-wise and applied to various fields, also military (Soufani et al., 2018a; Soufani et al., 2018), as retardation, circular flow of treated post-industrial wastewater, remediation, and recultivation, etc. (Janikowski, 2013).

It is crucial to state that the basic concept of a circular economy, also in the armed forces, must be founded on the following rules:

- creating closed loops of material flow,
- slowing down the flow of materials,
- limiting the amount of materials in the flow.

The economy in the armed forces

Abandoning the linear economy model in the armed forces is a slow process. Thus, it is essential to follow the rules and mechanisms that would accelerate it. Concerning the circular economy in the armed forces (CEAF), the first phase of implementing this idea has to focus on closing the loop of material flow. The linear model, "take-make-dispose", is based on large quantities of (economically) cheap and easily accessible raw materials and energy (Degórski, 2018). It stands in contradiction with the general economic rules at the present state of civilisation development. Management of this sector of the economy (armed forces during peacetime) should also follow the trail of other sectors of the Polish national economy. An equally important stimulant of economic changes, especially in military areas, is the deepening cooperation with NATO forces and the emerging global deficit of raw materials, both being of paramount importance for the military. These are, among others, lanthanides, tungsten, lithium and cobalt, so resources essential for high-level IT technologies (e.g., hard drives) and specialist steel used for military purposes (e.g., cannon barrels) or batteries (e.g., propulsion for drones).

In the fourth industrial revolution, securing permanent and continuous access to these mineral resources (both energy and non-energy) (Pavel, Tzimas, 2016) is a fundamental developmental factor for the military, armament and equipment (MAE). This is commonly outlined in planning documentation in the EU and Poland, and in the Ministries of Defence of the USA and Russian Federation. Many mineral resources are concentrated in only one area of the globe (e.g. China) with minimal options of substitution. For this reason, the European Commission is preparing and updating a list of resources (non-energy) which are of high-risk delivery stability and of significant economic importance. The constant and unlimited access to these resources is essential for European industries. In September 2017, the EC published this list and highlighted that 27 out of 78 analysed raw materials are deemed critical; it means they are essential for the harmonious and sustainable economic development and technological progress of all EU countries (COM (2017) 490 final). Abandoning the open, linear economy and wide use of secondary materials is a reaction to limiting the availability of raw materials.

The case of electronic waste may serve as an example of the importance of this approach for the military sector. Electronic waste contains noble metals (gold, silver, platinum), although in trace amounts, and – what is more important and valuable – metals known as *Rare Earth Elements* (REE) (Grasso, 2013) and tungsten. Improved communication, information and military technologies generate greater technological significance for these elements and rapidly increases their demand (Grasso, 2013). China holds a monopoly on obtaining and producing REE. The Chinese authorities noticed this fact and used it as a strategical weapon in geopolitics.

Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030) (SRD) formulates rules, goals and detailed activities of the new state development policy. It is directed at promoting structural changes on Poland's competitiveness factors and ensuring participation in the growth and increasing the quality of life for all Polish citizens. It is explicitly associated with engaging the Polish armed forces in the modern civilisation trend of shaping their development. As with other sectors of the national economy, the military sector during peacetime has to conform with the rules laid out in Article 5 of the Constitution: "The Republic of Poland shall safeguard the independence and integrity of its territory and ensure the freedoms and rights of persons and citizens, the security of the citizens, safeguard the national heritage and shall ensure the protection of the natural environment pursuant to the principles of sustainable development."

The concept of sustainable growth clearly points to a change from a linear to a circular economic model. This is also reflected in the *Polish Raw Material Policy*, especially in its second pillar, based on the activities listed below, namely "obtaining raw materials from waste, raw material substitution along with recultivation and remediation (...).

2.1.2. Identification and classification of raw materials obtained from waste, along with directing their use.

2.2. Development of obtaining raw materials from waste:

2.2.1. Support for preparing and implementing technological solutions that reduce the amount of raw material required and waste products as well as technologies for processing waste;

2.2.2. Defining the category of critical raw materials to support selective waste collection that may provide raw materials;

2.2.3. Other activities related to recovering raw materials from waste, including the development of processing technologies;

2.2.4. Implementing the system of mandatory collection of waste containing valuable raw materials (especially strategic and critical) (in relation to Pillar 3 tasks)" (Polish Raw Material Policy, 2018).

The Subpillar 2.2.4 should be strictly followed by (Polish) armed forces in all military units. In other words, it is analogous to a "green military office", e.g., recycling toners, cartridges, paper, light sources and using a professional shredder (norm DIN 66399), satisfying the *General Data Protection Regulation* provisions. While the documents are shredded, a specific type of waste is accumulated, which is actually beneficial for further processing.

Another item/resource that should abide by the rules of CEAF is the real estates occupied by military training areas/units. After their use and optional degradation (*brownfields)* by the AF, they should not be left to fallow, but rather recycled by proper recultivation and restoring to their natural state (*greenfields*).

Poland shows a tendency to abandon current military properties and grant civilians access to them for further "green" use. The programme entitled *Recultivation for environmental purposes of degraded, post-military and post-military training areas managed by PGL State Forests* (Table 1) may serve as an example. "The primary goal of the endeavour was to eliminate the threat to human health and life in areas managed by State Forests. Therefore, the first activities within the project involved exploration and demining, which required the use of over 60% of the total costs of the project (underlined by author). The remaining amounts were assigned to completing recultivating projects submitted by forest inspectorates" (http://www.ckps.lasy.gov.pl/skala-przedsiewziecia#.XUmYAHvgo2w, 31-07-2019).

The above statements are in line with the theoretical assumptions (Janikowski, 2013), so a system in which three basic categories of land use are outlined:

A – strongly subject to anthropogenic factors,
L – half-natural (forest, agricultural),
N – strongly subject to natural factors,
and the total finite area equals to:

$$S = A + L + N,$$

the following rules have to be followed:

$$\rho, \varpi \rightarrow 1, \quad (1)$$

$$\alpha, \beta \rightarrow 1, \quad (2)$$

$$\delta, \gamma \rightarrow 0, \quad (3)$$

$$\xi = 0, \quad (4)$$

where:
$\rho = x^A/A$, $\varpi = x^L/L$ – size of the recoverable area, used again within A and L categories (land recycling),
$\alpha = x^A/A$, $\beta = x^L/L$ – size of the area obtained from categories A and L, respectively,
$\delta = x^L/L$, $\gamma = x^N/N$ – size of the area obtained from categories L and N, respectively,
$\xi = x^N/N$ – size of the area obtained from category N,
x^k – size of the area obtained from a specific category k = {A, L, N}.

Table 1. Recultivation for environmental purposes of degraded, post-military and post-military training areas managed by PGL State Forests

No.	Forest inspectorate	No.	Forest inspectorate	No.	Forest inspectorate
1	Drygały	20	Jedwabno	39	Czarnobór
2	Choczewo	21	Przasnysz	40	Bydgoszcz
3	Elbląg	22	Spychowo	41	Gniewkowo
4	Kolbudy	23	Strzałowo	42	Solec Kujawski
5	Chrzanów	24	Wipsowo	43	Włocławek
6	Kłobuck	25	Okonek	44	Żołędowo
7	Koszęcin	26	Wałcz	45	Chojnów
8	Rudziniec	27	Łopuchówko	46	Chocianów
9	Siewierz	28	Piaski	47	Jawor
10	Tułowice	29	Stąporków	48	Kamienna Góra
11	Lubaczów	30	Włoszczowa	49	Przemków
12	Mielec	31	Barlinek	50	Świętoszów
13	Tuszyma	32	Chojna	51	Złotoryja
14	Brzeziny	33	Kliniska	52	Gubin
15	Grotniki	34	Międzychód	53	Lubsko
16	Opoczno	35	Międzyzdroje	54	Sulechów
17	Radziwiłłów	36	Resko	55	Świebodzin
18	Skierniewice	37	Skwierzyna	56	Wolsztyn
19	Spała	38	Borne Sulinowo	57	Wymiarki

Source: http://www.ckps.lasy.gov.pl/rekultywacja-poligonow#.XUGfCXvgo2w [31-07-2019].

"Infinite" reusing

Ammunition, just like many other items/products, has a particular expiry date, prior to which it can be used in an effective and efficient manner (Ferreira et al., 2019). After that date, it was usually "destroyed." However, current CEAF regulations have changed the end-use of ammunition, from its original military application to civilian usage (mining, building, demolition, etc.) To do so, proper methods of regaining the explosive materials have to be applied. A similar approach has to be assumed towards military food rations past their expiry date.

Textile waste

Each soldier has a legal right to a proper uniform assortment (Regulation of the Minister of National Defence of 31 October 2014 on uniforms and equipment of active-duty soldiers and candidate soldiers (Journal of Laws of 2014, item 615 – annex no. XXX). In Poland, each year, this generates 100 thousand sets of uniforms. This number fluctuates and is closely tied to the number of active-duty soldiers in Poland (in the next two decades, it may reach 200 thousand soldiers). There are also normative periods of wear, after which the uniform and equipment (according to the law) become the soldier's property. It means that the administration of the AF is not responsible for the fate of this textile waste. It also entails that textile waste around military units becomes spatially dispersed.

From several perspectives, transferring the ownership of uniforms to their current user is inappropriate and should be forbidden. This addresses several perspectives on the flow of waste, particularly:

- Sustainability (sustainable growth) (EC 2016), where in the life cycle of a product the waste stage is also important, {where in the context of a specific (basic) need the product becomes unusable}; however, it is possible to still successfully use it on the next stage (secondary raw material).
- Spatio-environmental, on the quantitative spatial concentration of a homogenous secondary raw material. Satisfying this requirement prevents disorganised and chaotic landfills (concentrated waste) in any location.
- Circular economy, which ensures that the generated waste returns to the economic flow for further use (Pardo, Schweitzer, 2018).
- Resource perspectives, which make sure that the environmental resources will be used in an economic cycle once obtained.

- Homogenous waste flow, which entails that the emerging sub-streams of waste will not be mixed together; on the contrary, homogenous waste flows will be permanently outlined.
- Raw materials, where all waste is a source of secondary raw materials, so conditions should be created to make use of this material.
- National security – in the light of current experience with methods of various terrorist groups, it is not inconceivable to assume that those uniforms might be used to clothe the terrorist formations and their soldiers would be mistakenly treated as soldiers of the Polish AF.
- Costs of obtaining waste/secondary raw materials, where minimising the costs of obtaining secondary raw materials results from concentrating the material and its homogeneity.

Standing in contrast to the transfer of uniform ownership to the soldier, collecting this type of waste at military units concentrates the textile secondary raw material for recirculation. Initially, it may appear as unprofitable for the functioning of each military unit. It generates costs of gathering and storing waste, along with disposal costs as quoted by companies specialising in this area. At the end of 2019, this cost reaches 200 PLN/Mg. Furthermore, appropriate consents from environmental and governmental authorities for waste collection need to be obtained. Bearing in mind the significance of the above argumentation, a simple and only possible solution comes to the fore. Collecting, storing and disposing of textile waste should be taken over by specialised internal military teams.

Conclusions

First signs of the transformation of the AF into a circular economy may be observed. It is confirmed by the number of scientific publications and reports on the applied practical solutions. At the same time, analyses point to the fact that implementing the rules of the circular economy, namely *creating closed loops of material flow, slowing down the flow of materials and lowering the number of materials in the flow* requires their in-depth understanding for the application processes. It is crucial to include the trailing effects co-creating the links in the cause-and-effect chain, include its non-linearity and economic efficiency. Simultaneously, it is paramount to use social sensitivity towards shaping sustainable growth and responsibility for the quality of life of later generations at this current initial stage. Thus, the claim "take-make-dispose" should quickly become obsolete in the military sector during peacetime, just as in other state economy sectors.

References

COM(2015) 614 final, 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.

COM(2017) 490 final, 2017. Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów w sprawie wykazu surowców krytycznych dla UE 2017.

Degórski, M., 2018. Gospodarka o obiegu zamkniętym. Circular economy – nowe podejście w rozumieniu relacji człowiek-środowisko. Studia KPZF, t. 183.

European Commission, 2016. Next steps for a sustainable European future – European action for sustainability. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM(2016) 739 final, Strasbourg.

Ferreira, C. et al., 2018. Circular Economy Approach to Military Munitions: Valorization of Energetic Material from Ammunition Disposal through Incorporation in Civil Explosives. Sustainability, 11, 255-261, DOI: 10.3390/su11010255.

Grasso, V.B., 2013. Rare Earth Elements in National Defense: Background, Oversight Issues, and Options for Congress, Congressional Research Service, 7-5700.

Janikowski, R., 1999. Zarządzanie ekologiczne. Akademicka Oficyna Wydawnicza PLJ, Warszawa.

Janikowski, R., 2010, The Dimensions of Sustainable Development. Wydawnictwo Wyższej Szkoły Bankowej, Wrocław.

Janikowski, R., 2013. Retardacja jako element konceptualizacji rozwoju zrównoważonego. Inżynieria Ekologiczna, 34, 5-16.

Janikowski, R., 2017a, Środowiskowe aspekty czwartej rewolucji przemysłowej. Studia i Prace WNEIZ US, 47/2 201, 67-76, DOI: 10.18276/SIP.2017.47/2-06.

Janikowski, R., 2017b, Dilemmas of environmental programming in the context of sustainable development. Ekonomia i Środowisko, 1(60), 49-59.

Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the circular economy: An analysis of 114 definitions. Conservation and Recycling, 127, 221-232, https://doi.org/10.1016/j.resconrec.2017.09.005.

Pardo, R., Schweitzer, J.P., 2018. A long-term strategy for a European circular economy – setting the course for success. Policy Paper produced for the Think 2030 project, Brussels.

Pavel, C., Tzimas, E., 2016. Raw materials in the European defence industry, European Commission, Joint Research Centre, Directorate for Energy, Transport & Climate, Knowledge for Energy Union Unit, doi:10.2790/0444.

Polityka Surowcowa Państwa, Projekt, 2018. Ministerstwo Środowiska, Warszawa.

Regulation of the Minister of National Defence of 31 October 2014 on uniforms and equipment of active-duty soldiers and candidate soldiers (Journal of Laws of 2014, item 615 – annex no. XXX).

Soufani, K. et al., 2018a. A roadmap to circular economy in EU defence inspired by the case of the Dutch Ministry of Defence. The European Financial Review.

Soufani, K., et al., 2018b. Bridging the circular economy and social enterprise: the Dutch Ministry of Defence and Biga Groep. European Business Review.

STUDIES AND MATERIALS

STUDIA I MATERIAŁY

Demetrio Miloslavo **BOVA** • JERZY **ŚLESZYŃSKI**

SUSTAINABLE DEVELOPMENT INDICATORS: THE ITALIAN EQUITABLE AND SUSTAINABLE WELL-BEING APPROACH AND ITS APPLICATION TO THE LOCAL LEVEL

Demetrio Miloslavo **Bova,** MsC (ORCID: 0000-0002-4205-9241) – *University of Warsaw*
Jerzy **Śleszyński,** Prof. (ORCID: 0000-0001-7814-4037) – *University of Warsaw*

Correspondence address:
Magiera Street 4/2, 01-873, Warsaw, Poland
e-mail: demetriombova@gmail.com

ABSTRACT: The aim of this article is to present both the methods through which sustainable well-being is measured on a local level and to improve its adherence to the subjective well-being of the community under study. The first part of the paper introduces the features and the assumptions generally adopted in literature to measure the progress towards sustainable development on a local level with special regards to the role of subjective perception. These assumptions are the basis of the Italian equitable, and sustainable well-being indicators framework (B-BES) used to measure the progress of communities. It was applied to a small Italian town, Ceccano, and was supported by a further innovative survey, the virtual budget, directed to measure the subjective preferences. Thanks to the virtual budget, it was possible to identify differences between the subjective preferences of respondents and the ex-ante results of the B-BES model. The approach used allows for better implementation of indicators on a local level by improving the indicators framework's consistency with the local specificity, preferences and aspirations.

KEY WORDS: sustainable development; sustainable development indicators; indicators for local communities; subjective well-being

Introduction

The indicators of sustainable development proposed for the evaluation of the quality of life within the local community would be better defined in the process of partner-like discussions and negotiations of sustainable development professionals with potential recipients, to whom information on the indicative assessment will be addressed (Chiras, Corson, 1997). The role of external and internal experts consists of informing, moderating consultation, and professional assistance in formulating the final list of indicators. Direct participation in the consultations of all stakeholders and interested parties is a condition for the success of the entire undertaking.

The Scandinavian and British (Strathclyde Sustainability Indicators, 1995; Quality of Life Counts. Indicators for a Strategy for Sustainable Development for the United Kingdom: A Baseline Assessment, 1999) publications and studies showed the character of these indicators and proved that in this approach self-management plays an extremely important role and considers the specificity and preferences of local communities. This was also represented in Polish studies addressing sustainability indicators and their applicability on the local level (Śleszyński, 1997; Borys, 2005a; Borys, 2005b; Gutowska, Śleszyński, 2012; Gutowska, Grodzińska-Jurczak, Śleszyński, 2012). In particular, the multidimensional character of sustainability was underlined by including sociological aspects like the subjective perception of environmental problems (Borys, Rogala, 2008).

The literature review here is not complete but convincingly indicates that two aspects are most important and valuable in formulating suitable indicators for the local community (Bell, Morse, 2000; Bell, Morse, 2003; Reed, Fraser, Dougill, 2006; Śleszyński, 2017).

First of all, indicators must reflect the specificity of a given place (Holman, 2009). The local community is a group of people, usually relatively homogenous, living in similar geographical conditions, often also economical, with the baggage of shared historical experience, with an identifiable resource of local tradition and culture. Under certain circumstances, these features are further strengthened. The specificity of the place becomes exceptionally clear in the case of geographically isolated locations, hence the distinct cultural differences of the inhabitants of islands and mountain areas. Strengthening the local specificity is also generated by racial dissimilarity, national identity, and linguistic diversity. Some places create a mélange of different traditions; we call them a melting pot, a singular and unique mix of dialects, customs, and behaviours.

The second important aspect that must be reflected in the indicators of the development of the local community is the specificity associated with

local aspirations and preferences. It is not surprising that several neighbouring and similar local communities will have their own goals and priorities. The similarity of historical fate, immersion in the same folk tradition, or the use of the same dialect do not exclude developmental differences, which are created by specific expectations and plans for the future, therefore requiring unique and specific monitoring.

Methodology: The BES framework

The BES is the Italian framework of sustainable and equitable well-being indicators set. It is a theme-based model composed of twelve domains: Health, Education and training, Work and life balance, Economic well-being, Social relationships, Politics and institutions, Security, Subjective well-being, Landscape and cultural heritage, Environment, Innovation research and creativity, Quality of services. It is provided by ISTAT (Italian Institute of Statistics) on an annual base, and some of these indicators are included in the DEF (Documento di Economia e Finanza, i.e. the financial report of the government). Its approach is consistent to "A framework to measure the progress of societies" (Hall et al., 2010), and its main philosophy avoids reductionist schedules, supporting the view that the complexity of the world cannot be reduced to synthetic indicators, thus, according to the so-called "beyond the GDP movement" which arose on the track of Stiglitz J., Sen. A., Fitoussi, J.-P. (2009).

The subjective sphere involves the economic, relational, cultural, environmental dimensions and others. Hence, the attempt to define well-being and measure its dimensions copes with a high degree of complexity. In the Italian experience, a panel of experts defined these domains and related indicators. The subjective well-being that is the core of all is relegated to one domain, and the population was not involved in its definition. However, instead of using a normative approach to define it, such as the Maslow's "Hierarchy of Needs" (1954) or a panel of experts, at the local level it is recommended the citizens, or their representatives, be involved in defining these conditions or at least to weigh the domains. This is done here, in the very last part of the paper. Finally, the benchmark, according to which the degree of progress is measured, is the year 2010.

The Bova's BES[1] (labelled from now on B-BES) is the Italian equitable and sustainable well-being approach for the local level (Bova, 2019). It follows the national approach, but it supports the idea that different publics need different accuracy degrees and, therefore, different levels of information.

[1] In its Italian application: BES (Benessere Equo e Sostenibile) Organico per comuni.

Hence, whenever the public is not specialized in these analyses, it is important to provide an integrated interpretation model. The B-BES includes these integrated areas, which are interconnected through an interpretational model, allowing for an integrated analysis of the town. These areas are the subjective well-being, that is the core element, the capitals (that allow its satisfaction/maintenance), their access (accessibility), and the sustainability and resilience capacity, in order to check whenever it will be maintained over time and its resilience to shocks. Moreover, the benchmark is the same, but the aggregation is done through the re-parameterized average (Bova, 2019) while the normalization is done by the ratio of the indicators with respect to the national average (if the polarization is positive) or vice versa (if the polarization is negative)[2].

More than one hundred indicators and data sources for the areas are listed in Bova (2019). According to the informative level structure of Montmollin and Altwed (2000) and what has been said in the previous paragraph, the structure that was followed takes into account the different publics and their different degree of knowledge to which the local level analysis refers: the community, the politicians, the entrepreneurs, the town managers, the associations. It is summarized in table 1.

Table 1. B-BES indicators for each public and degree of knowledge

Communication level*	Type of indicator (number of indicators)	Indicators' description
Scientists and experts	Basic indicators (110 or 86 without surveys)	All the indicators that refer to the local equitable and sustainable well-being domains. It includes many simple indicators relevant to the territorial analysis that may be considered for the integrated areas. In the B-BES the number of indicators is 110 or 86 (without surveys).
Politicians Entrepreneurs Associations Managers	Synthetic and composite (8)	The integrated areas are Subjective Well-being, Health, Economic Wellbeing, Social Wellbeing and Accessibility, Cultural Intensity and Accessibility, Environment, Economic Accessibility, Social and Cultural Resilience and Sustainability.
Politicians General Public	Synthetic and composite (3)	The TriBES indicators are three: Well-being, Equity and Sustainability. They aggregate all eight integrated areas.
	Synthetic and composite (1)	The product of the three TriBES indicators generates the final indicator of equitable and sustainable development of the community: Super TriBES.

*Communication levels follow the aggregation order of indicators

Source: author's work based on Bova, 2019.

[2] Such aggregation and normalization method avoids strange results (that at a local level can happen, due to the lower amount of data and high volatility), it also avoids that the lack of data could impede reaching any numerical result. More details are available comparing (Bova, 2019, pp. 105-11) and (Handbook on Constructing Composite Indicators: Methodology and User Guide, 2008).

Modelling the local framework B-BES

The B-BES model has its roots in the Italian framework. In "A framework to measure the progress of societies" (Hall et al., 2010), a general framework is provided for the measurement of the progress of a society. It defines the "progress of society" (or societal progress) as the improvement in human well-being and the ecosystem condition" and the "well-being of society" (or societal well-being) as the sum of the human well-being and the condition of the ecosystem.

Well-being that has a subjective status (Maggino, 2015), is a given condition to which a certain subjective degree of satisfaction and happiness is related. Progress is a set of goals and conditions that increases or protects such a degree. It becomes equitable and sustainable development if it makes well-being accessible (equitable) among the people and generations (sustainable). To reach precise progress implying the necessity to have a theoretical infrastructure with several principles and assumptions. The first assumption is the superiority of wellbeing-driven progress to the endogenous value. In other words, the progress is the sum of the individual's well-being and is not attached to the value of something per se[3].

This has huge implications because the BES model affects the politics and social choices, the policies are (or should be) based on the indicators selected, and the development path is (or should be) shaped by the model results and, therefore, by its assumptions. In turn, political agents should pursue a program or, more generally, a principle of justice, promoting the superiority of well-being defined as the sum of individuals' well-being.

In order to pursue this principle reaching equality and equity in two different moments is necessary. The first is ex-ante: ignorance about the willingness and preferences of future generations forces us to provide them with the same (equality) possibilities (capitals and capitals accessibility, natural capital included). The logic is the veil of ignorance of Rawls (1971): it is better to agree ex-ante to a mutual provision and equity among generations. The second is ex-post: once the people have the same potential well-being, then everyone pursues it with different tools and, therefore, with different resources. To pursue well-being requires the possibility to generate capabilities (Sen, 1999). However, it is equity and not equality. Self-realization cannot hold under homogeneity; the possibility to be different is also a source of capabilities and well-being. Indeed, well-being and development pass through a certain degree of inequality (not too low, not too high) (Cornia, 2004; Cornia, 2006). The superiority of the well-being principle requires a

[3] An interesting discussion on this perspective, albeit with different nomenclature, is provided in the first part of Żylicz (2010).

modern responsibility principle (Jonas, 1979) for the politicians: they have the responsibility to develop equitable and sustainable well-being. The sets of equitable and sustainable well-being indicators support the decision and the monitoring process.

A scientific and objective definition of well-being does not exist. It is a state declared by the subjects and, once declared, it becomes objective. Specifically, well-being is a multidimensional and subjective phenomenon (Maggino, 2015). As such, it can be treated, without loss of generalities, as a multidimensional utility function or, better, as the sum of different utility functions, each by dimension.

$$W_i = \sum_{d=1}^{d=n} U_d. \tag{1}$$

Where W is the well-being of the i-th person, U_d is the utility of the d-th dimension and n the number of dimensions. The utilities come from the exploitation of different capital outputs and outcomes: the social, the natural, the economic, the cultural and the human capitals. These utility functions do not have to be equal. The value W depends on the subject and, whenever we apply a model to its measurement without surveys, we estimate it. In particular, we could attempt to take a number of dimensions k lower than the real number of relevant dimensions n. into account.

$$W_i^e = \sum_{d=1}^{d=k<n} U_d^e. \tag{2}$$

Clearly, if the estimated well-being W_i^e is close to the individual well-being W_i such that then the model is good, otherwise, it must be rejected. In order to make them comparable, it is necessary to normalize the results as long as the dimensions k and n are not equal. To check the estimation adequacy to the subjects' perceptions, it is necessary to generate a survey or eventually a panel analysis. The well-being function changes as time changes, the people's age, culture, education, experiences, and hence, requires updating (surveys) from time to time. In any case, the aim is still the maximization of well-being.

The equity is intended as equality of well-being and as equality of opportunities (accessibility). If the utility U_{di} depends on the outcome of a capital X, then the access can be represented as the h-share of X acquired by the i-th individual:

$$U_{d,i} = f(h_i X). \tag{3}$$

The maximization of the utility passes through the allocation of the shares according to the individuals' utility function differences. Moreover, it highlights the trade-off between the individuals' well-being in the distribution process. In any case, an unequal distribution can be justified if it triggers the progress or if it raises the capabilities or social power and well-being. This is also reflected in the third dimension, sustainability and resilience.

Sustainability means the capacity to sustain well-being over time, and it naturally entails a trade-off between today and tomorrow[4]. The sustainability in normative terms is the intergenerational equity[5]. Function W needs to be updated over time such that the best we can do is to maximize the expected W, and because we cannot measure it, we focus on the conditions that are expected to maximize it. If there is a trade-off between the U_d in the time t and the U_d in the time t+l, then the intergenerational equity can be read as follows:

$$X_{t+1} = s_t X_t \implies U_{t+1} \geq U_t \Leftrightarrow s_t \geq 1, \tag{4}$$

where *s* stands for sustainability and involves all the factors that contribute to it. The limit is that we need to apply a symmetric or anonymity principle equating the utilities of the future to the present one.

The well-being, the equity, and the sustainability, in the terms presented here, are complementary: The future well-being has to balance with the present and the well-being of a person in a community with the well-being of another. We can assess this complementarity by multiplying the results obtained for each of these three pillars. This is called SUPER TriBES (where BES stands for sustainable and equitable well-being). Where the TriBES[6] is the set of the three composite indicators for well-being, equity and sustainability.

$$Super\ TriBES = W \sum(h_i\ X\ s_i). \tag{5}$$

---

4 This has a strong implication because we do not attempt to measure the sustainability of anything else that does not provide well-being.

5 This is present in: Our Common Future. Brundtland Commission on Environment and Development (1987).

6 TriBES is the Italian short cut for Tripla BES (triple BES) and identifies the three indicators of Wellbeing (B), Equity (E) and sustainability (S).

Each of the composites is generated by indicators from the relative areas aggregated through the re-parametrized average (Bova, 2018).

The principal integrated area is the subjective well-being, that is mainly the life satisfaction and hopefulness. The first source of well-being and the first capital is the very same human body and mind, hence, the health. Health is intended as the quantity and quality of time where the well-being can be enjoyed. The main means to well-being, useful to generate well-being or capabilities, are reduced to four: the well-being deriving by the monetary trade, relationships (family, politics, law), knowledge (culture as evaluation criterion), human capital (as individual knowledge) and the environmental services. These are supported, respectively, by the economic, the social, the cultural, the human and the natural capital. Access to them can be measured as the income inequality and occupation, political representation, rights availability, the presence of schools, museums and cultural centres, and the quality of the air, land, and water. The sustainability and resilience assess the process that modifies the capitals and their regeneration capacity. Resilience includes those factors of innovation and tensions to change both in economic, cultural and social terms, such as the number of innovative and non-profit organizations. Sustainability considers the degree according to which an economic, social, and cultural system is accepted, shared and inclusive. Hence, it includes indicators such as the number of NEET and criminal offences. Finally, for the environment, resilience and sustainability are evaluated according to the indexes of human impact over the sustainability and preservation of biodiversity level.

The B-BES model has the advantage that it does not require a specific number of indicators. It can be covered to different degrees without losing its descriptive capacity while it can absorb more data over time, increasing it. This is a crucial quality on the local level where data is often scarce. Hence, the choice of indicators is free to the extent that they respect criteria that do not compromise the schedule structure (OECD, 2008).

The measurement of the adequacy of the model to the subjective well-being

To test the adherence of the B-BES model to the subjective perceptions of the community, the first steps are to measure the B-BES indicators and to collect the priority and the value for each integrated area through a particular survey: the virtual budget. Once the data is collected, it is possible to proceed with the tests presented below.

The virtual budget survey demands to assign X points (no more, no less) to Y dimensions (for us the integrated areas) according to the value and the priority assigned to their improvement. In this way, we simulate the expenditure of a budget (X points) in a "market" (Y goods) to, indirectly, gather information related to the marginal utility for a unitary improvement of a dimension. Moreover, the respondents must assign from 1 to 7 points to each area (1=no priority … 7=absolute priority) and X is equal to four times Y such that the average "expenditure" is equal to the average priority.

Test I. The integrated areas' adequacy to the subjectivity: Error test

If the model is adequate to the community preferences, then the corresponding subjective values should be symmetric to the model composite indicators (see figure 2). Indeed, if the model is correct, whenever the integrated area has a low (high) composite indicator value, we expect to assign a higher (lower) value and priority to this area. However, by doing so, we implicitly exclude that ignorance of the problem prompted respondents to assessments which are not consistent with their own interest.

The composite and subjective values are rescaled in order to be comparable. Such rescaling leads to having an average equal 1 by dividing all values with the average of the values. Since the subjective and the composite rescaled values (respectively s.r.v. and c.r.v.) have an average equal to one, the symmetric point is one. Therefore, we can compute the adequate subjective value (a.s.v.) as the symmetric point (equal 1) plus the distance from the symmetric point of the rescaled composite value (1 minus rescaled composite value):

$$\text{a.s.v.} = 1 + (1 - \text{c.r.v.}) = 2 - \text{c.r.v.} \tag{6}$$

The error corresponding to an integrated area is the distance between the adequate subjective value and the subjective rescaled value, and it is a measure of asymmetry.

Test II. The overall model adequacy to the subjectivity: Adequacy test

The sum of the absolute value of the errors contains information on the adequacy of the model to the preferences. Let me remark that the error was computed on the subjective and composite rescaled values to have an average equal to one. Then the average error can be evaluated on the same scale equal to 1, such that the distance of the average error to 1 is a measure of adequacy. Indeed, if there is perfect symmetry, then this average distance is 1, and if there is perfect asymmetry (the subjective and composite rescaled

values are equal), then the average distance is 0. We are going to express this distance in terms of percentage applying the formula (7).

$$Adequacy\ index = \left(1 - \frac{\sum|error|}{I}\right) \cdot 100, \tag{7}$$

where I is the number of integrated areas evaluated.

Test III. Overall approximation of the subjective well-being: Subjective weight test

Since the rescaled subjective values have an average equal to one, and since they depend on the preferences of the community, they may be used as weights for the corresponding integrated area composites in order to compute a weighted average. This weighted average is supposed to balance the different integrated areas according to their perceived contribution to the subjective well-being. Hence, this average can be compared to the subjective well-being, represented here by the life satisfaction index, to evaluate if the model improves by the survey information. If the distance between the weighted average and the subjective well-being is lower than the distance between the non-weighted average and the subjective well-being, then the introduction of the subjective preferences improves the model by reducing the asymmetries.

The empirical study of Ceccano and its results

The results are for Ceccano, a town of 23,000 habitants in Lazio, central Italy. They concern the year 2018. This town is famous for its high level of pollution in its river and lands. We collected all the indicators of the model, both subjective and objective. The subjective indicators come from a survey of 700 people in 2018 while the rest of the data from the ARCHIMEDE library of ISTAT (Italian Institute of Statistics) with an average lag of 2 years. Other results concerning Ceccano were described in (Bova et al., 2018).

In this survey, we gathered only six of eight integrated areas for two reasons. First, the subjective well-being was in an isolated question that people could assign from 1 to 7 points to describe their life satisfaction (1 = not satisfied … 7 = very satisfied). It coincides with the life satisfaction index. Second, the "cultural and human capital intensity and accessibility" included too many heterogeneous and complex aspects such that it was considered erroneous to encompass it in such a survey type. We did it for "cultural resilience and sustainability" and, indeed, the perception bias was the highest.

It is assumed that the subjects' perception and value depend mainly on the context of life and that they slowly adjust over time. In other words, the subjects are assumed to evaluate their condition according to their context, we assumed the national average, and with a lag, we fixed the year 2010.

Table 2. Synthetic and composite indicators of the B-BES Model applied to Ceccano, 2018

Super TriBES			
Super TriBES 0.84			
TriBES			
Well-being 1.00	Equity 1.05		Sustainability 0.79
Integrated Areas			
Subjective well-being 0.99	Subjective well-being 0.99	Subjective well-being 0.99	Social cohesion 1.34
Cultural resilience and sustainability 0.79	Cultural and human capital intensity and accessibility 0.79	Economic access 1.02	Environment 0.80
Average			
0.97			

Source: author's work.

Test I. The integrated areas adequacy to the subjectivity: Error test

Table 3. Results of test I

	Environment	Economic Access	Economic Well-being	Social cohesion	Health	Cultural resilience and sustainability
Composites rescaled value (c.r.v.)	0.82	1.05	0.85	1.38	1.07	0.82
Adequate subjective value (a.s.v.)	1.18	0.95	1.15	0.62	0.93	1.18
Subjective rescaled value (s.r.v.)	1.19	0.90	1.05	0.81	1.21	0.85
Error	0.01	0.05	0.10	0.19	0.28	0.33

Source: author's work.

These assumptions require further studies but are standard. Nevertheless, the indicators are selected according to their low volatility over time[7].

[7] There is more and more research about the selection of the BES indicators in Italy. For instance, Mazziotta showed that the population size does not affect wellbeing while the labor intensity

Hence, the temporal lag does affect the results, but the error should be lower than the information provided.

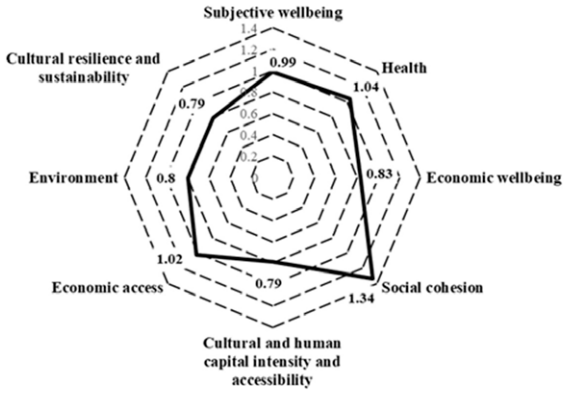


Figure 1. B-BES integrated areas indicators

Source: author's work.

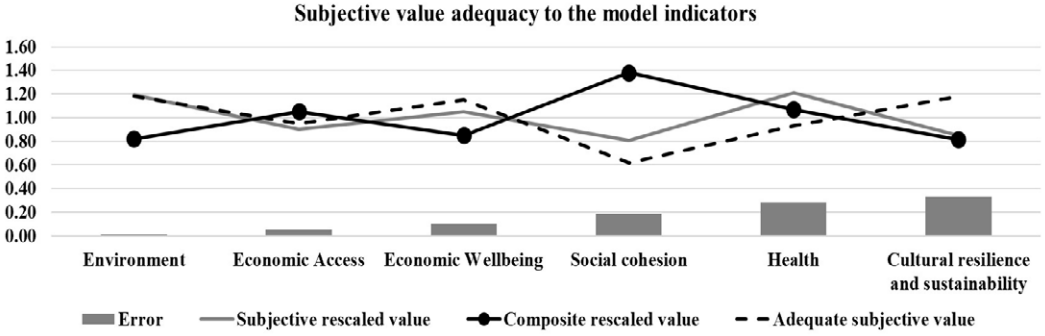


Figure 2. Subjective values adequacy to synthetic and composite indicators

Source: author's work.

As the graph shows, the B-BES is quite adequate with the exception of health and cultural resilience. The community of Ceccano has, on average, a higher sensibility to health and a lower sensibility to cultural resilience and sustainability. The reasons for this are connected with the history of Ceccano (Bova et al., 2018).

within the family is the most important factor (Mazziotta, Pareto, 2011).

Test II. The overall model adequacy to the subjectivity: Adequacy test

The result of the adequacy index is 84% showing that the asymmetries with the model count for a relevant part of the results.

Test III. Overall approximation of the subjective well-being: Subjective weight test

The life satisfaction index is normalized for the Italian average as we did all the other indicators. In the table, we also added the composite indicator of the subjective well-being, which considers the life satisfaction, the free time satisfaction, the judgment on the future index and the relative attractiveness index, to allow further considerations.

Table 4. Results of test III

Cultural resilience and sustainability	0.65
Economic access	0.90
Economic well-being	0.82
Environment	0.91
Health	1.25
Social cohesion	1.05
Average	0.93
Life satisfaction Index	0.95
|Average – Life satisfaction Index|	0.02
Subjective well-being composite	0.99

Source: author's work.

The distance between the average of the composite indicators weighted according to the community preferences and the life satisfaction index is 0.02. It is the same distance to the non-weighted average (see table 2); hence, there is no improvement in adding information about preferences. However, without the weights, there is an overestimation of the subjective well-being (+0.02) while with them, there is underestimation (-0.02). Since this is the first application of this methodology and considering the aforementioned precautions regarding the lags and the benchmark, further studies are desirable.

Conclusions

In this study, we have discussed the desirable features of the sustainability indicators for local communities applying the B-BES model as a set of sustainability indicators, to then test it empirically by introducing a new quantitative methodology. The objective was to check the B-BES's consistency with the subjective preferences of the community.

The local level is unique because of the opportunity to create direct contact with the community and include their aspirations and priorities to assess the living conditions and life satisfaction by consultations and surveys. It is also a necessity when sustainability is seen in terms of quality of life. The B-BES model measures the sustainable and equitable well-being. It contains integrated areas measuring specific parts of the socio-economic and natural systems in terms of how they contribute to the overall well-being, sustainability, and equity. Well-being can be better measured by involving the community directly. Hence, a methodology to check quantitatively whether the model and the local community preferences are consistent was introduced.

This quantitative methodology was composed of three tests. The first and the second concern respectively, the measurement of the adequacy to the local preferences for each integrated area and to the model as a whole. The third compares the life satisfaction index, as a measure of subjective well-being, to the weighted average of integrated areas, where the weights were given by the subjective preferences.

The case study was Ceccano, an Italian town of 23,000 inhabitants. The empirical results showed that the B-BES fits the aggregated individual preferences on the integrated areas of Environment, Economic accessibility, Economic Wellbeing and Social Cohesion while it does not fit adequately to the areas of Health, Cultural Resilience and Social Cohesion. Consequently, in the second test, the overall model showed a degree of adequacy of 84%. The third test revealed a difference between the weighted average and the life satisfaction index of -0.02 while the difference between the non-weighted average and the same index is +0.02, showing that the first underestimated the subjective well-being while the second overestimated it while their distance to the index was the same.

Summing up, the involvement of the population, crucial for the local assessment of the quality of life and sustainability, allows for a deeper evaluation of the usefulness of the B-BES model.

The contribution of the authors

Demetrio Miloslavo Bova, 60% (conceptualization, methodology, software, validation, formal analysis, investigation, data curation, writing – original draft preparation, writing – review and editing, visualization).

Jerzy Śleszyński, 40% (conceptualization, writing – original draft preparation, writing – review and editing, visualization).

Literature

Bell, S., Morse, S., 2003. Measuring Sustainability. Learning from Doing. Earthscan, London.

Bell, S., Morse, S., 2000. Sustainability Indicators. Measuring the Immeasurable. Earthscan, London.

Borys, T. (Ed.), 2005a. Wskaźniki zrównoważonego rozwoju. Wydawnictwo Ekonomia i Środowisko, Warszawa-Białystok.

Borys, T., 2005b. Indicators for Sustainable Development – Polish Experiences. Wydawnictwo Ekonomia i Środowisko, Warszawa-Białystok.

Borys, T., Rogala, P. (Eds.), 2008. Quality of Life on Local Level. An Indicators-Based Study. United Nations Development Programme, Warszawa.

Bova, D.M., 2019. Guida per il rapporto del BES organico per comuni: manuale applicativo. Franco Angeli Editore, Milano.

Bova, D.M. et al., 2018. Uso innovativo delle tecnologie di substrato attivo e di fitodepurazione per l'impatto ambientale chimico del suolo e valutazione di nuovi indicatori BES. In: Di Bella, E. et al., AIQUAV. University of Genoa Press, Genova, 101-107.

Chiras, D.D., Corson, W.H., 1997. Indicators of sustainability and quality of life: translating vision into reality. Journal of Environmental Science and Health, 15, 61-82, https://doi: 10.1080/10590509709373490.

Cornia, G.A., 2004. Inequality, Growth, and Poverty in an Era of Liberalization and Globalization. Oxford University Press, Oxford.

Cornia, G.A. (Ed.), 2006. Pro-Poor Macroeconomics: Potential and Limitations. Palgrave Macmillan, London.

Gutowska, J., Śleszyński, J., 2012. Wskaźniki zrównoważonego rozwoju dla społeczności lokalnych – od teorii do praktyki na przykładzie Milanówka. In: Sochaczewski, P. (Ed.), W kierunku zrównoważonej gospodarki opartej na wiedzy w Polsce. Wyższa Szkoła Ekonomiczna w Białymstoku, Białystok, 31-51.

Gutowska, J., Grodzińska-Jurczak, M., Śleszyński, J., 2012. Selecting sustainability indicators for local community – Case Study of Milanówek Municipality, Poland. Problems of Sustainable Development, 7, 77-86.

Handbook on Constructing Composite Indicators: Methodology and User Guide, 2008. OECD, Paris.

Hall, J. et al., 2010. A Framework to Measure the Progress of Societies. OECD Statistics Working Papers, 2010/05, https://doi.org/10.1787/5km4k7mnrkzw-en.

Holman, N., 2009. Incorporating local sustainability indicators into structures of local governance: a review of the literature. Local Environment, 14, 365-375.

Jonas, H., 1984. The Imperative of Responsibility: In Search of Ethics for the Technological Age. University of Chicago Press, Chicago.

Maggino, F., 2015. Subjective well-being and subjective aspects of well-being: methodology and theory. Rivista Internazionale di Scienze Sociali, 1, 89-121.

Maslow, A., 1954. Motivation and Personality. Harper & Brothers, New York.

Mazziotta, M., Pareto, A., 2011. Nuove misure del benessere: dal quadro teorico alla sintesi degli indicatori. Rivista On-line della Società Italiana di Statistica, http://old.sis-statistica.org/magazine/spip.php?article194.

Mazziotta, M., Pareto, A., 2013. Methods for constructing composite indices: one for all or all for one. Rivista Italiana di Economia, Demografia e Statistica, 67, 67-80.

Montmollin, A., Altwed, D., 2000. Sustainable Development in Switzerland. Factors for an Indicators System. Swiss Federal Statistical Office.

Our Common Future. Brundtland Commission on Environment and Development, 1987. World Commission on Environment and Development.

Quality of Life Counts. Indicators for a Strategy for Sustainable Development for the United Kingdom: A Baseline Assessment, 1999. The Government Statistical Service, London.

Rawls, J., 1971. A Theory of Justice. Belknap Press of Harvard University, Cambridge.

Reed, M., Fraser, E.D., Dougill, A.A., 2006. An adaptive learning process for developing and applying sustainability indicators with local communities. Ecological Economics, 59, 406-418, https://doi: 10.1016/j.ecolecon.2005.11.008.

Sen, A., 1999. Development as Freedom. Oxford University Press, Oxford.

Śleszyński, J., 1997. Wskaźniki trwałego rozwoju. Ekonomia i Środowisko, 2, 15-34.

Śleszyński, J., 2017. Wskaźniki trwałego rozwoju na poziomie lokalnym. Optimum – Economic Studies, 88, 39-52.

Stiglitz, J., Sen A., Fitoussi, J.-P., 2009. Report by the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP), Paris.

Strathclyde Sustainability Indicators, 1995. Strathclyde Regional Council, Glasgow.

Żylicz,T., 2010. Goals and principles of environmental policy. International Review of Environmental and Resources Economics, 3, 299-334, https://doi: 10.1561/101.00000028.

Piotr P. MAŁECKI

DEVELOPMENT OF FEES FOR PLACING WASTE ON LANDFILL AND THEIR INFLUENCE ON THE MANAGEMENT OF MUNICIPAL WASTE

Piotr P. **Małecki**, Associate Prof. (ORCID: 0000-0001-7810-4617) – *Cracow University of Economics*

Correspondence address:
Koło Białuchy Street 19, 31-235, Kraków, Poland
e-mail: maleckip@uek.krakow.pl

ABSTRACT: The dynamic development of fees for using the environment in Poland took place after 1989, that is from the moment of implementation of systemic transformation. Then, among others, waste disposal fees equivalent to the current charges for placing waste in a landfill were introduced. Rates of these fees related to some types of waste, including municipal waste, increased in selected years not proportionally to the inflation rate – in contrast to other fees for the use of the environment. This was the case, for example, between 2008 and 2009, when the rate for unsorted municipal waste increased from PLN 15.71 to PLN 75 per Mg. In 2018 this rate was raised by about PLN 20 in relation to the previous year. The aim of the article is to answer the question whether and how much a radical increase in rates for placing waste in a landfill had an impact on the management of municipal waste in the context of limiting their mass deposited in landfills. The article will conduct a comparative analysis between the development of fees and the volume of municipal waste sent to landfills within a representative period. The conducted analysis denied, in principle, the thesis that very high fees for waste in the years immediately after their introduction will cause a significant reduction of their flow to the landfill.

KEY WORDS: ecological fees, municipal waste, waste storage

Introduction

According to the Waste Act, municipal waste is considered to be the waste generated in households, with the exception of end-of-life vehicles, as well as wastes that do not contain hazardous waste from other waste producers, which, by their nature or composition, are similar to wastes generated on farms petitions (Act of 14 December 2012, Art. 3.1). According to the applicable classification of waste, as waste it is considered waste (Regulation of 14 June 2007):

- segregated and separately collected (excluding packaging waste),
- from gardens and parks (including: from cemeteries),
- other (including unsegregated).

The latter consists of unsorted (mixed) municipal waste.

Ecological fees, apart from the income function, should also serve as incentives, and thus stimulate pro-ecological attitudes of consumers and producers. With regard to fees for landfilling of municipal waste, it is primarily aimed at limiting their volume to landfills of this type.

The article will be subject to verification – it would seem – quite an obvious thesis, that the increase in rates of waste fees will result in limiting their stream to the landfill within a certain time.

Some foreign research analysis indicate the connection – not always unequivocal – between the increase in fee rates and the volume of municipal waste storage. "It has been possible to establish a strong apparent correlation between increasing landfill tax rates and decreasing rates of landfill for MS in at least three MS (Austria, Sweden and the UK)" (Use..., 2012, p. 71). "Neither in France nor the UK has there been much impact seen in respect of reducing municipal waste sent to landfills. In Austria, there has been a significant shift in fates of municipal waste over time, but it is difficult to know the extent to which this is attributable to the tax itself or other instruments operating to move waste management up the hierarchy" (Study..., 2001, p. 190). "Waste collection and treatment fees collected by Austrian municipalities increased from €72 per household in 1995 to €155 per household in 2006, due to a 23% increase in waste generation per household" (Use..., 2012, p. 91). The UK Landfill Tax was effective in reducing landfilling rates; however, it was less efficient in promoting priorities from higher up the waste hierarchy, primarily the reduction of waste production in the first instance (Martin, Scott, 2003, p. 688). The landfill tax in Finland has helped divert heavier waste streams such as construction and demolition waste but has had less effect on BMW and municipal waste (Diverting..., 2009, p. 32).

The aim of the article is therefore to conduct a comparative analysis between the development of fees and related volumes expressing waste

management in Poland, in particular – the mass of municipal waste sent to landfills[1] in certain years, and thus – the answer to the question whether and how much a radical increase in rates for placing waste in a landfill does it affect the limits of their stream?

The article reflects a simple comparative analysis carried out on the basis of literature sources and collect statistical data of the evolution of two variables, i.e. rates of fees for waste storage and the amount of waste deposited in landfills.

Charges for storing municipal waste – current status

Waste disposal fees, and more precisely – for placing them in a landfill, are collected for a single operation consisting in depositing waste in a landfill[2]. They are one of the types (until recently four[3]) Polish fees for the use of the environment in addition to fees for gas and dust emissions, water abstraction and sewage disposal. The rates of these fees are imputed in PLN per Mg of waste deposited. The obligation to pay them results from the act – environmental protection law (Act of 27 April 2001), and the rates of rates are set periodically (generally once a year) by an appropriate ordinance of the Council of Ministers or announcement by the minister for the environment[4].

These fees are to be borne by all entities using the environment in the field of waste storage. At the same time, a uniform rule applies as to their collection (calculation and transmission). It consists of the fact that full responsibility in this regard is borne by the entity using the environment. It is obliged to pay the due fee on its own and transfer it to the bank account of the Marshal Office – territorially competent due to the use of the environment. Marshal Offices transfer some of the collected funds to environmental protection and water management funds, budgets of poviats and communes, whereas – in the case of fees for landfilling – a significant part of these funds remain in the municipality.

The operation of the fee for landfilling as an economic instrument is intended, firstly, to reduce the waste stream directed to landfills, and secondly, to create special-purpose funds for waste management. This fee is part

1 The content of this article assumes convention of unambiguity of statements: waste sent to landfills, waste deposited in a landfill, waste destined for storage.

2 In the past, the waste disposal fee was two-part – for one-time depositing, i.e. placing in a landfill and – for each year of storage.

3 In connection with the adoption in 2017 of a new water law (Act of 2 July 2017), the existing fees for water abstraction and sewage disposal ceased to apply as fees for the use of the environment in accordance with environmental law (Act of 27 April 2001).

4 At the time of preparation of this article (Regulation of 22 December 2017)

of the rate of the fee for municipal waste management[5]. This fee is, therefore, the implementation of the "polluter pays" principle in municipal waste management (Famielec, 2018, pp. 80, 81).

The rates of the majority of fees for using the environment from the beginning of their validity in their current form, i.e. from the beginning of the nineties of the twentieth century, increased each year to an extent similar to the inflation rate. Only in the case of fees for placing waste in a landfill periodically, the rates of some of them grew very significantly. This also applies to the rates of fees for storing unsorted municipal waste. Figure 1 shows the rates of fees for storing unsorted (mixed) municipal waste in force in 2005-2018 and planned for 2019 and 2020.

Table 1. Characteristics of municipal waste volumes in 2005-2018 and fees for their storage in 2005-2018

Year	Mass of waste collected in thousand Mg	Mass of waste to be stored in relation to – collected in %
2005	9 760	94,2
2006	9 350	92,2
2007	9 880	91,0
2008	10 080	90,3
2009	10 040	86,6
2010	10 050	78,2
2011	10 040	73,4
2012	9 830	70,9
2013	9 580	74,7
2014	9 470	63,1
2015	10 300	52,8
2016	10 860	44,3
2017	11 969	41,8
2018	12 485	41,6

Source: author's work based on Małecki, 2009; Ochrona, 2016; Ochrona, 2017; Ochrona, 2018; Ochrona, 2019.

As can be seen, on the basis of the data in figure 1, a very radical "non-inflationary" increase in rates of these fees occurred between 2007 and 2008,

[5] The fee for municipal waste management is a fee paid to the municipality by the owners of the property for waste disposal.

when the rate in question increased from PLN 17.71 to PLN 75 per Mg, i.e. almost five times. The next increase, also "non-inflationary" although clearly milder, took place the following year. The fee rate increased between 2008 and 2009 from 75 to 100 PLN for Mg.

The rationale for such an increase in the rates of fees was, above all, obligations arising from the legal regulations of the European Union. The provisions contained in the Waste Directive (Directive, 2006) provide that storing them is the final and the least desirable way of proceeding. However, from the Directive on Landfill (Directive, 1999), it is necessary to take decisive action in the area of gradual but significant reduction of municipal waste sent to landfills. According to the provisions of the Polish Waste Act (Act of 27 April 2001), the storage of biodegradable municipal waste is to be increasingly limited – in such a way that the share of biodegradable municipal waste in relation to the volume of waste generated in 1995, could not be higher than 50% in 2013, and in 2020 – less than 35%. An important reason for the significant increase in fees for the storage of some types of municipal waste is also the insufficient level of their separate collection. At the same time, legal regulations (Regulation of 14 June 2007) oblige to a significant increase, over the next few years, the levels of recovery and recycling of specific types of waste (Małecki, 2012, p. 124).

The impact of the increase in fees on the amount of municipal waste storage

The relationship between the increase in fees for placing unsorted municipal waste in the landfill and related quantities expressing waste management can be traced by analysing the data in table 1, figures 1, 2 and 3. They show how the amounts of unsorted municipal waste collected and intended for storage were shaped in 2005-2018. Table 1 also presents the relation between the amount of waste destined for storage and – collected. It can be seen that the amount of collected waste is at a fairly constant level throughout the period considered and fluctuates around 10-12 thousand Mg per year, with a slight upward trend in the last two years. A slight gradual decrease in this volume has been observed for three years, starting from 2012. This may be interpreted as the effect of an increase in rates of fees for landfilling. On the other hand, in the entire analysed period, the share of the mass of waste destined for landfilling of the entire collected waste is relatively stable and clear, with the exception of 2013, when this indicator slightly increased.

The relationship between the increase in fees for storing unsorted municipal waste and the amount of waste deposited on landfills in particular years can be seen by analysing figures 1 and 2. The radical increase in fee rates

between 2007 and 2008 and 2008 and 2009 should theoretically result in a reduction in the weight of waste landfilled mainly in 2009 and 2010. Meanwhile, the tendency of a decrease in the amount of waste to be stored is basically constant, starting from 2009. Only in 2013 and in 2017 and 2018, it can be noticed that it is difficult to explain the increase in the volume of municipal waste sent to landfills (see figure 2).

The relationship between the rates of fees for placing unsigned municipal waste in the landfill and the amount of waste deposited in individual years of the analysed period is therefore only marginally visible. This is clearly shown in figure 3 shows the trend of both phenomena. In the first case – the amount of fees – it is growing, as evenly starting from 2009. However, in the second case – the mass of deposited wastes – the trend is evenly decreasing. There was no clear decline in the mass of waste deposited in the landfill in the years immediately following the radical increase in fees in 2008 and 2009, which may indicate lack of a clear impact of the increase in fee rates. For a constantly declining trend, with the exception of the aforementioned year 2013, the volume of waste deposited in individual years is probably also influenced by other various factors, such as activities recorded in the "National Waste Management Plan 2022" (Resolution of 1 July 2016)[6].

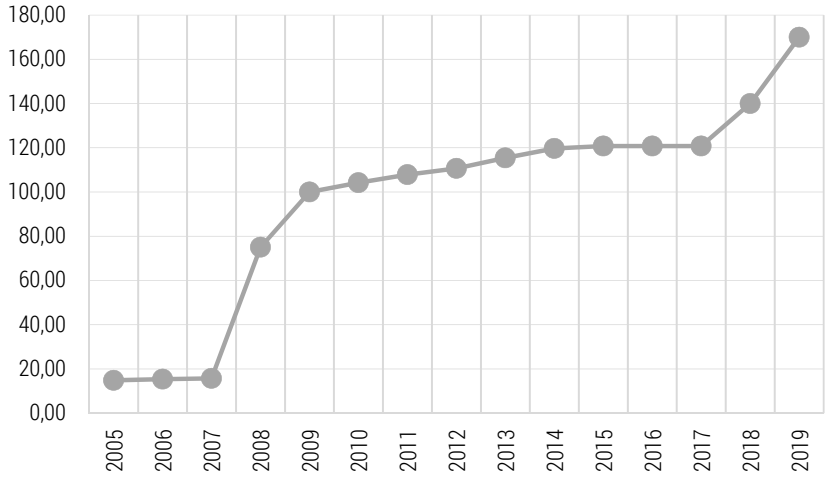


Figure 1. The increase in fees for municipal waste storage in the period 2005-2019 in PLN for Mg

Source: author's work based on Małecki, 2009; Regulation of 22 December 2017; Notice of 4 October 2010; Notice of 26 September 2011; Notice of 10 September 2012; Notice of 13 August 2013; Notice of 11 August 2014.

6 More details about this in the next part of this article.

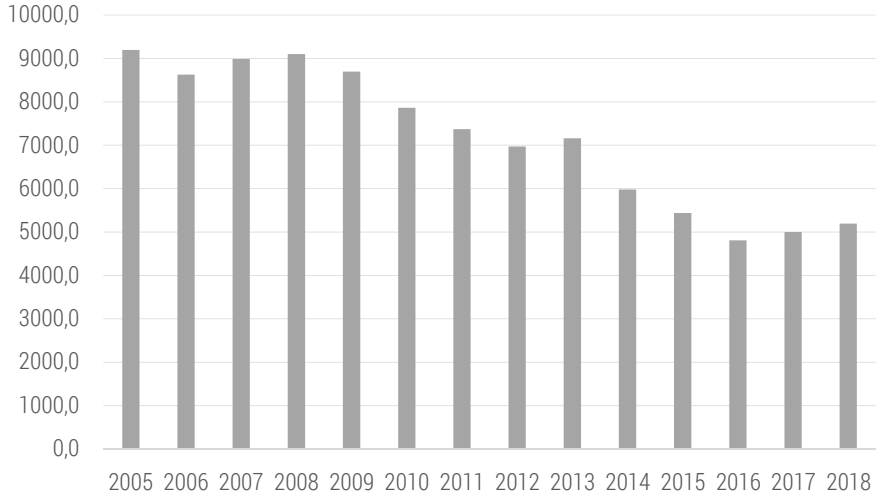
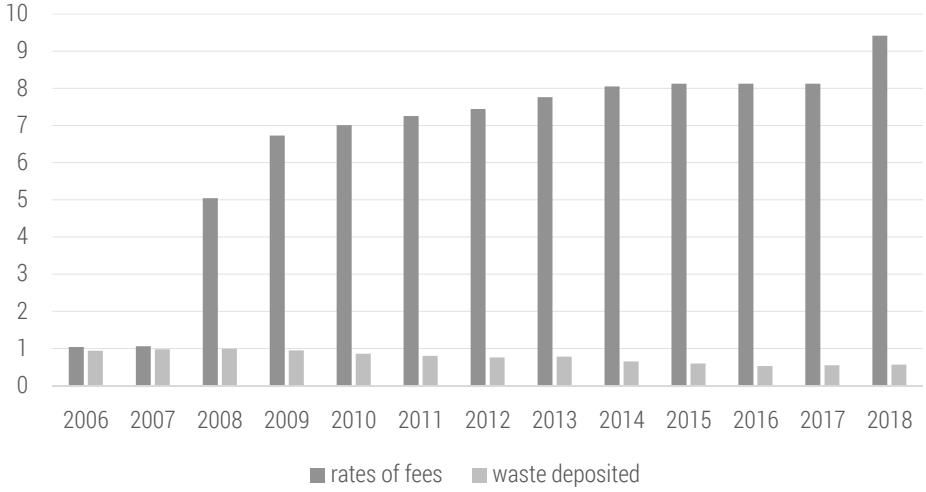


Figure 2. The amount of municipal waste to be stored in 2005-2017 in thousand Mg

Source: author's work based on Małecki, 2009; GUS, 2016; GUS, 2017; GUS, 2018; GUS, 2019.

Figure 3. Increase in rates of charges and the mass of waste deposited in the landfill in



2006-2018 (2005=1)

Source: author's work based on data from figure 1 and 2.

The amount of waste placed in a landfill can also be affected by several other issues, such as the number of population or the volume of consumption (in particular in households). However, the number of Polish residents in the analysed period remained at a similar level, slightly above 38 million. Therefore, it was considered unnecessary to determine and use in the analysis of

the amount of waste per capita. However, the level of consumption in households does not indicate a clear trend. Only in 2011, 2014 and 2017, there was a certain increase compared to the previous year (see table 2). Therefore, this factor should rather affect the increase in the mass of municipal waste deposited, and this is not the case (see figure 2).

Table 2. Consumption dynamics in the households sector in 2008-2018 at constant prices

Year	Previous year = 100
2008	106,1
2009	103,3
2010	102,5
2011	103,3
2012	100,8
2013	100,3
2014	102,6
2015	103,0
2016	103,9
2017	104,5
2018	104,3

Source: author's work based on GUS, 2015; GUS 2019.

Further development of fees for landfilling of municipal waste

The development of fees for landfilling has been manifested mainly in the further increase of their unit rates. This is to stimulate, to an even greater extent, the reduction of waste generation, in particular those that will not be economically utilised. It is important, therefore, that the smallest part of the collected municipal waste be sent to landfills.

The latest regulation on environmental fees (Regulation of 22 December 2017) in 2018, 2019, 2020 and subsequent years provides for the next significant "non-inflationary" increase in fees for the storage of unsorted municipal waste. Particularly significant – almost twice – is the increase in the rate between 2019 and 2020 – by approx. 160%. Subsequently, these rates are supposed to amount to:

- PLN 140 for Mg in 2018,
- PLN 170 for Mg in 2019,

- PLN 270 for Mg in 2020 and in the next years.

At the same time, starting in 2021, the rate is to increase "inflationary" so far – in proportion to the price index and consumer services.

Such a radical increase in fee rates is aimed at stopping waste management from storing mixed municipal waste, and thus – "driving" waste collection with division into individual fractions (paper, glass, plastic). It is also intended to lead to the situation where waste management will be more profitable than storage, i.e. recovery, thermal transformation, production of alternative fuels and mechanical and biological waste treatment. Consequently, higher storage fees should potentially contribute to increasing the level of waste recycling. A signal to the discussed increase in fees for landfilling is also some of the objectives adopted in municipal waste management, formulated in the "National Waste Management Plan 2022" (Resolution of 1 July 2016, p. 98). They are as follows:

- reducing the amount of municipal waste generated by limiting food wastage and introducing a separate collection of bio-waste from collective feeding facilities,
- raising public awareness of proper management of municipal waste, including food waste and other biodegradable waste,
- bringing the functioning of waste management systems in line with the hierarchy of methods of waste management, including,
- reducing the share of mixed municipal waste in the whole stream of collected waste (increasing the share of waste collected selectively),
- cessation of storage of selectively collected biodegradable waste,
- cessation of storage of mixed municipal waste without treatment.

Conclusions

The conducted analysis denied, in principle, the thesis that very high fees for waste in the years immediately after their introduction will cause a significant reduction of their flow to the landfill. The volume of waste deposited on a yearly basis in the landfill gradually decreased, but evenly throughout the period 2009-2017 (except for the year 2013 and 2017 and 2018), and thus – not only directly after significant rate increases. This proves, therefore, the lack of a clear relationship between the radical increase in rates of fees for landfilling of municipal waste in a given year and the mass of waste deposited in landfills in the following years.

The volumes of unsegregated municipal waste collected are at a fairly constant level throughout the period considered, with a slight decrease in this volume observed for three years starting from 2012, a slight increase – in

2017 and 2018. On the other hand, in the whole of this period, the share of the mass of waste destined for storing the entire collected waste is relatively stable and noticeable (with the exception of 2013, when this indicator slightly increased). Both of these regularities may be interpreted as the effect of raising the fees for landfilling.

The results of the research carried out in this article largely do not coincide with the conclusions of foreign surveys described in the Introduction (Study..., 2001; Martin, Scott, 2003; Diverting..., 2009; Use..., 2012), which in most cases show a decrease in the volume of municipal waste deposited as a result of an earlier increase in the rates of fees. This may indicate that the rates in Poland are still too low or that there are no other factors such as adequate environmental awareness. Therefore it seems reasonable to further research in this regard, especially after the introduction of significant changes introduced from 2020 both in terms of the rates of fees themselves and the organisation of municipal waste management.

References

Directive 1999/31/EC of the European Parliament and of the Council on the landfill of waste, L 182.

Directive 2006/12/EC of the European Parliament and of the Council on waste, L 114.

Diverting waste from landfill. Effectiveness of waste-management policies in the European Union, EEA Report, No. 7/2009.

Famielec, J., Famielec, S., 2018. Restrukturyzacja gospodarki odpadami komunalnymi. In: Famielec, J., Kożuch, M. (Eds.), Restrukturyzacja sektorów gospodarki i przedsiębiorstw. Wybrane zagadnienia. Fundacja Uniwersytetu Ekonomicznego w Krakowie, Kraków.

Martin, A., Scott, I., 2003. The Effectiveness of the UK Landfill Tax. Journal of Environmental Planning and Management, 46, 5, 688.

Małecki, P.P., 2009. Opłaty ekologiczne w Polsce. Analiza i ocena za lata 2002-2007. Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków.

Małecki, P.P., 2012. System opłat i podatków ekologicznych w Polsce na tle rozwiązań w krajach OECD. Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków.

Notice of the Minister of the Environment of 10 September 2012 on the level of environmental charges for 2013. M.P. 2012, item 766.

Notice of the Minister of the Environment of 11 August 2014 on the level of environmental charges for 2015. M.P. 2014, item 790.

Notice of the Minister of the Environment of 13 August 2013 on the level of environmental charges for 2014. M.P. 2013, item 729.

Notice of the Minister of the Environment of 26 September 2011 on the level of environmental charges for 2012. M.P. 2011 No. 94, item 958.

Notice of the Minister of the Environment of 4 October 2010 on the level of environmental charges for 2011. M.P. 2010 No. 74, item 945.

Regulation of the Council of Ministers of 22 December 2017 on unit rates of environmental charges (Journal of Laws 2017, item 2490).

Regulation of the Minister of the Environment of 14 June 2007 on annual levels of recovery and recycling of packaging and post-use waste (Journal of Laws 2007 No. 109, item 2007, 752).

Resolution No. 88 of the Council of Ministers of 1 July 2016 on the National Waste Management Plan 2022. M. P. 2016, item 784.

Statistics Poland (GUS), 2015. Rocznik Statystyczny RP 2015, Warszawa.

Statistics Poland (GUS), 2016. Ochrona Środowiska 2016, Warszawa.

Statistics Poland (GUS), 2017. Ochrona Środowiska 2017, Warszawa.

Statistics Poland (GUS), 2018. Ochrona Środowiska 2018, Warszawa.

Statistics Poland (GUS), 2019. Ochrona Środowiska 2019, Warszawa.

Statistics Poland (GUS), 2019. Rocznik Statystyczny RP 2019, Warszawa.

Study on Environmental Taxes and Charges in the EU Final Report: Ch10: Landfill Taxes, April 2001, https://friendsoftheearth.uk/sites/default/files/downloads/effectiveness_landfill_tax.pdf [1503-2020].

The Act of 20 July 2017 Water Law (Journal of Laws 2017, item 1566).

The Act of 27 April 2001 Environmental Law (Journal of Laws 2001 No. 62, item 627).

The Waste Act of 14 December 2012 (Journal of Laws 2013, item 21).

The Waste Act of 27 April 2001 (Journal of Laws 2001 No. 62, item 628).

Use of Economic Instruments and Waste Management Performances. European Commission (DG ENV), Unit G.4 Sustainable Production and Consumption. Final Report, 10 April 2012, https://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf [11-01-2020].

Stefan DEMCAK • Magdalena BALINTOVA • Marian HOLUB

THE REMOVAL OF SULPHATE IONS FROM MODEL SOLUTIONS AND THEIR INFLUENCE ON ION EXCHANGE RESINS

Stefan **Demcak,** PhD (ORCID: 0000-0001-6660-6142) – *Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering*

Magdalena **Balintova,** Prof. (ORCID: 0000-0002-5644-2866) – *Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering*

Marian **Holub,** PhD (ORCID: 0000-0003-2066-8350) – *Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering*

Correspondence address:
Vysokoskolska 4, 042 00 Kosice, Slovakia
e-mail: stefan.demcak@tuke.sk

ABSTRACT: There is a growing tendency for industries around the globe to diminish the contents of pollutants in industrial wastewaters to an acceptable level. Conventional methods are unfavourable and economically unacceptable, especially for large volumes of wastewaters with a high content of undesirable compounds. In contrast, ion–exchange is a very powerful technology capable of removing contamination from water.

This paper analyses a study of ion exchange in Amberlite MB20 and Purolite MB400 resins after sulphate removal from a model solution. For the characterisation of ion exchange in resins, infrared spectroscopy was used. The IR spectra of both ion exchange resins show a similar composition after adsorption. Experiments that are due to this same used matrix in producing. The efficiency of sulphate ion removal and pH changes were also measured. Amberlite MB20 has proven to be a suitable ion exchange resin due to its high efficiency (about 86%) for the removal of sulphates from solutions with initial concentrations of 100 and 500 $mg.L^{-1}$, respectively.

KEY WORDS: ion exchange, resins, sulphate, water treatment

Introduction

Sulphates are commonly found in many bodies of water, some of which have concentrations exceeding recommended limits. However, most sulphate discharges are found in industrial wastewaters (Johnson and Hallberg, 2005). These anthropogenic sources are responsible for enhanced concentrations of sulphates, but there are industries such as metallurgy, tanneries, agriculture, and mainly mining that load/burden the aquatic environment with sulphates (Balintova et al., 2012; Macingova and Luptakova, 2012). Water pollution by sulphates is causing an array of problems such as ecological damage, disease, and disorders for living organisms. Sulphates affect people by inducing headaches, digestive problems, diarrhoea and at higher concentrations may be lethal (Fernando et al., 2018).

Acid mine drainage (AMD) is responsible for wide environmental deterioration as a result of the microbial oxidation of iron pyrite ore. The whole process occurs in the presence of water and air, creating an acidic solution that contains a high concentration of different kinds of toxic metals and sulphates. Generally, inhibiting the formation or transportation of AMD from its source to the surrounding environment is the preferable option, but unfortunately, it is not applicable in many affected locations.

Thus, various options are available for remediating AMD, which may be categorised into those that use either chemical or biological mechanisms to neutralise AMD and remove heavy metals and sulphates (Akcil and Koldas, 2006). These include methods such as chemical precipitation, ion exchange, membrane separation, reverse osmosis, electro-dialysis, sorption techniques, and sulphate reducing bacteria (Runtti et al., 2016; Chernysh et al., 2019).

The most commonly used method for sulphate removal is chemical precipitation with soluble barium, magnesium or calcium salts as alternatives, especially for the treatment of wastewaters with high sulphate concentrations. The limitation of sulphate precipitation is due to the high cost of the input materials (Silva et al., 2002). An effective sulphate precipitation process is influenced by a suitable pH, temperature and appropriate stirring intensity (Sánchez-Andrea et al., 2014). Frequently after the final step (filtration), the concentration of sulphate in the filtrate still remains at a level of a few $mg.L^{-1}$ (Balintova et al., 2016). The presence of sulphate in wastewater is often accompanied with pollution with other elements, mainly heavy metals. For this reason, systems for the separation and appropriate removal of solid components are necessary. Filtration using membranes is another possibility, but in the case of this study the significant economic aspect due to the price of the membranes and energy consumption, proportional to the sulphate concentration, must be taken into account (Silva et al., 2002).

Over the last decades, sulphate reducing bacteria was studied as a suitable technique for sulphate removal (Muyzer and Stams, 2008). The disadvantages of biochemical methods are the large areas required for biochemical treatment and the slowness of these processes (Hybska et al., 2017). These processes are based on the ability of anaerobic sulphate, reducing bacteria to reduce the sulphate contents of hydrogen sulphide (Luptakova et al., 2012). The produced H_2S must be pumped out, for example to the bioreactor, because of heavy metals precipitation with hydrogen sulphide that can inhibit the reduction processes. The limitations of biochemical processes are strongly affected with pH values where failure to optimise values inhibits sulphate reducing bacteria or their extinction (Silva et al., 2002; Dolla et al., 2006; Al Zuhair et al., 2008).

There is a tendency for all types of industry to diminish the contents of sulphates in wastewaters to an acceptable level. Compared with other methods, ion exchange provides benefits because either the ions can be completely removed from a solution or substances separated (Dąbrowski et al., 2004). Likewise, we can divide ion exchange resins into two separate groups. The first is designed for selective ion removal and the latter for complete purification of wastewaters. The decision is based on the contamination characteristics and also expected extent of the whole decontamination process. Selectivity is achieved by the application of ion exchangers with a specific affinity to selected ions or groups of cations and anions. During the purification process, the undesirable ion or group is replaced by another one which is neutral within the aquatic environment (Dąbrowski et al., 2004; Fu and Wang, 2011).

Sulphate pollution can be treated with a combination of different methods, but they are often limited. The use of ion exchange is promising due to its capability to reduce sulphate ion to very low concentration levels (Lens et al., 1998). Moreover, its economic impact can be reduced by selecting an appropriate resin and propose proper conditions that maximise the purification process and also improve regeneration after using. Feng et al. (2000) proposed a two-step process for AMD treatment based on metal precipitation in the first step and subsequent sulphate reduction on ion exchange resins Amberlyst A21. Guimarães and Leão (2014) showed a detailed application of the resin Amberlyst A21 for sulphate removal to conclude that the process has positive features that make it a good candidate for these applications (11.6 mg of sulphate on 1 mL of resin). Its adsorption capacity exhibit lower results compared to other resins commercially designed for sulphate removal, but on the other hand, almost 100% of the resin elution was achieved by increasing the pH to 10 and 12 with NaOH solution.

The Ion exchange resins are materials that contain large polar exchange groups that removal ions or molecules between solid and liquid with no sub-

stantial change to the solid structure. Sulphate ions in the wastewater interfere heavily to the other ions removal and result in short service runs (Runtti et al., 2018). From this reason must be applied resins capable of removing not only high sulphate concentrations but also other present ions in wastewaters as Amberlite MB20 and Purolite MB400.

The aim of this paper is a study of ion exchange in Amberlite MB20 and Purolite MB400 resins after sulphate removal from acidic model solutions. For the characterisation changes of ion exchange resins, infrared spectroscopy was used. The efficiency of sulphate ion removal and pH changes were also measured.

Research methods

The ion exchange resins, Amberlite MB20 and Purolite MB400, were obtained from a commercial resin supplier in Slovakia and were used for static adsorption experiments. Purolite MB400 is a mixture of high-quality ion-exchange resin used for water purification. It is suitable for usage in both regenerable and non-regenerable cartridges and large ion exchange units. The mixture is composed of an ion-balanced mixed resin in a ratio of 40% catex to 60% anex. Amberlite MB20 is an ion-balanced mixed resin containing 38-44% catex and 56-62% anex. This resin was developed for the preparation of high purity water where 97% of the ionex resin has a grain <0.3 mm. It is also most commonly used for the preparation of demineralised water free of silica and carbon dioxide.

1 g of resin was mixed with 100 mL of each model solution containing 100, 500, and 1000 $mg.L^{-1}$ of sulphates, respectively (laboratory temperature t = 20±1 °C). The model solutions were prepared by concentrated sulphuric acid and deionised water. The reaction was carried out under static conditions in a batch adsorption system with an interaction time of 24 h. After absorption, resins were filtrated. Colorimetric method (Colorimeter DR 890, HACH company, Loveland, USA) was applied for the determination of residual sulphate concentration. The pH values of solutions were also measured with a pH meter inoLab pH 730 (WTW, Weilheim, Germany). The IR spectra of resins before and after adsorption experiments were studied for the characterisation of present functional groups that can be responsible for sulphate binding. Measures were performed by an Alpha spectrometer with a Platinum-ATR module (Bruker Optik, Ettlingen, Germany).

In addition, the efficiency of ion removal was calculated using the following equation (Eq. 1):

$$\eta = \frac{(c_0 - c_e)}{c_0} \cdot 100\,, \tag{1}$$

where:
η – sorption efficiency [%],
c_o – the initial concentration of appropriate ions [mg.L^{-1}],
c_e – equilibrium concentration of ions [mg.L^{-1}].

All adsorption experiments were performed in triplicate under batch conditions, and the results are expressed as arithmetic mean values with standard deviations.

Results of the research

Infrared spectra

The ability of ion exchange could be influenced by different factors but is closely linked to selective or multi-componential removal of pollutants. The functional groups of Amberlite MB20 and Purolite MB400 ion exchange resins were determined using Fourier Transform Infrared Spectroscopy (FTIR). The IR spectra of resins before and after adsorption experiments are shown in Figures 1 and 2. The FTIR spectrum of the studied resins revealed several major intense bands which could be observed within wavenumbers of 3,600–2,800 cm^{-1}; and 1,750–650 cm^{-1}.

The FTIR spectrum of Amberlite MB20 resin recorded before and after sulphate adsorption is shown in figure 1. The strong broad band at around wavenumbers 3,353 cm^{-1} and 1,634 cm^{-1} was assigned to the hydroxyl functional groups (Demcak et al., 2017). The peak intensity at wavenumber around 1,634 cm^{-1} on the adsorbed resins shows that the -OH functional groups was released into the solution but the peak at wavenumber about 3,353 cm^{-1} was only slightly decreased due to the natural water adsorption process. The end of the strong broad peak centred at a wavenumber around 3,353 cm^{-1} could also be attributed to amine (–NH) functional groups. The deformation bands at wavenumber 2,928 cm^{-1} were due to the stretching mode of C–H (Nguyen et al., 2010; Kovacova et al., 2019). The three bands that followed each other at 1,599; 1,450 and 1,411 cm^{-1} are assigned to the ring vibration of benzene rings, which also contribute to bending observed at wavenumbers 830 and 773 cm^{-1} assigned to an out of plane ring C–H bonding vibrations (Merdivan et al., 2001). The deformation peak at wavenumber 1,357 cm^{-1} could be attributed to C–H vibrations of the aliphatic group. The band at 1,150 cm^{-1} was assigned to the vibration involving the ester oxygen and the next two carbons attached to it in the hydrocarbon chain. Amberlite MB20 could be containing ester group O–C=O as all esters give IR bands at approximately 1,700; 1,200; and 1,100 cm^{-1} wavenumbers. Ghosh et al. (2015) found that the peaks at wavenumbers 1,031; 1,003; and 667 cm-1

belong to the presence of $-SO_3H$ groups in the catex component of the resin. On the other hand, they observed that the strong deformation at 890 cm^{-1} is due to the presence of $-N(CH_3)_3$ group in the annex component of resin.

In figure 2 the IR spectra of Purolite MB400 before and after the sorption experiment are depicted. In comparison with Amberlite MB20, IR spectrum reveals changes in the composition and slight shifting of band positions of the same functional groups. The spectrum exhibits a band at 2,926 cm^{-1} ascribed to the asymmetric stretching modes of aliphatic C–H groups but also presented symmetrical C–H stretching at wavenumber 3,032 cm^{-1}. The stretching vibrations observed at wavenumber 2,652 cm^{-1} could be attributed to OH bonded to $N(CH_3)_3$. The four bands that following each other at 1,612; 1,512; 1,478 and 1,454 cm^{-1} are assigned to ring vibration of benzene rings, which also contain a contribution due to bending observed at 923 and 834 cm^{-1} assigned to the out of plane ring C–H bonding vibrations. The peak at 1,089 cm^{-1} could represent the content of an ester group O–C=O (Kerkez et al., 2012; Ghosh et al., 2015). Deformation vibrations of C–H out-of-plane functional groups of monosubstituted benzene rings was observed at wavenumber 976 and 857 cm^{-1} (Kerkez et al., 2012; Lazar et al., 2014; Ghosh et al., 2015).

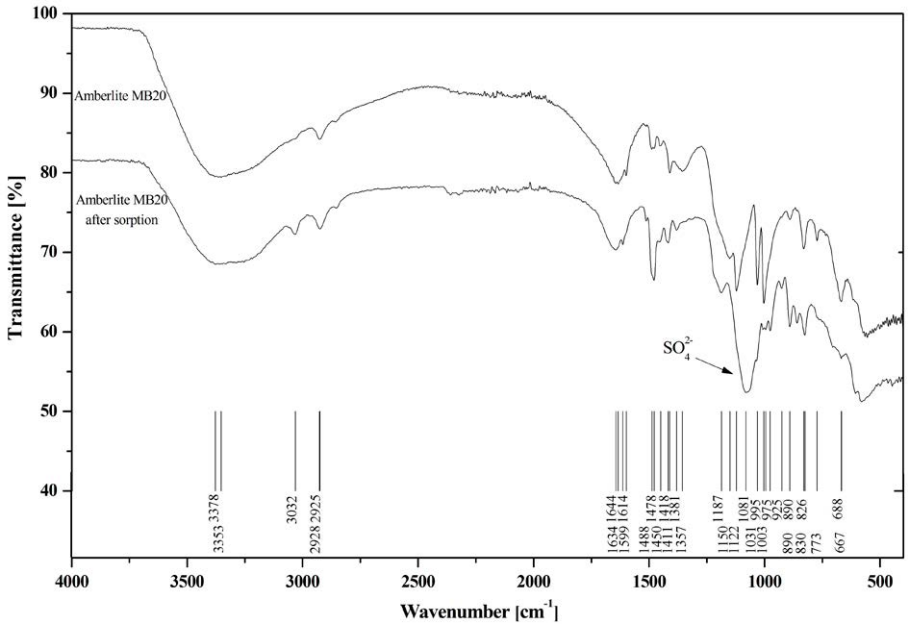


Figure 1. Infrared spectra of Amberlite MB20 before and after sorption experiments

Source: author's work.

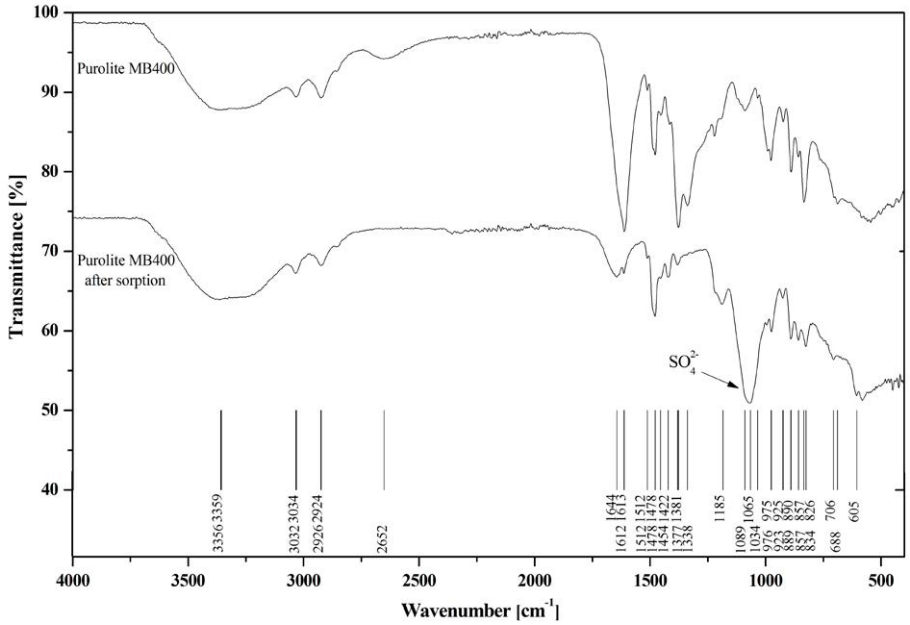


Figure 2. Infrared spectra of Purolite MB400 before and after sorption experiments

Source: author's work.

A difference was observed between the FTIR spectrum of both resins before and after sulphate adsorption. The strong broad band of OH functional groups increased due to water adsorption in resins. The sulphate sorption revealed symmetrical aliphatic C-H groups in the structure of the Amberlite MB20 resin around 3,032 cm^{-1} wavenumber. In both resins, significant changes were observed at wavenumbers between 1,500 to 1,300 cm^{-1} with ring vibration of benzene rings observed at (1,450 and 1,411 cm^{-1}) and C–H vibrations of the aliphatic group at (1,357 cm^{-1}). Anew wide band with a double-peak at wavenumber 1,187 cm^{-1} and 1,081 cm^{-1} (Amberlite MB20) and 1,183 cm^{-1} and 1,065 cm^{-1} (Purolite MB400) were observed. These deformations are visible for both spectra and are characteristic for the sulphate functional group that was adsorbed on both resins in the process of ion exchange. Clearly evident from figures 1 and 2, the IR spectra after sulphate adsorption are almost identical due to the same matrix used on for the production of the studied resins.

Ion exchange study

Results of sorption experiments for model solutions with different sulphate concentrations are shown in Table 1. The selected ion exchange resins used in these sorption experiments were capable of removing the sulphate from the solutions. Amberlite MB20 exhibits a similar efficiency (86.6%) of sulphate removal from the model solution with sulphate concentrations of 100 and 500 $mg.L^{-1}$. In the model solution with a sulphate concentration of 1000 $mg.L^{-1}$, the efficiency of sulphate removal was reduced to 70%. Table 1 presents the efficiency of sulphate removal using Purolite MB400 solutions, where the best efficiency (84.9%) of sulphate removal from the model solution with the initial concentration of 500 $mg.L^{-1}$ was achieved. At the 1,000 $mg.L^{-1}$ level of sulphate, Purolite MB400 reached an ion removal efficiency of only 48.0%. Both used ion exchange resins exhibit a suitable effect in experiments for sulphate removal, but have a limited absorption capacity as was observed in the case of Purolite MB400 at the higher level of sulphate in the model solution.

Based on the results of FTIR analysis and Ion exchange experiments, we can suppose weak base anion resins character that is suitable for sulphate removal. On the other hand Runtti et al. (2018) mention, that ion exchange may not be suitable as a primary technology, but it has potential to be used in combination with other processes like chemical precipitation. Robertson and Rohrs (1995) show the ion exchange processes could be used as an alternative for chemical precipitation or as a post-treatment process to lime precipitation. Additionally, the technique may also serve as a suitable pre-treatment method. For example, Robertson et al. (1993) found that combination the gypsum precipitation and ion exchange enhance the efficiency of sulphate removal from 75.3 to 97.5%.

As shown in table 1, changes of pH values were also observed during batch experiments. In all cases, both resins influenced increasing pH values. As is clearly observed from IR spectra after the sorption experiment, the deformation peak at wavenumber about 1,644 cm^{-1} represents the hydroxyl functional group and confirmed weak base anion resins character. In both cases, the intensity of the deformation peak decreased (significantly at ion exchange resin Purolite MB400). This was caused due to ion exchange between the hydroxyl functional group (released to model solutions) and sulphate ions (caught on ion exchange resins). With increasing, initial sulphate concentrations in model solutions, less pronounced pH changes were also observed (Holub et al., 2014).

Guimarães and Leão (2014) study the utilisation of a weak base resin for sulphate removal confers the advantage of easy elution via pH as an impor-

tant parameter in the treatment of sulphate-loaded waters is elution resin. Although this adsorption capacity is low compared to strong base resins, almost 100% resin elution is easily accomplished by increasing the pH to 10 and 12 with sodium hydroxide solutions. Conversely, although chloride was also loaded, it was later desorbed as the bed became saturated with sulphate, which had a higher affinity for the resin.

Table 1. Results of the sorption experiments with ion exchange resins for the sulphate removal from the model solutions

Ion exchange resins	Input values of model solutions at different sulphate concentration								
	=100 mg.L^{-1}; pH= 2.5			=500 mg.L^{-1}; pH= 2.0			=1000 mg.L^{-1}; pH=1.5		
	η		pH	η		pH	η		pH
	[mg.L^{-1}]	[%]		[mg.L^{-1}]	[%]		[mg.L^{-1}]	[%]	
Amberlite MB20	13.4±0.20	86.6	7.9	67.1±0.83	86.6	3.5	330.8±1,44	66.9	2.1
Purolite MB400	25.4±0.06	74.6	6.4	84.9±0.26	83.0	3.0	519.7±0.64	48.0	2.0

Source: author's work.

Conclusions

This study shows that using ion exchange resins Amberlite MB20 and Purolite MB400 for sulphate removal from model solutions is applicable. Based on experimental results, Amberlite MB20 was a more effective adsorbent than Purolite MB400. The efficiencies of both ion exchange resins were similar (about 80%) for sulphate removal from model solutions with the lower concentrations (100 and 500 mg.L^{-1}). At a concentration of 1,000 mg L^{-1}, the efficiency of Amberlite MB20 for sulphate removal from the model solution was about 68% in comparison to Purolite MB400 (only 48%).

It was observed that there is a difference between the FTIR spectra of both resins before sulphate adsorption. The IR spectra after sulphate adsorption are almost identical due to the same matrix used in the production of the studied resins. Despite the fact that Purolite MB400 contains more kinds of functional groups, Amberlite MB20 exhibited better results for sulphate removal.

The FTIR and ion exchange experiments show weak base anion resins character. Despite the lower adsorption capacity compared to strong base resins this property is a promising potential of full regeneration resin by NaOH solution.

Acknowledgements

This work has been supported by the Slovak Grant Agency for Science (Grant No. 1/0419/19) and Slovak Grant Agency for Science (Grant No. 1/0326/18).

The contribution of the authors

Stefan Demcak – 40% (conceived and designed the experiments, performed the experiments, analysed the data, wrote the paper; measured and analysed the data from IR spectroscopy).

Magdalena Balintova – 30% (discussed and coordinated the research activities and paper structure; supervised the paper and made the final corrections of the paper).

Marian Holub – 30% (conceived and designed the experiments, performed the experiments, analysed the data, wrote the paper; measured and analysed the data from the colorimetric method).

References

Akcil, A., Koldas, S., 2006. Acid Mine Drainage (AMD): causes, treatment and case studies. Journal of Cleaner Production, 14(12-13), 1139-1145, https://doi.org/10.1016/j.jclepro.2004.09.006.

Al Zuhair, S. et al., 2008. Sulfate inhibition effect on sulfate reducing bacteria. Journal of Biochemical Technology, 1(2), 39-44.

Balintova, M. et al., 2016. Study of Precipitates from Mine Water after Defrosting and Oxidation. Solid State Phenomena, 244, 234-239, https://doi.org/10.4028/www.scientific.net/SSP.244.234.

Balintova, M. et al., 2012. Study of iron, copper and zinc removal from acidic solutions by sorption. Chemical Engineering Transactions, 28, 175-180.

Chernysh, Y. et al., 2018. The influence of phosphogypsum addition on phosphorus release in biochemical treatment of sewage sludge. International Journal of Environmental Research and Public Health, 15(6), 1269, https://doi.org/10.3390/ijerph15061269.

Dąbrowski, A. et al., 2004. Selective removal of the heavy metal ions from waters and industrial wastewaters by ion-exchange method. Chemosphere, 56(2), 91-106, https://doi.org/10.1016/j.chemosphere.2004.03.006.

Demcak, S. et al., 2017. Utilisation of poplar wood sawdust for heavy metals removal from model solutions. Nova Biotechnologica et Chimica, 16(1), 26-31, https://doi.org/10.1515/nbec-2017-0004.

Dolla, A. et al., 2006. Oxygen defense in sulfate-reducing bacteria. Journal of Biotechnology, 126(1), 87-100, https://doi.org/10.1016/j.jbiotec.2006.03.041.

Feng, D. et al., 2000. Treatment of acid mine water by use of heavy metal precipitation and ion exchange. Minerals Engineering, 13(6), 623-642, https://doi.org/10.1016/S0892-6875(00)00045-5.

Fernando, W.A.M. et al., 2018. Challenges and opportunities in the removal of sulphate ions in contaminated mine water: A review. Minerals Engineering, 117, 74-90, https://doi.org/10.1016/j.mineng.2017.12.004.

Fu, F., Wang, Q., 2011. Removal of heavy metal ions from wastewaters: a review. Journal of Environmental Management, 92(3), 407-418, https://doi.org/10.1016/j.jenvman.2010.11.011.

Ghosh, S. et al., 2015, FTIR spectroscopy in the characterisation of the mixture of nuclear grade cation and anion exchange resins. Journal of Radioanalytical and Nuclear Chemistry, 304(2), 917-923, https://doi.org/10.1007/s10967-014-3906-3.

Guimarães, D., Leão, V.A., 2014. Batch and fixed-bed assessment of sulphate removal by the weak base ion exchange resin Amberlyst A21. Journal of Hazardous Materials, 280, 209-215, https://doi.org/10.1016/j.jhazmat.2014.07.071.

Holub, M. et al., 2014. Application of various methods for sulphates removal under acidic conditions. SGEM2014 Conference Proceedings, 2(5), 39-46.

Hybska, H. et al., 2018. Study of the Regeneration Cleaning of Used Mineral Oils–Ecotoxicological Properties and Biodegradation. Chemical and Biochemical Engineering Quarterly, 31(4), 487-496, https://doi.org/10.15255/CABEQ.2017.1109.

Johnson, D.B., Hallberg, K.B., 2005. Acid mine drainage remediation options: a review. Science of the Total Environment, 338(1-2), 3-14, https://doi.org/10.1016/j.scitotenv.2004.09.002.

Kerkez, Ö. et al., 2012. A comperative study for adsorption of methylene blue from aqueous solutions by two kinds of amberlite resin materials. Desalination and Water Treatment, 45(1-3), 206-214, https://doi.org/10.1080/19443994.2012.692057.

Kovacova, Z. et al., 2019. Removal of copper, zinc and iron from water solutions by spruce sawdust adsorption. Economics and Environment, 3(70), 64-74, https://doi.org/10.34659/2019/3/35.

Lazar, L. et al., 2014. FTIR analysis of ion exchange resins with application in permanent hard water softening. Environmental Engineering & Management Journal, 13(9), 2145-2152.

Lens, P.N.L. et al., 1998. Biotechnological treatment of sulfate-rich wastewaters. Critical Reviews in Environmental Science and Technology, 28(1), 41-88, https://doi.org/10.1080/10643389891254160.

Luptakova, A. et al., 2012. Application of physical–chemical and biological–chemical methods for heavy metals removal from acid mine drainage. Process Biochemistry, 47(11), 1633-1639, https://doi.org/10.1016/j.procbio.2012.02.025.

Macingova, E., Luptakova, A., 2012. Recovery of metals from acid mine drainage. Chemical Engineering Transactions, 28, 115-120.

Merdivan, M. et al., 2001. Sorption behaviour of uranium (VI) with N, N-dibutyl-N′-benzoylthiourea impregnated in Amberlite XAD-16. Talanta, 55(3), 639-645, https://doi.org/10.1016/S0039-9140(01)00476-3.

Muyzer, G., Stams, A.J., 2008. The ecology and biotechnology of sulphate-reducing bacteria. Nature Reviews Microbiology, 6(6), 441, https://doi.org/10.1038/nrmicro1892.

Nguyen, N. et al., 2010. Adsorption of gold (III) from waste rinse water of semiconductor manufacturing industries using Amberlite XAD-7HP resin. Gold Bulletin, 43(3), 200-208, https://doi.org/10.1007/BF03214987.

Robertson, A. et al., 1993. Sulfate removal by GYPCIX process following lime treatment. Proceedings of the SUPERFUND XIV Conference, Washington, USA, October-December 1993.

Robertson, A., Rohrs, R.G., 1995. Sulphate removal of acid mine drainage water after lime treatment. Proceedings of Sudbury 95, Conference on Mining and the Environment, Sudbury, Ontario, May-June 1995, 575-586.

Runtti, H. et al., 2016. Sulphate removal over barium-modified blast-furnace-slag geopolymer. Journal of Hazardous Materials, 317, 373-384, https://doi.org/10.1016/j.jhazmat.2016.06.001.

Runtti, H. et al., 2018. How to tackle the stringent sulfate removal requirements in mine water treatment – A review of potential methods. Environmental Research, 167, 207-222, https://doi.org/10.1016/j.envres.2018.07.018.

Sánchez-Andrea, I. et al., 2014. Sulfate reduction at low pH to remediate acid mine drainage. Journal of Hazardous Materials, 269, 98-109, https://doi.org/10.1016/j.jhazmat.2013.12.032.

Silva, A.J. et al., 2002. Sulphate removal from industrial wastewater using a packed-bed anaerobic reactor. Process Biochemistry, 37(9), 927-935, https://doi.org/10.1016/S0032-9592(01)00297-7.

Gabriela HANUS

THE PHENOMENON OF ECOLOGISATION IN THE FOOD BEHAVIOUR OF POLES – RESULTS OF EMPIRICAL RESEARCH

Gabriela **Hanus,** PhD (ORCID: 0000-0002-1028-0670) – *University of Economics in Katowice*

Correspondence address:
1 Maja Street 50, 40-287, Katowice, Poland
gabriela.hanus@ue.katowice.pl

ABSTRACT: The main purpose of this research is to identify and characterise the phenomenon of ecologisation in the food behaviour of Polish consumers and the factors shaping it. The research was conducted in 2018, covering the entire territory of Poland. The measurement tool in the primary research was a questionnaire. The collected data is analysed using factor analysis (main component method), Cronbach's alpha-factor, ordered logit models, Pearson's $\chi 2$ and Cramer's V coefficients, as well as descriptive statistics and structure indicators. The analyses show that the phenomenon of ecologisation is clearly visible in the food behaviour of Polish consumers, especially among older people. It is associated with higher food awareness in Poles and manifests itself, in particular, in the relatively frequent purchase of organic products and their introduction to the daily diet. The most important factors shaping their attitude to organic food are age, education level and place of residence.

KEY WORDS: ecologisation; new trends; food behaviour in Poland; organic food

Introduction

Due to the increasingly serious health problems caused by the excessive consumption of highly processed and genetically modified food produced by modern food conglomerates, for many consumers health has become the key factor determining their food choices (Goetzke and Spiller, 2014; Larue et al., 2004, p. 155). Consumers take various steps to improve their health by following diets and purchasing organic products and functional foods. Studies show that, in North America, consumers believe that modifying their diet and using supplements are the two most important conditions to reduce treatment costs and improve overall health (Milner, 2002). Changes in consumer behaviour on the food market are mainly caused by demographic changes and, above all, by the ageing of societies in most developed countries, higher life expectancy and the desire to improve quality of life. Health and wellness promotion, as well as preventing or minimising the occurrence of diseases, such as heart disease, cancer or diabetes, are also very important factors (Doyon and Labrecque, 2008). It should be noted that health and disease begin to be perceived by consumers as a consequence of individual behaviour rather than as a result of the external environment or genetic load. As a result, governments begin to place emphasis on preventive action, opening up many development opportunities for the food market aimed at improving health. This contributes to the growing interest of consumers in alternative treatments, i.e. without medicines, using natural ingredients or diets (Thompson and Moughan, 2008). Nowadays, when the relationships between unhealthy eating habits and some diseases are known, organic food, known as healthy or eco-food, is becoming increasingly important in the nutritional market.

The main purpose of this research is to identify and characterise the phenomenon of ecologisation in the food behaviour of Polish consumers and the factors shaping it. Two hypotheses have been drawn up: 1) The phenomenon of ecologisation is clearly visible in Polish consumers' food behaviour; 2) The phenomenon of ecologisation is most often manifested in the food choices of the elderly.

In order to achieve the objectives of this paper and to verify the assumed hypotheses, it was necessary to conduct primary and secondary studies of a quantitative nature. The primary and secondary sources used in this paper include scientific publications, as well as data from the Institute of Market and Social Opinion Research. The original sources are the result of an online and distributed survey covering the whole of Poland.

For data analysis, some statistics methods were used. A factor analysis and Cronbach's alpha-factor measured the reliability of scales describing

consumer behaviour. In order to verify the hypotheses concerning the relationship between consumer behaviour and consumer characteristics, ordered logit models were used. Additionally, Pearson's $\chi 2$ and Cramer's V coefficients were employed in the analysis of dependencies between pairs of variables. Descriptive statistics and structure indicators for single questions and summary scales were also determined.

Although this topic is often raised by scientists, new factors have emerged that may influence the degree of ecologisation in consumer food behaviour, such as an increase in the wealth of Poles, for instance, resulting from low unemployment, dynamically growing wages and more specific measures, such as the grant of a child-rearing benefit of 500+ for each child up to 18 years old, which increased the average disposable income of the programme beneficiaries by almost 20%. Moreover, society is still ageing, while consumers are increasingly more nutrition aware. Therefore, it is very important to present the latest empirical research on this topic and compare it with previous studies.

This study, however, has some limitations, which should be indicated. First of all, the studies carried out are non-exhaustive. As such, it is not possible to generalise them for the entire population. Secondly, the research method was a questionnaire, which is not without flaws, such as superficiality and limited opportunity for a more in-depth examination of the subject.

The subjective scope of the primary research concerns individual consumers, who independently decide about their diet (over 18 years of age). The temporal scope of direct research falls in the third quarter of 2018. The spatial scope of the research covers the whole of Poland.

The paper is divided into the following sections. The first presents organic food and the organic food market in theory. The second is dedicated to methodology and data collection, while the third presents the empirical results. The fourth section concerns a comparison of the present results with the research of other authors and discusses in general terms the phenomenon of ecologisation in the eating behaviour of Poles. The conclusion provides a summary and indicates applications of the work and further research directions.

An overview of the literature

The growing nutritional awareness of Poles means that increasingly more consumers take care of the natural environment, prefer ecological products that are healthy, safe and produced in a traditional way, and limit their post-consumer waste and the use of non-renewable resources. Organic food is defined as food created in sustainable conditions of plant and animal

production, using non-industrial mineral and biological agents. The basic principle is the rejection of agricultural, veterinary and food chemistry. Voinea (2011) defines organic food as natural products that are created in a manner compatible with natural biological processes and certified by an independent institute. An organic farm must be located away from areas burdened with contamination, emitted by industrial plants, landfills or roads. Organic farms are based on a sustainable, non-degraded natural environment (Shafie and Rennie, 2012). The quality of organic products depends on many different factors, such as the quality of raw materials, processing, storage and distribution technologies. It should be noted that the quality of organic food is recognised as its main source of competitive advantage over conventional products. Consumers are motivated towards the purchase of organic food by such reasons as health, taste, environmental concerns, concern over animal welfare, support for the local economy, a desire to sustain traditional cooking, concern over food safety and current food fashions (Zanoli and Naspetti, 2002; Krystallis and Chryssohoidis, 2005; Tarkiainen and Sundqvist, 2005; Honkanen et al., 2006; Hughner et al., 2007).

Consumers appreciate the nutritional value, quality and taste of products supplied by organic farming, and pay attention to the lack of growth hormones and cleaning. What is more, organic food is rich in vitamins, minerals, fatty acids and antioxidants, which have a positive effect on the human immune system. Eco-food, introduced into the daily diet reduces allergic reactions to the body, while nitrates help reduce the risk of cancer. Examples of organic food include organic eggs from poultry that is not fed with modified feed, milk, a solution containing conjugated linoleic acid 60% higher than its standard equivalent, products from organically farmed animals, cold oil, twice as rich in vitamins A, D and E than other types of refined oil, including olive oil.

The organic food market is considered to be the fastest-growing food production sector in the world. This phenomenon is positively influenced, for example, by the increase of affluence in societies, as well as by the growing nutritional awareness of consumers, and food safety and its significant impact on human health. In 2015, the world market for certified organic food and beverages was estimated at $77.4 billion, and the turnover of organic products has more than doubled since 1999. By 2025, the global organic food and beverage market is expected to reach $320.5 billion. According to a report by the Foundation for Assistance to Agriculture, the value of the global market increased by 355% between 2000 and 2015. In 2017, according to Ecovia Intelligence, organic food and drink sales reached $97 billion. The largest market remains the United States (worth almost €40 billion), followed by Germany (worth €10 billion), France (€7.9 billion) and China (€7.6

billion). The largest annual consumption is recorded in Switzerland (about €177 per capita), Denmark (about €162), Luxembourg (about €134) and Austria (about €127). The CEE countries have the lowest share of organic food consumption in Europe but are on an upward trend (Willer and Lernoud 2019). Willer and Lernoud (2019) noted that there are more than 69.8 million hectares of organic farmland. The largest areas of organic agricultural land can be found in Oceania (35.9 million hectares) and Europe (14.6 million hectares). Australia (35.6 million hectares) and Argentina (3.4 million hectares) are the two countries with the most organic agricultural land. In 2017, there were at least 2.9 million organic producers. Compared to 2016, there has been an increase of producers of nearly 5%. Analysing organic farming and market development in Europe and the European Union, it should be noted that its development is characterised by two trends. Firstly, the market has shown a double-digit growth rate (1.5% in Europe; 10.9% in the European Union). Secondly, the growth of organic agricultural land continues to be slower than market growth, but is much faster than in the first years of the previous decade, increasing by 7.9% in Europe and 6.4% in the European Union. The trend towards market growth at a faster rate than organic farmland growth has been observed for several years, which shows that production is still not keeping pace with consumer demand. The total organic area, however, is only one factor. Comparing the development of organic areas with the development of retail sales, it is more profitable to look at land use and cultivation practices, types of animal husbandry and, above all, production values. It is also important to note in this context that growth rates of more intensive production, such as fruit, vegetables and milk, have increased significantly in the last few years (Hermaniuk, 2018; Willer et al., 2019).

Research methods

The main secondary sources used in work are scientific publications and international reports. The primary source of the survey includes the results of an online and a distributed survey covering the whole of Poland. A total of 660 people took part in the study, including 393 women (59.5%) and 267 men (40.5%). People aged 18–34 constituted about 42% of those surveyed, people aged 35–54 formed 28%, and people aged over 55 were 31% of those surveyed. The structure of the sample in terms of age and gender resulted from the quota selection, which reflected the structure of the population in Poland as of 31.12.2016. Other characteristics of the research sample included: education, income situation and place of residence. Almost half of the respondents had secondary education (49.5%), over 1/3 had vocational

education (35.3%), and every seventh person had higher education. Only 2.3% of respondents declared primary or lower secondary education. Table 1 presents characteristics of consumers participating in the survey. Table 2 characteristics of consumers participating in the survey (n=660).

The empirical information was collected through direct research using quantitative methods. Individual consumers independently deciding on their diet (over 18 years of age) took part in direct research using quantitative methods. The research was conducted in 2018 across Poland. The measurement tool in the primary research was a questionnaire, which consisted of an introduction, instructions for the respondents, ten relevant questions and five questions about demographic items. The main goal of the study was to identify new trends in Poles' eating behaviour. This was possible by learning about the food choices of consumers (in terms of selected types of food consumed and restaurants), the importance of selected factors when purchasing food products (composition, price, calorific value, company, packaging), ways of organising food purchases (who buys food most often, where is it acquired from) and planning and eating meals (regularity and frequency, method of preparation), as well as the overall quality of Poles' diets.

Table 1. Characteristics of consumers participating in the survey (n=660)

Characteristics of respondents	Respondents	
	Quantity	%
Sex		
Female	393	59.50%
Male	267	40.50%
Age		
18–24	103	15.6%
25–34	166	25.2%
35–44	102	15.5%
45–54	84	12.7%
55–59	50	7.6%
60–64	50	7.6%
65 and above	105	15.9%

Source: author's work based on the results of primary research.

In order to examine the degree of occurrence of selected new trends in Poles' eating behaviour, variables were operationalised. Table 2 presents how the phenomenon was measured.

Table 2. Operationalisation and measurement of variables

Studied phenomenon	Scale position (questions)*	Cronbach's alpha for the scale
Ecologisation	Purchase of food labelled organic, healthy Dominance of organic food in the diet	Alpha=0.687***

* Intensity scales from 1 to 5 were used in the questions; the ends of these scales are described differently, depending on the question asked *** Not reliable; analysis of answers to individual questions.
Source: author's work.

In the study, a target-quota sample selection was applied, and the amounts were determined with reference to age and gender criteria, which reflected the structure of the population in Poland as of 31 December 2016.

Results of the research

In order to examine the extent to which the phenomenon of ecologisation occurs in the nutritional behaviours of Polish consumers, some questions were asked in the questionnaire concerning the frequency of purchasing organic food and the evaluation of the diet in terms of the share of organic food in the diet on a scale from 1–5 (where 1 = does not fit at all, and 5 = fits very well). The results of the study show that ecologisation is a trend clearly visible in the behaviour of Polish consumers. The mean score for behaviours in the field of ecologisation is 3.03, and the standard deviation on a five-grade scale is 1.17 (table 3).

Table 3. Descriptive statistics for new trends in the nutritional behaviours of Poles*

Phenomenon	Average	Standard deviation
Ecologisation	3.03	1.17

* In the questions, the intensity scales from 1 to 5 were used, and the ends of these scales were described differently, depending on the question asked.
Source: author's work based on primary research results.

Although compared to other highly developed countries, the size of the Polish organic food market is negligible, a steady increase in sales and the

number of companies producing certified organic food is observed. According to the Agricultural and Food Quality Inspection, in 2015, 23,000 organic producers were registered on the Polish market. This market is in a phase of intensive development, far from maturity, with a large potential for further growth of up to 20% per year. In 2016, the organic food market accounted for only 0.5% of the Polish grocery market. In Western European countries, this market accounts for 2–8% of the grocery market. According to industry forecasts, the upward trend on the Polish market is expected to continue at least until 2030 (IMAS International, 2017)

Direct research indicates that the level of ecologisation can be conditioned by many factors. Among demographic factors, it is found that the age of consumers is very important. Research shows that people aged 55 and above show a higher level of ecologisation of nutritional behaviours than those aged 18–24 (table 4). There is no doubt that consumer behaviour changes with age. The source of this may be the different perceptions, needs, as well as experiences gained over time. Direct research shows that ecologisation is visible especially among older people, which confirms the hypotheses set out in this paper. Age significantly differentiates consumers' food behaviour, influencing, among other things, the perception of the importance of selected factors when purchasing food products, the choice of food and the place of its purchase, and the organisation of meals. Age also clearly determines the diet of consumers. It should be noted that older people, whose health condition usually deteriorates, focus more on health and nutritional issues, and prefer healthy food more than young people. At the same time, their propensity to buy innovative products decreases and the importance of habits increases (Cheah et al., 2015). The connection between age and purchasing organic food is also noticed by Muhammada et al. (2015), who shows that the age of the consumer has a significant impact on the acquisition of organic products in the United Arab Emirates. As age increases, consumers tend to spend more money on organic food. Generally, young people show less care for their health. Awareness in this respect only increases with age.

Direct research also shows that consumer education is important in purchasing organic products. The analysis of the questionnaires shows that people with primary education show a higher degree of ecologisation in their behaviours than people with vocational education (table 4). It is not shown that people with higher education are more inclined to buy eco-food, but other authors' research confirms this. It is indicated that people with higher education have a broader knowledge of pro-health food and its basic bioactive components. Moreover, according to American researchers, better edu-

cated, wealthier and older pregnant women follow a better quality diet (Kranjac et al., 2017; Bodnar and Siega-Riz, 2002).

It is also found that a higher level of ecologisation is observed among rural inhabitants than in urban areas (table 4). It should be noted that the different behaviour of consumers living in other areas is not the result of different needs, but rather of different ways of meeting them. Hence, a higher share of natural product consumption can be observed in rural households than in households from urban areas, where market consumption dominates the total volume of consumption.

Among economic factors, the price that determines the real value of organic food and the purchasing power of consumers are often indicated. They are treated as two of the most important criteria for purchasing decisions, regardless of the place of residence of consumers, their professional group, gender or professional activity. Although the importance of price as a determinant of choice is inversely proportional to the increase in consumer income, wealthy buyers also take this factor into account in their purchasing decisions, including of organic food (Aschemann-Witzel, Zielke and Thøgersen, 2014; Aschemann-Witzel and Zielke, 2017; Smoluk-Sikorska, 2017).

Table 4. Results of estimation of ordered logit models for questions regarding the phenomenon of ecologisation

	Purchase of food labelled organic		Dominance of organic food in the diet	
	b	std(b)	b	std(b)
According to the "you are what you eat" principle, do you pay attention to what food products you choose?_yes	0.926	0.235***	1.315	0.281***
What does packaging mean for you when choosing a food product?	0.127	0.078	0.161	0.078**
What does price mean for you when choosing a food product?	−0.153	0.113	−0.174	0.126
What does the company mean for you when choosing a food product?	−0.039	0.095	−0.014	0.091
What does quality mean for you when choosing a food product?	0.394	0.141***	0.175	0.156
What does caloric content mean for you when choosing a food product?	0.082	0.107	−0.071	0.092
What does composition mean for you when choosing a food product?	0.476	0.118***	0.218	0.116*

	Purchase of food labelled organic		Dominance of organic food in the diet	
	b	std(b)	b	std(b)
Do you think you are eating healthily?_yes	0.444	0.195**	1.116	0.198***
Do you use any diet (e.g. vegetable and fruit)?	0.136	0.212	0.036	0.202
Do you broaden your knowledge of proper nutrition?	0.365	0.227	0.813	0.220***
Do you use dietary supplements advertised in the media?	−0.012	0.236	−0.028	0.233
sex_female	0.049	0.177	0.025	0.179
age_25_34	0.076	0.263	0.047	0.256
age_35_44	0.377	0.290	0.308	0.274
age_45_54	−0.022	0.280	0.505	0.313
age_55_59	0.567	0.327*	0.954	0.389**
age_60_64	0.102	0.414	0.759	0.334**
age_65_and_above	−0.432	0.327	0.948	0.328***
primary education	1.711	0.807**	2.306	1.182*
junior high school education	0.466	0.535	−0.199	0.631
secondary education	−0.084	0.270	0.063	0.270
higher education	0.040	0.275	0.120	0.288
very poor income situation	0.388	0.830	−2.053	1.299
bad income situation	−0.658	1.346	0.590	0.966
good income situation	0.240	0.193	0.145	0.187
very good income situation	0.364	0.292	−0.034	0.293
place of residence_city	0.137	0.191	−0.560	0.199***
_cons	0.129		0.135	
R2	637		637	

Column b provides estimates of regression coefficients; column std (b) contains the average parameter estimation errors calculated using a formula resistant to random component heteroscedasticity; statistically significant estimates are marked with stars:
* p <0.1; ** p <0.05; *** p <0.01
Source: author's work based on the results of primary research.

Nowadays, the average Pole spends about PLN 20 a year on organic food, while the average Swiss spends up to EUR 190, and the average for the European Union is EUR 44 per inhabitant per year (IMAS International, 2017). Interestingly, the research does not show statistical significance in terms of

the impact of the consumers' income situation on the purchase of organic food. Also, the price is not a statistically significant factor in determining food purchases. There is some research, however, which argues that consumers must accept a higher price if they prefer organic products over conventional ones. This reasoning suggests that it is not the price but the willingness to pay (WTP) that is the key factor in the decision to purchase organic products. If companies are able to justify a premium through benefits, consumers will be willing to pay a higher price. The benefits offered to the consumer are able to recoup a higher price, and the price premium should not be seen as a barrier. The perceived dependence of value and price, and thus willingness to pay, is an important predictive factor in purchasing decisions (Gil et al., 2000). It can be assumed that a similar phenomenon is beginning to appear among increasingly wealthy and nutrition-conscious Polish consumers.

In this context, it should also be mentioned that, in previous years, when the price was the main obstacle to buying organic products, large-format stores were not interested in promoting this type of food; thus, its availability was significantly limited for the average Pole. Due to the systematic improvement of the income situation of Poles, the rapid development of specialised food stores, offering local, organic and regional products, as well as the expansion of the range of premium products in large supermarkets and hypermarkets are observed. Increasingly more brands, present on the Polish market, are introducing their own eco-product lines, e.g. Lidl Bio, Rossmann EnerBio or the K-Bio Kaufland line. Therefore, the availability of organic products has significantly increased and is no longer a serious barrier. It should be noted that a sufficient quantity and variety of goods on the market makes it possible to increase the appeal of such products, while insufficient supply may be a reason for limiting consumption until the consumption of certain goods is almost entirely eliminated.

It is worth noting that research also shows that people who declare a healthy diet and pay attention to the composition and quality of food products are more likely to purchase organic food, which confirmed that the phenomenon of ecologisation is more visible in the food behaviour of consumers with a higher level of nutritional awareness.

Finally, it should be noted that increased interest in organic food is generally due to consumers' growing awareness of sustainability. Therefore, changes in nutrition are only one aspect of consumers' ecological attitude, which is also manifested in the growing importance of packaging, confirmed by direct studies presented in this paper. The information on food packaging, as a marketing element, is a factor that significantly influences consumers' opinion on products. Consumers indicate food packaging as one of the most important sources of information on food and is now essential for consum-

ers. Eco-consumers notice that packaging should be biodegradable while guaranteeing food safety and maintaining its high sensory quality throughout the chain from producer to consumer. Scientists emphasise that increasingly more consumers appreciate innovative materials used in food production, based on the latest solutions in the field of bio- and nanotechnology. In collective and individual packaging, sensors monitoring the conditions during production and distribution, as well as the quality and durability of food have also become common. They allow full traceability of products, taking into account their regional origin (Orzan et al., 2018), which seems to be particularly important nowadays, due to the increasing ethnocentric attitudes among Poles.

Conclusions

The organic food market develops very fast alongside the rapidly changing reality and behaviour of consumers. In this context, the identification of the phenomenon of ecologisation in Poles' food behaviour and the factors shaping it are a very important research subject.

The main purpose of this study was to identify and characterise the phenomenon of ecologisation in the food behaviour of Polish consumers and the factors shaping it. The analyses show that ecologisation is clearly visible in the food behaviour of Polish consumers, especially among the elderly. It is associated with the higher food awareness of Poles and manifests itself in particular in the relatively frequent purchase of organic products and their introduction to the daily diet. Therefore, the two hypotheses that were drawn up are positively verified.

The most important factors shaping consumers' attitudes to organic food are age, education level and place of residence. Moreover, it is indicated that eco-consumers pay attention to the packaging of products, while organic food is definitely more often purchased by people who prefer healthy eating, broaden their knowledge in this field and pay attention to the composition and quality of food products. Importantly, there is no statistical significance of income and price in the purchase of organic food, which has been previously demonstrated by many authors.

This paper presents some application advantages. The identification of new phenomena driving consumers' food behaviour is significant for the food and catering industry in Poland. The results clearly show which path should be taken in order to achieve a competitive advantage in the modern food market. In Poland, the number of people for whom the improvement of quality of life is closely related to the promotion of a healthy lifestyle, including a rational diet, is constantly increasing and, consequently, there will be

wider demand for organic food. Therefore, given the growing wealth of Poles, their fast and busy lifestyle and the high level of ecologisation in their food behaviour, it can be assumed that today's consumers are looking for a dietary alternative that will allow them to shorten the time of preparing meals and cleaning up after, while maintaining their health. This trend is confirmed by the growing popularity of diet catering and healthy convenience food prepared from high-quality ingredients of ecological origin, with reduced content of fats and other substances unfavourable to health, as well as enriched with vitamins and minerals. Against this background, it is assumed that fast food bars offering healthy, organic food from a proven source may be a profitable investment.

It should be noted that the considerations presented in this paper do not exhaust the entire catalogue of trends on the food market, but rather present one aspect of it, which is ecologisation. Further studies can be associated with the identification of other factors motivating Poles to purchase organic food, comparing the findings with other countries. In addition, the study may be supplemented with the typology of consumers in the organic food market, which is also a very important research area.

References

Aschemann-Witzel, J., Zielke, S., Thøgersen, J., 2014. Income and price as a barrier to organic food choice. Building Organic Bridges, 1, 175-178, https://10.3220/REP_20_1_2014.

Aschemann-Witzel, J., Zielke, S., 2017. Can't buy me green? A review of consumer perceptions of and behavior toward the price of organic food. Journal of Consumer Affairs, 51(1), 211-251, https://doi.org/10.1111/joca.12092.

Bodnar, L.M., Siega-Riz, A.M., 2002. A diet quality index for pregnancy detects variation in diet and differences by sociodemographic factors. Public Heath Nutrition, 5(6), 801-809, https://10.1079/PHN2002348.

Bryła, P., 2016. Organic food consumption in Poland: Motives and barriers. Appetite, 105, 737-746, https://10.1016/j.appet.2016.07.012.

Cheah, Y.K., Moy, F.M., Loh D. A., 2015. Socio-demographic and lifestyle factors associated with nutrition label use among Malaysian adults. British Food Journal, 117(11), 2777-2787, http://doi.org/10.1108/BFJ-01-2015-0001.

Doyon, M., Labrecque, J., 2008. Functional foods: a conceptual definitione. British Food Journal, 110(11), 1134-1149, https://10.1108/00070700810918036.

Gil, J.M., Gracia, A., Sanchez, M., 2000. Market segmentation and willingness to pay for organic products in Spain, The International Food and Agribusiness Management Review, 3(2), 207-226, https://10.1016/S1096-7508(01)00040-4.

Goetzke, B.I., Spiller A., 2014. Health – improwing lifestyles of organic and functional food consumers. British Food Journal, 116(3), 510-526, https://10.1108/BFJ-03-2012-0073.

Hermaniuk, T., 2018. Attitudes and behaviour of consumers on the organic food market. Handel Wewnętrzny, 2(373), 190-191.

Honkanen, P., Verplanken, B., Olsen, S.O., 2006. Ethical values and motives driving organic food choice. Journal of Consumer Behaviour: An International Research Review, 5(5), 420-430, https://10.1002/cb.190.

Hughner, R.S. et al., 2007. Who are organic food consumers? A compilation and review of why people purchase organic food. Journal of Consumer Behaviour: An International Research Review, 6(2-3), 94-110, https://10.1002/cb.210.

IMAS International, 2017. Organic Food in Poland, http://imas.pl/wpcontent/uploads/2017/08/Zywnosc_ekologiczna_w_Polsce_2017_IMAS_International.pdf [01-01-2020].

Kranjac, M., Vapa-Tankosic, J., Knežević, M., 2017. Profile of organic food consumers. Economics of Agriculture, 64(2), 497-514, https://10.5937/ekoPolj1702497K.

Krystallis, A., Chryssohoidis, G., 2005. Consumers' willingness to pay for organic food: Factors that affect it and variation per organic product type. British Food Journal, 107(5), 320-343, https://10.1108/00070700510596901.

Larue, B. et al., 2004. Consumer Response to Functional Foods Produced by Conventional, Organic, or Genetic Manipulation. Agribusiness, 20, 155-166, https://doi.org/10.1002/agr.20006.

Milner, J.A., 2002. Functional foods and health: a US perspective. British Journal of Nutrition, 88, 151-158; https://10.1079/BJN2002680.

Muhammada, S. et al., 2015. Factors Affecting Consumers' Willingness to Pay for Certified Organic Food Products in United Arab Emirates. Journal of Food Distribution Research, 46(1), 37-40, https://10.22004/ag.econ.199045.

Orzan, G. et al., 2018. Consumers' Behavior Concerning Sustainable Packaging: An Exploratory Study on Romanian Consumers. Sustainability, 10(6), 1787, https://doi.org/10.3390/su10061787.

Shafie, F.A., Rennie, D., 2012. Consumer perceptions towards organic food. Procedia-Social and Behavioral Sciences, 49, 360-367, https://10.1016/j.sbspro.2012.07.034.

Smoluk-Sikorska, J., 2017. Pricing policy in organic food retail trade. Journal of Agribusiness and Rural Development, 3(45), 675-683, https://doi.org/10.17306/J.JARD.2017.00365.

Tarkiainen, A., Sundqvist, S., 2005. Subjective norms, attitudes and intentions of Finnish consumers in buying organic food. British Food Journal, 107(11), 808-822, https://10.1108/00070700510629760.

Thompson, A., Moughan, P., 2008. Innovation in the food industry: Functional foods. Innovation: Organization & Management, 10, 61-73, https://doi.org/10.5172/impp.453.10.1.61.

Willer, H., Lernoud, J., 2019. The world of organic agriculture. Statistics and emerging trends 2019. Research Institute of Organic Agriculture FiBL and IFOAM Organics International, https://shop.fibl.org/CHde/mwdownloads/download/link/id/1202/?ref=1 [23-01-2020].

Zanoli, R., Naspetti, S., 2002. Consumer motivations in the purchase of organic food: a means-end approach. British Food Journal, 104(8), 643-653, https://10.1108/00070700210425930.

GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

PROBLEMATYKA OGÓLNOEKOLOGICZNA I SPOŁECZNA

Aleksandra **PAWEŁKO**

LIFE IN A CLEAN ENVIRONMENT AS A PERSONAL INTEREST

Aleksandra **Pawełko**, MSc – *University of Bialystok*

Correspondence address:
Wiejska Street 57/51, 15-351, Białystok, Poland
e-mail: aleksandrapawelko@gmail.com

ABSTRACT: The purpose of this article is to assess the emerging trend in Poland for seeking redress dictated by the inadequate state of the environment, based on the concept of personal rights. The considerations begin with the classification of life in a clean environment internationally. Then, the topic of determining the nature of the right to live in a clean environment in the Polish legal order is raised. First of all, constitutional regulations in this respect are assessed. In the further part of the work, the considerations focus on the subject of life in a clean environment treated as a personal interest, which is closely related to the findings made in part on the constitutional approach to the use of the natural environment. As a part of these considerations, the issue of addressing possible claims is also raised. The paper presents a general assessment of the enforcement of the right to live in a clean environment by formulating claims based on the concept of violation of personal rights, in particular those, which include financial demands.

KEY WORDS: environment, health, personal interest, compensation

Introduction

The natural environment creates conditions for proper functioning and development of the society. The condition of the community influences the quality of life of the society as a whole and of the individuals living in it. In the 1990s, the American philosopher and law professor James W. Nickel formulated the question: "Should environmentalists use rights language?" (Nickel, 1993). It seems that there are three standpoints in this respect – two extreme and one intermediate. The first of them approve of speaking in terms of rights about all environmental issues, including biotic or animal rights (e.g. Shelton, 2015). The opposite view assumes the avoidance of using legal categories in relation to the sphere of the environment (e.g. Stone, 1987). In this regard, the indirect position Nickel postulates assume using rather categories of environmental goods, respect for them and obligations towards nature, resting on both present and future generations. On the basis of this concept, he does not deviate completely from speaking about the rights related to functioning in the natural environment. It is emphasized, however, that this should only concern the most important issues, such as the right to a safe environment (Nickel, 1993). Contemporary discussion on this topic goes much further, as it reveals a tendency to treat the ht to the environment in terms of human rights. A proper environment is a prime condition for the fulfilment of other individual rights, hence the justification that such a claim is a fundamental matter.

The connection between human rights and environmental law in international law appeared in the 1970s. At The United Nations Conference on the Human Environment, held in 1972 in Stockholm, the so-called The Stockholm Declaration, which endorses the direct links between the human environment and his fundamental rights, including the right to life, was accepted (Stockholm Declaration, 1972). Also in The Rio Declaration on Environment and Development in principle 1 it was pointed out that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature (Rio Declaration, 1992). However, no specific regulations were formulated that would directly enunciate the human right to the environment. The human rights acts in force concern human rights to the environment indirectly, treating them as falling within the scope of the right which is directly protected. An example in this respect may be Art. 12 of The International Covenant on Economic, Social and Cultural Rights, which provides the right of everyone to enjoy the highest attainable state of physical and mental health (International Covenant, 1966). In practice, this provision may also apply to environmental issues to the extent that they may constitute an obstacle to the enforcement of this right.

The view contained in the Report to the UN Sub-Commission on Prevention of Discrimination and Protection of Minorities is important in this respect (Ksentini, 1994). In this report, the author points out that in international law there are tendencies to shift the emphasis from the position of international law relating to the environment to the position of the human right to a satisfactory environment. It is true that universal norms of international law do not explicitly define the human right to the proper environment, however, according to the author, this right can be derived from other human rights, and it falls under the existing system of protection of human rights. The author of the report indicates that they can be derived from the norms of substantive law, including the right to life, proper healthcare, the right to food, the right to private property, etc., and procedural standards, in particular the right to information and access to justice. Also, under Polish law, there is a conviction that the environment is a common good, which is why its protection should be a priority from society's point of view and thus be addressed by the combined efforts of the governments and individuals in order to realize the public interests. Its high priority is primarily supported by the fact that in the Constitution of the Republic of Poland, the country's supreme law, the Polish legislature has extensively outlined numerous issues concerning the environmental protection and obligations for public authorities to fulfill in that regard. Regulating the matters of the environmental protection in the Constitution is of utmost importance, as it enlists the most crucial points concerned with the organization of the state. Consequently, providing society with the appropriate environmental conditions is one of the government's fundamental duties. Considering these points, it can be concluded that every citizen should be guaranteed a right to environment usage. The logical consequence of such a notion is the following question: can such law be executed efficiently?

An overview of the literature

The issue of considering environmental issues in legal terms is widely described, in particular at the international level. Many papers have been published presenting various concepts in this respect – from extreme, ordering a close relationship between these two spheres (Shelton, 2015), through indirect, accepting mutual relations of law and environment, but properly balanced (Nickel, 1993), and extremely avoiding any connections between these two areas (Stone, 1987). This discussion has evolved towards accepting the validity of environmental rights and giving them the value of human rights. As for the ground of Polish law and the title problem of a clean environment treated as a personal right, it should be emphasized that this is a

novelty in Polish public space. Until now, the doctrine rather talked about the possibility of enforcing the right to a clean environment, citing violation of other personal rights (Smólska-Korpała, 1981). This concept was approved in the jurisprudence (e.g. docket number: I CR 356/75). The opposite standpoint also appeared; however, it did not find clear support in case law (Radecki, 1983). Currently, the problem of a clean environment treated as a personal right is a novelty in Polish public space. The discussion on this topic was initiated in 2015, when a Polish citizen residing in the Śląskie Voivodeship, one of the most polluted areas in the country, filed a lawsuit against the State Treasury (docket number: II C 1259/15). He demanded financial compensation for the violation of the personal right to live n a clean environment. This case has not yet been completed. The first instant court hearing ruled that living in a clean environment is not a personal right, while the second instance court hearing asked the Supreme Court to resolve the legal question presented.

The institution of legal questions (Art. 390 of the Code of Civil Procedure) serves to ensure uniformity, correctness and stability of court decisions. Importantly, a resolution of the Supreme Court resolving a specific issue is binding on the given case. This is very important in the context of personal rights because of the regulations in Art. 23 of the Civil Code, which provide for them, only list a sample catalogue of personal rights. Hence the general conclusion that there are also other personal rights not mentioned in this provision. With regard to the recognition of these "other" goods, an important role is attributed to judicature because each time the plaintiff formulates a request based on the violation (or threat) of his personal interest that is not listed in the Civil Code, the court first decides whether such personal interest exists at all. The court's decision to recognize the value indicated by the plaintiff as personal interest is in a way the basis for formulating claims on such grounds for the future. It is true that everything depends on the circumstances of the case, but the mere recognition of the existence of specific personal interest, in at least one case, enlarges the catalogue of examples of personal rights that can be invoked. When it comes to living in a clean environment treated as a personal right, it should be emphasized that it is a new approach. The mere interest in enforcing this right is a recent phenomenon. This is due to the fact that in Poland it was only recently that the awareness of the need to care for the state of the environment and legal measures to enforce the right to live in a healthy environment begun to arise. From the overview of research on ecological awareness of Poles carried out in the years 1992-2012 (Kłos, 2015), it appears that Polish society at the turn of the 1980s and 1990s was at the stage of shaping ecological awareness. On the one hand, Poles were becoming aware of the importance of environmental

protection for their lives and health; on the other hand, they did not know how to use this knowledge in practice. Emerging environmental organizations and associations (e.g. Klub Przyrodników) played a large role at that time. In the first years of the 21st century, an increase in the level of appropriate social attitudes towards the natural environment was noted. Importantly, Polish citizens increasingly began to notice the close relationship between their own behaviour and the quality of the environment. The overview of the research also shows that the number of people representing the attitude of the so-called ecological indifference began to decrease. The current state of ecological awareness is to some extent shown by the one-themed research conducted for the Ministry of the Environment in 2019, which concerned the awareness and ecological behaviour of Polish residents in the area of air quality, waste management and the so-called returnable bottles. Due to the theme of this work, the results of the air quality research will be presented (Jakość Powietrza, 2019). According to these surveys, only 1/3 of respondents take actions aimed at protecting their own health connected to air quality at their place of residence. The survey report indicates that this mainly applies to residents of large cities. It is also pointed out that every third Pole makes personal efforts to reduce emissions. The sample tested is representative because it takes into account demographic variables: gender, age and place of residence. The results of the study lead to the conclusion that the ecological awareness of Polish society is increasing, but it is still not fully satisfactory. Poles' ecological awareness can be described as germinating. This, in turn, means that some citizens, out of concern for their health and life, have decided to enforce the right to live in a clean environment through the courts. Until now, these were lawsuits based on the violation of already recognized personal rights, such as, for example, freedom of movement or privacy (e.g. Judgment of the Regional Court for Warsaw-Śródmieście in Warsaw – VI Civil Department of 24 January 2019, VI C 1043/18).

Environment as a constitutional right

It has been accepted in the doctrine that environmental law should be included in administrative law. It should be noted, however, that the objectives of environmental protection are also implemented by means of norms belonging to other branches of law, in particular constitutional law, public international criminal law. It is emphasized that the characteristic of this law is the fact that it "contacts" various areas of law (Cieślak, 2011). This chapter will detail the constitutional regulation of environmental issues, which may help answer the question about the nature of the right to live in a clean environment.

In the Constitution of Poland, the state lawmaker has extensively outlined numerous points concerning environmental matters. Constitutional codes focus chiefly on the obligations of the state authorities towards its protection. However, they do not limit those responsibilities exclusively to the respective government's acts. The regulations also place the duty to safeguard its well-being on every citizen. Art. 86 of the Constitution of Poland declares that *"Everyone shall care for the quality of the environment and shall be held responsible for causing its degradation"*. Within the frame of Polish constitutional doctrine, it became accepted that the aforementioned obligation comprises both the abstention from the acts that might prove harmful for the environment, and active participation in measures aiming to combat or prevent the environmental degradation and to restore the ecological balance.

However, for purposes of this paper, it is more imperative to focus on duties concerning the environmental protection on the authorities' part. Notwithstanding, it is worth remembering that an appropriate attitude and consciousness amongst the individuals towards the problem can facilitate the pursuit of a pro-ecological policy by the state. The Constitution of Poland underscores the following duties of the authorities concerning environmental protection:

- the duty to prevent the negative health consequences of degradation of the environment – Art. 68(4),
- the duty to pursue policies ensuring the ecological security of current and future generations – Art. 74(1),
- the duty to protect the natural environment – Art. 5 and Art. 74(2),
- the duty to support the activities of citizens to protect and improve the quality of the environment – Art. 74(4).

The regulations concerning the protection of the environment are justified by Art. 1 of the Constitution of Poland, which states "*The Republic of Poland shall be the common good of all its citizens*". The aforementioned duties vary in their nature. Part of them directly addresses environmental protection, while others involve it indirectly – their main goal being the protection of other values connected to the environment.

Art. 74(1), which concerns providing the ecological protection to current and future generations, can be rated among the former group. Ecological protection does not possess a legal definition. However, the interpretation of this term is conducted by the doctrine. According to the most common view, providing ecological security should be summarized as defining the optimal health conditions and providing them to the people due to the environmental situation. Such actions should involve the evaluation of potential dangers originating from the pollution, and the construction of the rules preventing the effects of biological, chemical, or physical pollution. To summarize, the

state is accountable for environmental protection, and this is constituted within the expectations and needs of the members of the society.

The next obligation included in this category is the duty described in Art. 5 and Art. 74(2) of the Constitution of Poland, which directly underscores the necessity of environmental protection. Said protection was defined in Polish law in Art. 3(13) of the Environmental Law Act, which states that the environmental protection is defined as *"action or abstaining from therein to preserve or restore the natural ecological balance; this protection involves in particular: reasonably shaping the environment and managing environmental resources in accordance with the principle of sustainable development, pollution prevention, and restoring the elements of the environment to their natural state"*.

The last duty worth mentioning at this stage is the duty of the state authorities to support the activities of citizens aiming to protect and improve the state of the environment. In this case, the obligations of the state are limited to support for pro-environmental initiatives taken by citizens. The doctrine underlines that this law is very general and declaratory, which makes it impossible to derive any concrete legal rights.

The duty applicable to the second discussed category is the prevention of negative consequences of environmental degradation. Art. 68 outlines the universal privilege to protect one's health, while Paragraph 4 of the same article associates the possibility of using this privilege with the necessity to provide an appropriate environment, which will not negatively influence the people's health. The fundamental value protected by this law is thus the human health, whereas the appropriate care about the environment is somewhat a guarantee of the ongoing respect towards this value.

The aforementioned obligations are mainly guidelines, whose core is giving the state authorities certain sets of goals while simultaneously not explicitly stating how these duties are to be fulfilled or what exact consequences the failure to meet those expectations should eventually bring. The Constitution of Poland does not introduce a pronounced right to live in a clean environment. However, in the light of aforestated laws, the thesis that a clean environment is a constitutional right is entirely justifiable. The point is further supported by the ruling of the Constitutional Tribunal of May 13th, 2009 (docket number: Kp 2/09), in which the Tribunal, analyzing regulations stated within Art. 68(4), Art. 74, Art. 86, and also Art. 31(3), ruled that *"The first of the regulations in question obliges the state authorities to prevent the negative consequences of the degradation of the natural environment. The second states that the protection of the environment is a duty of the state authorities, the policies of which are to ensure the ecological safety for the current and future generations (as well as support citizens in their efforts towards both the*

environmental protection and the improvement of the state of the natural environment). The third law introduces the general duty to protect the state of the natural environment and mentions the eventual consequences of damaging the environment, based on the laws included in the statute. The combination of all aforementioned laws leads to the conclusion that "healthy" environment is, in fact, a constitutional right, the realization of which should the process of the interpretation of the Constitution be subordinated to". Consequently, it ought to be assumed that the right to a clean environment is a constitutional right, and in situations when executing it becomes difficult or is obstructed, citizens should possess the right to demand the reinstating of the factual opportunity to this privilege.

Life in a clean environment as a personal right

The literature indicates that environmental protection standards are oriented not only towards the public interest but also the private interest (Stelmasiak, 2013). Indeed, the dominant tools used under this law are public law instruments, but the scope of using private law instruments is also gradually increasing, particularly the claims for compensation and restitution (Skoczylas, 1989; Rakoczy, 2015).

As mentioned before, the right to live in a healthy environment was not precisely defined neither in the Constitution of Poland nor in the lower legislations. Nonetheless, based on enforced environmental laws, especially on the constitutional level, a reasonable conclusion stating that such laws apply to every individual, can be raised. The natural consequence of pledging for any law is the possibility of enforcing it, especially in courts. This opportunity originates from Art. 45 of the Constitution of Poland, enacting a universal a right to a fair trial. Claims concerning matters connected with the poor environmental condition can be brought to a civil trial, in particular in the character of claims for damage. In this case, damage can be interpreted as the state of affairs varying on the circumstances, e.g. damage to health, a decrease in the value of a property, etc. Thus, the matters in question are financial losses, i.e. the kind of damages that are economic in nature. Increasingly, however, aside from, or perhaps in the place of usual financial losses, people do seek legal claims by responsibility for the so-called infringement of personal interests.

What, then, are personal interests? Concerning the matter of their protection, Art. 23 and Art. 24 of the Civil Code regulate the subject. The first law contains a catalogue of the possible examples of personal interests and guarantees their protection on the grounds of civil law. The list includes the following personal interests: health, freedom, honour, freedom of conscience,

surname or pseudonym, image, the confidentiality of mail, immunity of residence, work in the fields of science, art, inventions and streamlining. In the Polish doctrine of the civil law, personal interests came to be defined as non-financial personal values and are an expression of human dignity, mainly concerning the matter of individuality, as well as both physical and mental integrity of a person (Machnikowski, 2019). This definition points towards the fact that personal interests are assigned to every person and are inalienable, just as human dignity is an imperative right. That human dignity is what every human is entitled to for the sole reason of being a human. The privilege is inborn and cannot be renounced. However, the character of individual interests should be examined based on objective criteria, which means a case-by-case classification of a situation in the framework of the social appraisal of the behaviour at hand, and not solely on the subjective feelings of the given individual. Personal interests are values vital for the entire society. It is also worth underlining that those values change with time, dictated by what merits are widely respected at the moment. Another characteristic of personal interests is their non-material character, which means they are not usually evaluated in economic terms. They are commonly held at a higher esteem than financial rights due to the close connection to human dignity. As mentioned before, the list of personal interests in Art. 23 of the Civil Code serves merely as an example. Sometimes it is said that it is an open catalogue (Sobolewski, 2020); however, this formulation should be used with caution. The term "open-ended" could potentially suggest certain flexibility when defining further personal interests, without any reflection on their actual state. The doctrine sometimes indicates that in a sense this catalogue is closed because the list is dependant on how many and which humane values the society currently recognizes and deems as the most important for the public (Machnikowski, 2019). This view is justified due to the fact that it is not possible to express approval for an unlimited extension of the catalogue of personal rights from Art. 23 of the Civil Code. Therefore, certain features have to be specified that a given value must have in order to qualify as a personal interest. It is emphasized in this connection that personal rights are values that are closely related to the essence of humanity and the nature of man, independent of his will, of a permanent nature and can be specified and objectified, or being a manifestation of creative activity, testify to the individuality of man (Grzybowski, 1957). The aforementioned Art. 24 of the Civil Code enumerates the catalogue of means entitled in the case of danger or infringement of personal interests, assuming that such action goes against the law. Among them, there are included financial claims, namely the ones demanding a monetary reparation or a particular payment for an indicated social cause, and fixing the property damage.

Moving the deliberation about personal interests towards the possible claims concerning the worsening state of the natural environment, it is necessary to state at the beginning that applying such construction to vindicate the examined rights is far from simple. The proceeding of the possible infringement of personal interests requires to present the subject responsible for the violation (or endangering), reasons showcasing his liability, and evidence of the infringement (or threat). The most extensive doubts concern the question of whether life in a clean environment is an individual right. An unequivocal answer in this respect is necessary because only establishing that there has been a violation of personal rights determines the possibility of considering the issue of liability in the light of Art. 24 of the Civil Code.

There are two basic views of the doctrine. The first refuses to grant an independent legal personality to a personal interest in the form of a clean environment. On the basis of this theory, the inherent nature of the subjective right to live in a clean environment is negated, which is justified by the thesis that it is unnecessary to fragment existing personal rights (Smólska-Korpała, 1981). The position of the Supreme Court from the 70s of the last century is significant in this respect, in which it was stated that the human right to an uncontaminated environment could be protected by means of instruments provided for in Art. 24 of the Civil Code, when the violation of this right also constitutes a violation or threat to personal rights from Art. 23 of the Civil Code (docket number: I CR 356/75). Therefore, on the basis of this concept, it is not possible to individualize the personal interest in the form of the natural environment.

The second concept assumes that a clean environment should be seen in the category of independent personal interest (Radecki, 1983). Referencing the aforementioned doctrinal definition of personal rights, one can state that it is justified to include living in a clean environment in such a category. It is a certain non-financial value for the healthy environment is a fundament of human existence (and by extension, the society as a whole) to properly function, which can fulfil both financial and non-financial human rights. However, the healthy environment by itself is an invaluable right, impossible to measure in economic terms. While referencing the other definition of personal interest, it is necessary to concur that functioning in a healthy environment is closely connected to a human being and is a representation of one's dignity. Every person is guaranteed the right to use the environment for the sole reason of being a human. It correlates with human dignity as it assures the proper conditions towards maintaining said dignity. The statement about the independent nature of the right to live in a clean environment is based on constitutional regulations. Although there is no provision that would explicitly indicate such a right, in accordance with the rules of proper legislation

referred to in Art. 2 of the Constitution, the law should not only declare future rights. It seems, therefore, that the right to live in a clean environment can be interpreted in particular from Art. 74(2) of the Constitution. Since environmental protection is the responsibility of public authorities, the consequence of its implementation should be a clean environment. In addition, constitutional provisions have been made more specific by the norm from Art. 4 of the Environmental Protection Act (Prawo ochrony środowiska, 2001) according to which everyone is entitled to the universal use of the environment by law and which includes the use of the environment, without the use of installations, to meet personal and household needs, including leisure and sports.

These reflections are not far from reality, as presently there has been an ongoing passionate debate in Poland, regarding whether life in a healthy natural environment is a personal interest, or not. The direct source of this debate was a case of a citizen of Rybnik (a city in Southern Poland), who in 2015 sued the State Treasury in Poland, demanding reparation of fifty thousand złotys for the infringement of personal interests due to high level of air pollution in the city (docket number: II C 1259/15). In his explanation, the plaintiff indicated that he had been living in Rybnik for several years, and every year the weather reports indicated that air pollution levels severely bypassed the norm, e.g. the concentration levels of PM10 and PM2.5 dust, sulphur dioxide, and carbon monoxide. The plaintiff believed that inhabiting a terrain with such volatile environmental conditions resulted in numerous negative consequences. The plaintiff mainly underscored the enormous physical discomfort, usually manifesting itself as fears concerning the influence of polluted air on his and his loved ones' health. He argued further that the pollution leads to the lowering of the comfort of living and limits the freedom to use one's property and movement, especially in the light of recommendations from authorities to stay inside homes due to the presence of dangerous substances in the air. The plaintiff supported his claim by both EU and Polish laws. As a basis, he included the directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008 on ambient air quality and cleaner air for Europe. Furthermore, he invoked Art. 5 and Art. 74 of the Constitution of Poland, stating that the public authorities are obliged to protect the quality of the environment and strive towards improving it. As the basis for the claimed responsibility of the State Treasury for the infringement of personal interests, the plaintiff invoked Art. 448 and Art. 417 of the Civil Code, which concern the claims in the case of the infringement of personal interests and the responsibilities of the State Treasury for the damage resulted due to its actions. The court of the first instance ruled that life in a clean natural environment cannot be generally recognized as a personal interest while acknowledging that a polluted environment does influence or

could potentially influence other personal interests, whether listed in the Civil Code or acknowledged under different judicial decisions.

While the court agreed with the plaintiff that the quality of air in Rybnik does leave much to be desired, it ruled that such a fact did not infringe a recognized personal interest that is health. It was added that the right to free movement was not violated and that the plaintiff was able to move out of Rybnik. The case was investigated by Polish Ombudsman, who demanded the claim to be re-examined by the court of the second instance. The court of appeal did not announce a substantive verdict but rather took the case to the Supreme Court with a request to settle the disputed legal issue (Art. 390 of the Code of Civil Procedure). Namely, it was the question of whether life in a clean environment is a personal interest, which can be potentially enforced in the court of law. The Supreme Court's ruling of this case can be a turning point in the ongoing discussion regarding the subject. On the one hand, it can open or close the door to future lawsuits against the State Treasury for the infringement of the personal interests of the citizens due to the negligence of the natural environment. On the other, it will reflect what axiological stance the Polish statue currently possesses, as to whether it is, in fact, connected with human dignity in the understanding of the Polish law.

The lack of a unitary stance in the doctrine and judicial decisions regarding the question of whether life in a clean environment is a personal right is not the only obstacle in the realization of such claims. Another problematic issue is the matter of who should be a respondent to such lawsuits – the central power or local authorities. From the evaluation of the author of this work, the party which such eventual claims should be directed towards is the State Treasury and not the local authorities. Primarily, the state (understood as the central authority) has a far greater range of options and possible measures to influence environmental politics in comparison to local authorities. The most efficient tools in that regard are the legislative powers, that is, those constituting appropriate regulations introducing concrete instruments towards the prevention of environmental pollution. In addition, there is a broadly developed government clerical apparatus in the field of environmental protection – both at the central and field level. Such central-level bodies include, first and foremost, the minister competent for the environment, the minister competent for the climate, government plenipotentiaries in environmental matters, the General Director for Environmental Protection, the Chief Inspector for Environmental Protection or the President of the National Water Management Board. At the local level, they include regional director for environmental protection, voivodship inspector for environmental protection, director of the regional water management board or director of the regional mining office. The extensive organizational network of government administra-

tion in the field of environmental protection implies a claim on the multitude of tasks carried out by these bodies. This also gives grounds to the claim that the central government has greater opportunities in the field of environmental protection. Addressing claims to local authorities is likely to end in failure, due to the fact that the legislator at the local level did not foresee such broad tools for combating environmental pollution as the ones at the governmental level. In the doctrine, tasks at the local government level were divided into four groups: organizational, direct-executive, obligatory-regulatory and supervisory-control tasks (Górski, 1992). As an example of organizational tasks, one can indicate the creation of self-government environmental protection programs (e.g. Art. 107 of the Environmental Protection Law). Direct-executive tasks are those that involve the elimination or reduction of specific threats arising as a result of the functioning of local communities, e.g. the generation of municipal waste. The binding and regulatory tasks consist of establishing specific bans and orders against entities that influence the environment or use it (e.g. Art. 116 of the Environmental Protection Law). As far as supervisory and control tasks are concerned, they consist of examining the state of the environment and complying with specific obligations in this respect (e.g. Article 379 of the Environmental Protection Act). The role of local government environmental bodies in the environmental law system is obviously big; however, the strongest tools for implementing environmental protection remain in the hands of central authorities. First of all, the most important in this respect is appropriate lawmaking, which is the responsibility of the legislative authority, because it is the applicable law that is the basis for all the rights and obligations of specific authorities. In practice, proving the lack of necessary activity from the local authorities and the fact that poor air quality is a result only of inappropriate policies of the local government is nearly impossible. As a consequence, when deciding to execute the right for a clean environment, it seems more efficient to direct the eventual lawsuits towards the central authority.

Conclusions

The right to a clean environment is a privilege of every individual since the environment creates the fundamental conditions for the survival and development of society. Its state determines all aspects of individual people's functioning. Based on the above considerations, it can be concluded that living in a healthy environment has the characteristics of personal interest within the meaning of Art. 23 of the Civil Code. In Polish law, the infringement of personal interest (or threat to) can result in particular resolutions imposed by the court of law, including those granting a recompensation to

the sufferers. When considering the concept of environmental actions in which specific financial demands are formulated, one should think about the sense of such a solution. If such an action is aimed at providing the public authority with an additional stimulus and motivation to make efforts to improve the state of the environment, then such an initiative should be considered right. It should be noted, however, that even if one considers life in a clean environment as a personal interest, it cannot be given an absolute character. The dynamic development of agglomerations, industrial centres and various civilization structures, on the one hand, causes some nuisance, but on the other hand, it is, as a rule, socially desirable and accepted. Therefore, assessments cannot be made in this respect, ignoring the current economic context. If these aspects are not taken into account, the provisions of Art. 5 of the Civil Code, which is an abuse of subjective law, might be made of us. As a result, basing the request on the concept of violation of personal interest may end up being classified as an attempt to obtain unjustified material benefits. Therefore, it should be recognized that this solution should be used in exceptional situations, where evident negligence on the part of public authorities resulting in violation of citizens' right to live in a clean environment can be identified.

In an ideal assumption, environmental protection and efforts towards improving the state of the environment should rather take the form of concrete actions, instead of filing lawsuits against the public authorities, and by extension co-citizens, for long-term negligence concerning the matter. This is since Art. 86 of the Constitution of Poland obliges every citizen to care for the environment and as a consequence, holds them responsible for every instance the state of it worsens due to earlier actions. As an example, in the majority of cases, the reason for the creation of smog is so-called low emission (Smog – przyczyny i możliwości zwalczania, 2017), e.g. emission from cars or households warmed with coal. Thus, one must conclude that society does have a tremendous impact on what state the common good, our environment, is in. Based on these conclusions, the administrative measures, such as the introduction of plans guaranteeing payments for the replacement of furnaces or linking residential areas to heating systems, seem to be a far more prominent alternative. In this regard, it is worth mentioning the expectations of the members of society themselves. According to thd research on air quality conducted for the Ministry of the Environment in 2019 (Jakość Powietrza, 2019), actions aimed at improving air quality should take the form of replacing old furnaces with low-emission ones, increasing the control of exhaust emissions in cars and increasing control over what is burned in home stoves. A crucial role is also played by public education in the field of environmental protection. Unfortunately, in Poland, littered forests and rivers, and the lack of com-

mitment to the obligation to segregate waste are still fairly common phenomena. Changing that requires a reformation of the collective consciousness of society members concerning the ecology and environmental protection. Social campaigns and various projects promoting pro-ecological behaviour are desirable in this respect. Such mechanisms result in shaping models of socially desirable behaviour. In addition, content related to economic awareness should be the subject of the core curriculum in schools at the lowest levels of education. Shaping ecological awareness in children and adolescents is crucial in this respect. It is worth remembering that the diligence towards the environment is a duty of the society as a whole, its representatives serving specified governmental functions, and individual people. Therefore, even the most innovative solutions will not have the same force as the actions of the whole society does, which comprise efforts concerning the condition of the environment, which, after all, is a common good.

References

Act of 23 April 1964 Civil Code (Journal of Laws of 2019, item 1145, with later amendments).

Act of 27 April 2001 Environmental Protection Law (Journal of Laws of 2019, item 1396, with later amendments).

Act of 17 November 1964 Code of Civil Procedure (Journal of Laws of 2019, item 1460, with later amendments).

Biuro Spraw Senatorskich Kancelarii Senatu, 2017. Smog – przyczyny i możliwości zwalczania. Zeszyty Zespołów Senackich, zeszyt Nr 32, materiały z czwartego posiedzenia Senackiego Zespołu Śląskiego.

Cieślak, Z., 2011. Ogólna charakterystyka prawa administracyjnego. In: Niewiadomski, Z. (Ed.), Prawo administracyjne. LexisNexis, Warszawa, 53.

EU, 2008. Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe, L 152/1.

Florczak-Wątor, M., 2019. Komentarz do art. 74. In: Tuleja, P. (Ed.), Konstytucja Rzeczypospolitej Polskiej. Komentarz, Wolters Kluwer Polska, Warszawa, https://sip.lex.pl/#/commentary/587806668/604108 [04-05-2020].

Górski, M., 1992. Ochrona środowiska jako zadanie administracji publicznej. Wydawnictwo Uniwersytetu Łódzkiego, Łódź, 105.

Grzybowski, S., 1957. Ochrona dóbr osobistych według przepisów ogólnych prawa cywilnego. Wydawnictwo Prawnicze, Warszawa, 78-79.

Korzeniowski, P., 2012. Bezpieczeństwo ekologiczne jako instytucja prawna ochrony środowiska. Wydawnictwo Uniwersystetu Łódzkiego, Łódź.

Ksentini, F.Z., 1994. Review of further developments in fields with which the Sub-Commission has been concerned. Human rights and the environment. Final report prepared by Mrs. Fatma Zohra Ksentini, Special Rapporteur, E/CN.4/Sub.2/1994/9.

Machnikowski, P., 2019. Komentarz do art. 23. In: Gniewek, E. (Ed.), Kodeks cywilny. Komentarz. C.H.Beck, Warszawa, http://sip.legalis.pl/document-view.seam?docume-tId=mjxw62zogi3damrtgu4dknboobqxalruhe2deojtge2q [27-02-2020].

Ministerstwo Środowiska, 2019. Raport z jednotematycznego badania świadomości i zachowań ekologicznych mieszkańców Polski – Jakość powietrza, https://www.gov.pl/web/klimat/swiadomosc-i-zachowania-ekologiczne-polakow [06-05-2020].

Nickel, J.W., 1993. The Human Right to a Safe Environment: Philosophical Perspectives on Its Scope and Justification, 18 Yale J. Int'l L., New Haven, 282.

Radecki, W., 1983. Żądanie wstrzymania działalności szkodliwej dla środowiska w prawie cywilnym. Palestra, 27/10(310), Warszawa, 10.

Rakoczy, B., 2015. Prawo ochrony środowiska w styku z innymi obszarami systemu prawa. In: Korzeniowski, P. (Ed.), Zagadnienia Systemowe Prawa ochrony środowiska. Polska Akademia Nauk Oddział w Łodzi, 73.

Shelton, D., 2015. Nature as a legal person, *VertigO – la revue électronique en sciences de l'environnement*, special issue 22, http://journals.openedition.org/vertigo/16188 [02-05-2020].

Skoczylas, J.J., 1989. Odpowiedzialność cywilna za naruszenie obowiązku ochrony środowiska. Palestra, 11-12, Warszawa, 53.

Smólska-Korpała, M., 1981. Ochrona dóbr osobistych w świetle ustawy o ochronie i kształtowaniu środowiska NP, 3, 5.

Sobolewski, P., 2020. Komentarz do art. 23. In: Osajda, K. (Ed.), Kodeks cywilny. Komentarz.C.H. Beck, Warszawa, http://sip.legalis.pl/document-view.seam?documentId=mjxw62zogi3damrvgi3dmmzoobqxalruhe2deojtge2q

Stelmasiak, J., 2013. Interes indywidualny a interes publiczny w ochronie środowiska w obszarze specjalnym o charakterze ekologicznym. Wydawnictwo Uniwersytetu Rzeszowskiego, Rzeszów, 16-19.

Stone, Ch.D., 1987. Earth and other ethics: The case for moral pluralism. Harper&Row, New York.

The Constitution of the Republic of Poland of 2 April 1997 (Journal of Laws of No. 78, item 483, with later amendments).

UN, 1966. International Covenant on Economic, Social and Cultural Rights, United Nations GeneralAssembly Resolution 2200A [XXI].

UN, 1992. Rio Declaration on Environment and development, Report of the United Nations Conference on Environment and Development, A/CONF.151/26 (Vol. I).

UN, 1972. Stockholm Declaration of the United Nations Conference on the Human Environment, Report of the United Nations Conference on the Human Environment, A/CONF.48/14/Rev.1.

Wyrok Sądu Najwyższego z dnia 10 lipca 1975 r., I CR 356/75, OSP 1976/12/232, LEX nr 344145.

Wyrok Sądu Rejonowego w Rybniku z dnia 30 maja 2018 r., II C 1259/15, LEX nr 2579727.

Wyrok Sądu Rejonowego dla Warszawy-Śródmieścia w Warszawie z dnia 24 stycznia 2019 r., VI C 1043/18, LEX nr 2817690.

Wyrok Trybunału Konstytucyjnego z dnia 13 maja 2009 r., Kp 2/09, OTK-A 2009/5/66, LEX nr 493281.

Maciej CIEŚLUKOWSKI

TAXATION OF GOLF COURSES IN POLAND AND SELECTED COUNTRIES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Maciej **Cieślukowski**, Associate Prof. (ORCID: 0000-0001-6058-0113) – *Poznań University of Economics and Business*

Correspondence address:
Niepodległości Avenue 10, 61-875, Poznań, Poland
e-mail: m.cieslukowski@ue.poznan.pl

ABSTRACT: The aim of the article is to present golf in the context of sustainable development and to assess the national tax conditions for the development of this discipline against the background of solutions of selected Central and Eastern European countries. Current literature on the comprehensive impact of golf on sustainable development is very limited, primarily discussing the health and tourist aspects of this discipline. The article is literature-empirical. The impact of golf on sustainable development was examined based on a review of domestic and English literature, analysis of source materials of various golf organizations and federations, and analysis of statistical data of internet databases. A comparative analysis of golf sectors in selected countries was carried out. Tax conditions were assessed based on the analysis of legal regulations and the comparison of tax rates between selected countries. The article shows that golf is conducive to health and economic development, while its impact on the natural environment is debatable. Golf is not very popular in Poland, and the golf sector is less developed compared to countries such as the Czech Republic, Estonia, Slovenia and Slovakia. In particular, property taxation is not conducive to the development of this discipline. In Poland, the golf sector has rather a low impact on sustainable development.

KEY WORDS: golfing, golf industry, sustainable development, taxation of golf courses

Introduction

The latest UNO 2030 Agenda for sustainable development has 17 goals (UNO, 2015). Achieving these goals requires not only international cooperation but above all, the establishment of comprehensive partnerships at the national and local level. States have committed themselves to mobilize public funds and take appropriate actions and tools (measures). Preliminary source studies indicate that such a measure may be playing golf and preferential taxation of golf courses may contribute to the development of this discipline. Golfing can contribute in particular to three goals of 2030 Agenda: goal number 3 (ensuring a healthy life and promoting well-being for persons of all ages), goal number 8 (promoting sustainable, inclusive growth, full and productive employment and decent work for all) and the goal 15 (protecting, restoring and promoting the sustainable use of terrestrial ecosystems, sustainable forest management, combating desertification and stopping and reversing land degradation, and halting the loss of biodiversity). The existing literature on the subject mainly focuses on the health and tourist aspects of golf, while the other aspects of sustainable development require more extensive and recent analysis.

The aim of the paper is to present golf in the context of the three goals of sustainable development presented above and to assess the national tax conditions for the development of this discipline against the background of solutions of selected Central and Eastern European countries.

An overview of the literature

National and English-language literature on the overall impact of golf on sustainable development is very limited. The most scientific positions were recorded in the field of health aspects of golf. A good meta-analysis of this literature is given by Murray, Daines, Archibald et al. (2016). These authors reviewed 301 scientific papers on the impact of golf on health published in the period before 1960 and until the end of 2016. These publications were published in 22 countries, most of them in the United States (162), Great Britain (38) Australia (27) and Japan (12) as well as Canada and South Korea (10 each). Most publications (over 100) were published in the years 2000-2009.

In the context of the golf's impact on economic, social and environmental aspects, various types of reports and studies of golf organizations dominate. In particular, valuable are studies originating in Australia, Canada and the United States in which golf is a very popular sport discipline and the golf industry has become an important sector of the economy.

Unfortunately, in Poland, these topics are rarely ever the subject of interest from science. It is worth mentioning here two items by Kowalczyk (2010) and Kowalczyk and Derek (2010) dealing with the role of golf in sustainable tourism and an article by M. Mitukiewicz (2004) illustrating the global dimension of golf. Kowalczyk and Derek (2010, p. 328) also indicate that despite pre-war traditions, golf in Poland did not become a popular game until the end of the 20th century. The internet resources of the Polish Golf Association and national golf clubs also do not contain any advanced studies on the impact of golf on sustainable development.

Research methods

The paper is literature-empirical. The impact of golf on sustainable development was examined on the basis of a review of domestic and English literature, analysis of source materials of various golf organizations and federations, and analysis of statistical data of internet databases (mainly Statista). The size of the golf sector and the economic benefits of golf have been compared across countries in different time configurations depending on the availability of data. Generally, the analysis covered the years 2008-2017. Using the indicators of the total number of golfers per population and the average number of golfers per golf course, the current state and potential for further development of the discipline in individual countries were also compared.

The tax conditions for running golf clubs are presented in two stages. First, the scope of taxation of these entities in Poland was presented from the point of view of the legal and organizational form of conducting a business activity, and then comparative analysis of the applicable rates in the most important taxes was made in such countries as the Czech Republic, Estonia, Poland, Slovenia and Slovakia. Data on this subject was obtained from the European Commission's database (*Data on taxation*). The analysis covered the years 2017-2019.

Results of the research

Health effects of golf

Murray, Daines, Archibald et al. (2016) show that regular golfing primarily strengthens the player's physical condition and prevents numerous diseases. The health benefits most often include improved lung function, improved cardiovascular system and aerobic fitness, better metabolism and improved functioning of the musculoskeletal system. As a result, the risk of

injury and diseases such as hip fracture, type 2 diabetes, heart attack, stroke, colorectal cancer and lung cancer is reduced. Golf is also moderately injurious compared to other disciplines. Researchers also point to the mental and social benefits of taking up this discipline, although these require further in-depth research. The first include improvement of self-esteem, an increase of self-worth, effectiveness, resistance to stress, an increase of satisfaction and improvement of well-being. The latter are expressed, inter alia, in the possibility of establishing new interpersonal relationships, belonging to a specific local sports group (golf club), charity. For example, Australians indicate that mental and social factors mainly motivate them to play golf (2018 Golf Club Participation Report of Australia, 2019, p. 6; Community Impact Survey September 2017, p. 37 et seq.). Scientists from Sweden prove that a golfer, regardless of gender, age and social status, lives about 5 years longer than a person who does not play golf (Farahmand, Broman, de Faire et al., 2009). Given the social status, the studies show that people with very different levels of wealth play golf. People with lower incomes may use public, inexpensive golf courses and rent golf equipment at a very affordable price.

Researchers also indicate health risks associated with taking up this discipline. These include the risk of skin cancer, dehydration and exhaustion in the event of hours of effort in the sun. The first risk may also result from the use of artificial fertilizers on golf courses. Also, especially during competitions, increased nervous tension and pressure increase are noted among competitors. However, these risks can be minimized by appropriate organizational and mental preparation for the game (proper clothing, sunscreen, lotions and conditioners, looking for shade, etc.).

Due to health and social values, regular golfing is recommended for people of all ages, especially the elderly. In some countries, both with a developed golf industry (e.g. in Canada, Australia, the United States) and ones the developing the golf industry (e.g. in India) golf is also included in the curricula and games of primary, secondary and higher education (Future Links, www.golfinschools.golfcanada.ca; Golf Australia, www.golf.org.au/schoolevents; Community Impact Survey, September 2017, p. 77 et seq.; Tee20, Strategic Plan, The Indian Golf Union, November 2013). It is also worth emphasizing that in recent years golf has been playing an increasingly important role in the rehabilitation of people with physical and mental disabilities.

One of the main causes of the appearance of diseases is low physical activity (Community Impact Survey, September 2017, p. 62). The health benefits of golfing result from many hours of moderate physical effort in the open air during one round of the game (18 holes). Regular and moderate physical activity (burning from 3.5 to 7.0 kcal/min) is recommended by the World Health Organization (EU Guidelines, 2008, pp. 8 and 9). Usually, the

game takes place in a group of two to a maximum of four people. Research shows that golfers perform from 11.2 to 16.7 thousand steps, walk from 6.4 to 12.8 km and burn from 531 to 2467 kcal (from 3.3 to 8.15 kcal/min). The scope of performance depends mainly on your handicap skills, gender and whether the player uses a trolley with a bag filled with clubs or uses the help of a caddy (a person who carries a bag with player's golf clubs, as well as gives advice and mentally supports the player). In contrast, people using golf carts generally achieve worse results by half. It is also worth emphasizing that significant physical effort is also made by supporters who follow players during tournaments (Lyu and Lee, 2013).

Economic benefits

A detailed description of the structure of the "golf industry" and its economic results are provided, among others, by TEConomy reports. They relate to the golf industry in the United States and are prepared every 5 years (e.g. US Golf Economy Report, 2017). Golfing contributes to income, employment and wages directly in the "golf industry" as well as indirectly in other sectors of the economy. In the United States, the golf industry is divided into key and supportive parts. The key industry includes entities and activities such as clubs and golf courses, investment in golf courses (construction of new courses and modernization of existing ones), producers and suppliers of golf equipment (clubs, bags, balls, clothing, etc.), golf services and charity golf events. Golf clubs and courses play the crucial role, they generate revenues mainly from green fees (fee for entering the field and using greens) and membership fees and bear the costs of maintaining golf courses. The clubs also offer additional golf services, e.g. organize tournaments, occasional events, rent space. Charity is also an important part of the industry being researched. It mainly takes place during professional tournaments in which golfers donate part of the cash prize for specific social purposes. Within the supportive industry, the real estate market in golf resorts (hotels, restaurants, houses, apartments, etc.) and the golf tourism industry stand out.

Indirect economic effects arise mainly in sectors outside the golf industry that provide products and services to the golf sector. Also, induced effects are distinguished, which constitute additional income generated in the entire economy caused by expenses of employees employed in the golf industry and its suppliers. Finally, the beneficiaries of golf are also the state and local governments, which earn tax revenues on the golf industry and related industries. The distribution of economic benefits, however, varies greatly across countries and regions depending on the degree of development and popularity of the discipline.

Gofing is one of the most popular sport in the world. Murray, Daines, Archibald and others in an article from 2016 place golf in third place in the world and say that 55 million registered amateur and professional players play golf in 206 countries, while 250 million players play football, 75 million players play tennis, and 5 million players – rugby (Murray, Daines, Archibald et al., 2016, p. 4).

Table 1. The number of registered players and golf courses in selected countries and regions in 2017

Countries	Population	Number of registered players	Number of golf courses	Number of players/ population	Number of players/ golf course
United States[1]	322 179 605	23 800 000[2]	15 014	7.39%	1 585.2
Japan[1]	127 748 513	5 500 000[2]	2 290	4.31%	2 401.7
Canada	36 624 199	5 700 000[2]	2 298	15.56%	2 480.4
Australia	24 450 561	978 000[2]	1 656	4.00%	590.6
Europe	741 447 158	4 140 000	6 861	0.56%	603.4
England	55 619 400	655 839	1 872	1.18%	350.3
Germany	82 521 653	644 943	731	0.78%	882.3
Sweden	9 995 153	468 570	442	4.69%	1 060.1
France	66 804 121	410 171	602	0.61%	681.3
Netherlands	17 181 084	387 797	250	2.26%	1 551.2
Spain	46 528 024	270 464	349	0.58%	775.0
Scotland	5 424 800	187 802	560	3.46%	335.4
Czech Republic	10 578 820	60 301	106	0.57%	568.9
Slovenia	2 065 895	8 762	13	0.42%	674.0
Slovakia	5 435 343	8 689	26	0.16%	334.2
Poland	37 976 687	5 646	33	0.01%	171.1
Estonia	1 315 635	2 843	8	0.22%	355.4

[1] data for 2016; [2] total number of players.

Source: author's work based on US Golf Economy Report, 2017, p. 4; NGF's 2017 Participation Report Golf, April 2017, www.thengfq.com [21-11-2019]; Club Participation Report of Australia 2017, June 2018, p. 3 and 10; Golf Facilities in Canada, 2017, Golf Canada, The PGA of Canada, p. 4; Canadian Golf Consumer Behaviour Study, NAVICOM, The National Allied Golf Associations (NAGA), www.canadagolfs.ca [20-11-2019]; Japanese playing golf 2016-2030, www.statista.com [17.11.2019]; Top 100 golf courses, www.top100golfcourses.com [17-11-2019].

In turn, on the PledgeSports website in the 2017 ranking, golf was placed 10th in the world, also after such disciplines like table tennis, cricket, basketball, volleyball, field hockey and badminton (10 Top Most Played Sports, www. pledgesports.org). In 2017, the largest number of players was recorded in the United States, Japan, Canada and Europe, and these are also the places where there were most of the registered golf courses (table 1).

In the years 1990-2010, in Europe alone, the number of golfers increased from 1.7 to 4.4 million, after which it decreased and at the end of 2017 reached 4.1 million (www.statista.com). In 2017, over 73.0% of the total number of players was registered in seven countries, i.e. England, Germany, Sweden, France, the Netherlands, Spain and Scotland. These countries also owned over 70.0% of the total number of golf courses registered in Europe.

Based on the total number of golfers per population and the average number of golfers per golf course, you can compare the current state and potential for further development of the discipline in individual countries, and the higher these indicators are, the better. This means that the demand for golf is still rising and outstripping supply. The table shows that the best-developed golf industries include the United States, Japan, Canada, Australia, England, Sweden, Scotland and the Netherlands. Scotland, England and Australia should also be considered very stable, where the relative balance between high demand and supply of golf services is maintained. The relatively high player rates for the population in the United States, Japan and Canada result from the analysis of all players, while only some of them are registered in clubs or play regularly. For example, in Canada, the share of these players in the total number of players is 62.0%.

In Central and Eastern Europe, in the years 2010-2017, golf was the most popular game in the Czech Republic, Slovakia, Slovenia, Poland and Estonia. The total number of golfers in these countries increased from over 64.9 to 86.3 thousand (figure 1), and the number of fields increased from 137 to 186 (figure 2). Most players were registered in the Czech Republic, Slovenia and Slovakia, and the most golf courses – in the Czech Republic, Poland and Slovakia. In the remaining countries of the region, the number of golfers did not exceed 2,000 and the number of golf courses (except Russia and Hungary) – 9. The indicated countries, except Poland, are considered to be markets with development potential (KPMG, 2016, p. 10). Unfortunately, in Poland, the golf sector development forecasts did not come true, as at the end of 2010, as many as 142 golf courses were anticipated (Mitukiewicz, 2004, p. 170). Table 1 shows that the interest in golf in Poland in 2017 was relatively low compared to other countries, and the number of fields was enough to meet the average demands for the game.

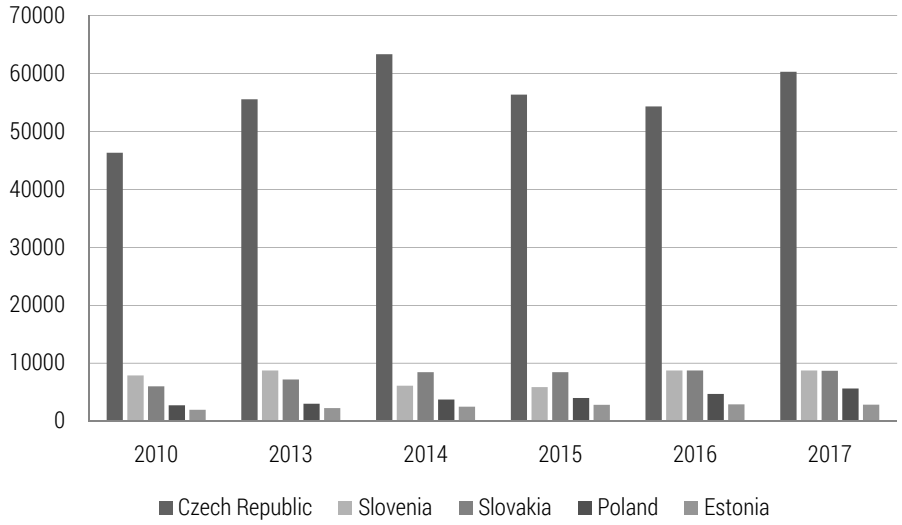


Figure 1. Number of registered golfers in 2010-2017 in selected countries of Central and Eastern Europe

Source: author's work based on www.statista.com [17-11-2019].

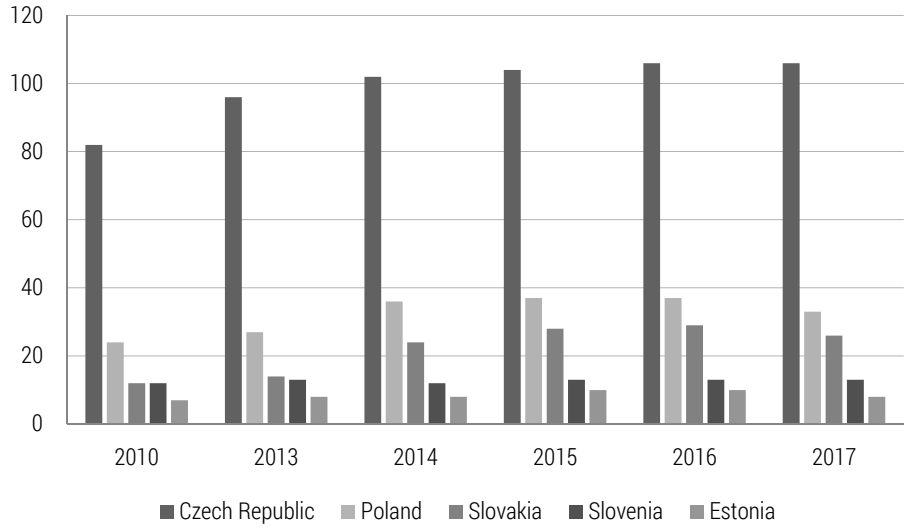


Figure 2. Number of golf courses registered in the years 2010-2017 in selected countries of Central and Eastern Europe

Source: author's work based on www.statista.com [17-11-2019].

Considering the gender and age broken down into male seniors, female seniors (15+) and juniors, the data obtained shows that in all the countries surveyed (table 1) and other European countries seniors predominate. For

Table 2. Economic effects of golf in selected countries and regions in 2008, 2011, 2012, 2016 and 2017 [million euros]

Specification	Australia (2008)	United States (2011)	Europe 2011/2012)[1]	Great Britain (2011/2012)[1]	Canada (2013)	United States (2016)	Australia (2017)[2]
Clubs and golf courses	1 125	22 688	8 435	3 621	3 412	32 696	
Investments in golf courses	164	1 575	1 715	756	273	2 048	
Production of golf equipment and services	317	5 839	3 237	1 490	4 476	5 741	1 983
Charity work	19	2 972	85	63	362	3 743	
Golf course real estate industry	47	3 599	95	10	5 663	8 874	
Golf tourism	393	15 622	1 553	229	4 981	24 438	315
Direct effect (total)	2 065	52 295	15 120	6 169	19 166	77 540	2 299
Total effect	no data	176 829	no data	no data	25 109	191 911	no data
Total employment in the golf industry	21 237[3]	1 976 477	180 000	78 900	300 100	1 885 674	no data
Salaries	no data	42 223	4 420	1 766	no data	55 732	no data
GDP	739 205	11 812 362	14 108 474[4]	1 912 458[4]	1 338 251	17 771 830	1 197 374[5]
Share of direct effects in GDP	0.28%	0.44%	0.11%	0.32%	1.43%	0.44%	0.19%
Share of total effects in GDP	-	1.50%	-	-	1.88%	1.08%	-
Number of registered golfers	1 181 100	25 700 000	4 400 300	1 359 400	5 700 000	20 100 000	978 000
Direct effect on the golfer (euro)	1 749	2 035	3 436	4 538	3 258	3 363	2 350

[1]April 2011-March 2012, [2]as of September 2017; [3]only in golf clubs; [4]state at the end of 2011; [5]as of the end of 2017.

Source: author's work based on The 2016 US Golf Economy Report, Golf 20/20, Teconomy, 2017; The 2011 US Golf Economy Report, Golf 20/20, October 2012; The Economic Impact of Golf on the Economy of Europe, Sports Marketing Surveys, February 2013; Community Impact Study September 2017, Australian Golf Industry Council; The Australian Golf Industry Economic Report 2010, Australian Golf Industry Council, 2010; NGF's 2017 Participation Report Golf, April 2017, www.thengfq.com [21-11-2019]; Club Participation Report of Australia 2017, June 2018; 2014 Economic Impact Study of Golf in Canada, The National Allied Golf Association, May 2014.

example, in 2016 in the United States juniors constituted 14.4% of players and men constituted 76.0% of players (US Golf Economy Report, 2017, p. 4; NGF's 2017 Participation Report Golf, April 2017, www.thengfq.com), while in Australia in 2017 juniors constituted only 3.5% of the total number of golfers, and men – as much as 80.0% (2017 Golf Club Participation Report, 2018, ps. 3 and 20). In 2015, in European countries, the average share of seniors in the total number of players was 66.0%, and for juniors – 9.0% (Golf Participation Report for Europe 2016, p. 11). It is worth noting that, e.g. in Slovakia, Slovenia and Germany the share of seniors in the total number of players was relatively high (34, 35 and 35% respectively), while in Turkey, Macedonia, Azerbaijan, Greece and Serbia – the share of juniors (respectively 44, 35, 33, 32 and 30%). In Poland, in 2015, golf was also clearly masculinized, as male seniors constituted as much as 74.0% of players, female seniors – 18.0%, and juniors – 8.0%.

The data obtained shows that golf brings the greatest economic benefits in the United States (table 2). This is due to the fact that the United States has most golfers, clubs and golf courses.

However, the share of direct effects in the economy is relatively similar in the countries studied and ranges from 0.11 to 1.43% of GDP, and per golfer – it ranges from less than 1.1 thousand euros in Europe to over 4.5 thousand euros in the UK. Economic benefits of multiplier effects have also been estimated in the United States and Canada. In the United States, they are more than twice as high than direct effects. The structure of economic benefits is very similar in all countries studied. Golf clubs, the tourism industry, and golf equipment and services providers earn the most.

Impact on the natural environment

The environmental impact of golfing is under discussion. Kowalczyk (2010, p. 278, 280 and 281) indicates that golf infrastructure brought more losses to the natural environment than benefits in the 90s of the last century. The negative impact is primarily related to the maintenance of the golf course, which first changes the original landscape, and then requires regular fertilization and consumption of large amounts of water). Consequently, there arises a conflict related to nature, the risk of disturbance of water management in nearby areas, the risk of soil erosion, as well as the extinction of some species of plants and animals. It should be emphasized, however, that losses in the natural environment also depend on the location, of course. For example, the uncontrolled construction of golf courses in selected countries of Central and Eastern Asia in the 1990s was criticized (Kowalczyk, 2010,

p. 281; Kowalczyk and Derek, 2010, p. 322 and 323). The fields were built on the site of rice fields, around temple complexes inscribed on the UNESCO list, national parks or nature reserves, which destroyed not only the natural environment but also the local cultural landscape, the lifestyle of residents and traditions.

However, in parallel with criticism, golf clubs take actions that reduce the negative effects and improve the image of the sports discipline. Table 3 presents the threats to the ecosystem caused by playing golf, actions taken by golf environments and the principles of ecological behaviour of golfers during the game.

Table 3. The impact of golf on the environment

Threats to the ecosystem	Activities of golf environments	The principles of ecological behaviour of golfers
• Polluting of ground and surface waters with chemical fertilizers, • Low water quality in the stream due to shoreline erosion, • Using large amounts of water for golf course irrigation, • Degradation of natural areas, • The harmful influence of chemicals on various species of plants and animals, • Cultivation of unnatural grasses as a result of the sophisticated expectations of golfers, • Loss or defragmentation of wildlife, • Destruction of wetlands, • Replacement of natural plant communities with managed landscape and alien plants.	• Creating the necessary wildlife reserves, • Preservation of natural areas in the urban environment, • Caring for a wilderness of the region, • Protection of water resources, • Filtering the outflow of rainwater through wetlands and bogs on the golf course, • Better hydration management, • Noise reduction, • Saving energy consumption, • The use of natural fertilizers, • Taking care of degraded areas, • Construction of golf courses in degraded areas, • Improving air quality in the area of the golf course, • Using electric golf carts, • Health and environmental education of golfers, • Research and training in the field of ecological golf course management, • Introduction of ecological compliance.	• Repairing damage to grass caused by divot or pitch mark, • Walking instead of using a cart or golf vehicle as far as the person is physically fit, • Hitting further and seeking consistency with the terrain rather than speed (low mowing height is more disruptive to the ecosystem), • Staying away from natural habitats and reserves, • Waste recycling, • Saving water when washing golf clubs, • Environmental education of other golfers, • Putting pressure on clubs for environmental activities.

Source: author's work based on Golf and Environment, www.audubоninternational.org [21-11-2019]; Golf Course Environmental Profile, www.gcsaa.org [21-11-2019]; The environmental principles for golf courses in the United States, www.beyondpesticides.org [21-11-2019]; Kowalczyk, 2010, p. 280 and 281; Kowalczyk and Derek, 2010, p. 322 and 323.

A good example of such action is building golf courses in degraded areas, wasteland, abandoned farms, along the coast, among opencast mines, quarries and in deserts. An example of this is the creation of a 9-hole golf course at the former landfill site in Gorzów Wielkopolski by Zakład Utylalizacji Odpadów Sp. z o.o. (Pole Golfowe Zawarcie, www.golfzawarcie.pl [25-11-

2019]). In 2012, an 18-hole golf course in the middle of barren lava fields was put into use in Grindavik (Iceland) (www.gggolf.is [12-04-2020]). Research also shows that an environmentally friendly field is more attractive to golfers, is better managed, and also reduces insurance costs (Golf and Environment, 2019). Awareness about the dangers and more responsible gaming among golfers is also rapidly growing.

Tax conditions for golf clubs in Poland

In Poland, Golf clubs run their own business and are subject to various taxes. The most important taxes include personal income tax (PIT), corporate income tax (CIT), value-added tax (VAT) and real estate tax (PN). In the case of departmental fields, Excise duties on alcohol products may also play an important role. The scope and amount of taxation depend primarily on the legal and organizational form of the club as well as ownership and access to the golf course. Table 4 presents the scope of taxation of goal clubs depending on the above criteria.

Table 4. The scope of taxation of golf clubs in Poland due to ownership and access to the golf course

Owner of the field (legal and organizational form)	Access to the field					
	No field	Urban public field	Paid public field (daily fee)	Departmental field	Semi-private field	Private field
Local government unit (legal entity)		VAT	VAT, PN			
One-man business (natural person)			PIT, VAT, PN	PIT, VAT, PN	PIT, VAT, PN	PIT, VAT, PN
Private Limited company. (legal entity)			CIT, VAT, PN	CIT, VAT, PN	CIT, VAT, PN	CIT, VAT, PN
Joint-stock company (legal person)			CIT, VAT, PN	PIT, VAT, PN	CIT, VAT, PN	CIT, VAT, PN
Association (Legal person)	PN		PN	PN	PN	

Source: author's work based on Kelley, 2019, www.liveabout.com [25-11-2019]; www.pzgolf.pl [04-11-2019 – 25-11-2019]; The Act of February 15, 1992 on corporate income tax, i.e. Laws 2019, item 865, as amended; Act of 26 July 1991 on personal income tax, i.e. Laws 2019, item 1387, as amended; Act of 11 March 2004 on tax on goods and services, i.e. 2018, item 2174, as amended; Act of 12 January 1991 on local taxes and fees, Journal of Laws 2018, item 1445.

In Poland, golf clubs usually operate in the form of a limited liability company, joint-stock company, association with legal personality or sole proprietorship. Then they are subject to PIT or CIT, as well as other taxes, depending on the scope of sale and assets owned. Associations are subject to CIT, but according to art. 17, paragraph 1, item 4 of the Act, the income is exempt from tax in part intended for statutory purposes, e.g. in the scope of physical culture and sport, educational activity. Membership fees, donations and voluntary contributions to associations do not constitute turnover within the meaning of VAT.

The owner of the field can also be a local government unit that supports the field from the local budget. Such fields are called urban public fields. They are available to the public at all times for free or for a small fee. Very often such fields have the character of city parks, so they are dealt with by budgetary units separated in the structure of local government units. In Poland, local government units are exempt from CIT, as well as municipal land and buildings that are not occupied for business activities are exempt from property tax (Article 7, item 15 of the Act on local taxes and fees). Local government units, on the other hand, are subject to VAT on general principles. A review of golf facilities shows that public urban fields do not yet exist in Poland (The Polish Golf Association, www.pzggolf.pl [04-11-2019 – 25-11-2019]), while they are very popular, among others in Canada, Australia and the United States (see, e.g., Golf Facilities in Canada, 2017, p. 4).

Public paid fields are also available to the general public; however, the owners are private entities, so they are usually better quality and more expensive than urban fields. The departmental field is an element of a larger real estate complex, usually including a luxury hotel, restaurant, wellness, other sports infrastructure, etc. Such golf courses are also available for a fee, but different rules for using the golf course usually apply to guests.

Semi-private fields are available primarily to club members, invited guests, and only for a limited time and under certain conditions (e.g. the appropriate handicap) also to the public. In turn, private fields are closed to the public, and made available only to club members and invited guests. Membership involves both relatively high fees and numerous privileges.

It is also worth paying attention to the functioning of the so-called social clubs that do not own golf courses. These clubs usually operate in the form of associations and are created mainly for players' handicap purposes. These clubs use other golf courses under the terms of separate agreements.

The degree of restrictiveness of access to fields varies across countries. In Poland, the borders between private and public fields are blurring. Mostly there are semi-private fields with open, paid and non-restrictive access for

the general public. In turn, belonging to the club allows you to play all year round on the field with an unlimited number of entries.

Selected elements of taxation in Poland and other European countries

Table 5 presents tax rates imposed on important products and real estate in the activities of golf clubs in selected countries in 2017-2019.

Table 5. Tax rates imposed on selected products and real estate in the Czech Republic, Estonia, Poland, Slovenia and Slovakia in 2017-2019

Tax	Czech Republic	Estonia	Poland	Slovenia	Slovakia
VAT (01.01.2019)					
Golf equipment	21%	20%	23%	22%	20%
Playing on the golf course	15%	20%	8%	9,5%	20%
Water supply	15%	20%	8%	9,5%	20%
Fertilizers	15%	20%	8%	9,5	20%
Hotel services	15%	9%	8%	9,5%	10%
Food services	15%, 21%	20%	8%	9,5%	20%
Excise duty (01.07.2019)					
Unleaded petrol [euro/1000 lit.]	498.4	563.0	425.7	490.1	547.0
Natural gas for heating business operations [euro/ gigajoule]	0.33	1.67	0.30	1.85	0.37
Electricity [Euro/MWh]	1.10	4.47	1.17	3.85	1.32
Beer [euro/hl Plato or Alcohol]	1.24	12.7	1.82	12.1	3.59
Wine [euro/hl]	0.0	147.8	36.92	0.0	0.0
PIT (2018)	15% (flat tax)	20,0% (flat tax)	18%, 32% (progressive scale)	16%, 27%, 34%, 39%, 50% (progressive scale)	25% (flat tax)
Tax wedge (2017)	38.1%	36.8%	34.3%	34.1%	33.8%
CIT (2018) ITR[1] (2017)	19% (20.2% ITR)	20,0% (7.4% ITR)	19% (12.1% ITR)	19,0% (18.3% ITR)	21% (29.3% ITR)

Tax	Czech Republic	Estonia	Poland	Slovenia	Slovakia
Real estate tax (2019) (Property tax)	• 0.2 CZK (0,03 PLN)/m^2 from land, • 2.0 CZK (0,32 PLN)/m^2 from built-up lands, • 10.0 CZK (1.66 PLN)/m^2 – usable area of buildings, • 6.0 CZK (0.96 PLN)/m^2 – other buildings and structures.	0.1 – 2.5% of land value.	• 0.93 PLN/m^2 – land for business activities, • 23.47 PLN/m^2 – usable area of buildings, • 2% – the value of the building.	Amounts are set by municipalities.	• 0.25% of land value, • 0.033 EUR (0.14 PLN)/m^2 – structures in built-up areas.

[1] *Implicit Tax Rate*.

Source: author's work based on Data on taxation, www.europa.eu [15-11-2019].

The table shows that the VAT rates imposed on products and services in selected countries are quite diverse. Similar rate distributions occur in Poland and Slovenia, only golf equipment is taxed at the basic rate, and services – at reduced rates. The highest rates occur in Estonia and Slovakia. The VAT regulations in individual countries do not contain any special tax preferences directly related to running clubs and golf courses. Considering excise rates, there are clear differences in energy and wine taxation. The highest electricity rates are found in Estonia and Slovakia, and the lowest – in the Czech Republic. In the Czech Republic, Slovenia and Slovakia, wine is taxed at 0%.

The income of individuals is taxed with the lowest flat taxes in the Czech Republic and Estonia. There are progressive taxes in Poland and Slovenia, but the nominal rates are the highest in the latter country. The tax burden on labour (the so-called tax wedge) is similar in all countries. Corporations are actually taxed the lowest in Estonia and Poland, and the highest in Slovakia. It is worth noting that the particularly low tax in Estonia is due to the fact that only profit divided between shareholders is taxed with CIT.

However, property tax is key to the operation of golf courses because of its potential costs. The structure of this tax varies in the countries surveyed because its competence divides countries with local governments. In the Czech Republic and Poland, land and buildings are taxed, while in Estonia – the value of land and buildings is taxed. There is a mixed system in Slovakia, and only local authorities decide on the amount of tax in Slovenia. These taxes have similar statutory objective (VAT) exemptions and most often relate to land, buildings and various structures for public use (education of children and youth, defence, parks, etc.). Only in the Czech Republic and Slo-

venia, among the statutory exemptions, the land intended for the construction of sports infrastructure for the public was also included. Tax rates vary, but in the Czech Republic they are definitely lower than in Poland. It should also be emphasized that in all countries, local authorities have the right to introduce additional tax preferences, e.g. in the form of reduced rates or objective (VAT) exemptions.

In Poland, pursuant to statutory provisions, a golf course is interpreted as an object located on agricultural land intended for conducting business activity and is therefore subject to real estate tax instead of agricultural tax (Lewandowski, 2012); Article 2 of the Act on local taxes and fees; Article 1 of 15 November 1984 on agricultural tax, i.e. Journal of Laws 2019, item 1256, as amended). Land constituting wasteland, ecological arable land, wooded and shrubland, except for land used for running a business, is also exempt from property tax. On this basis, it can be assumed that the area on the golf course, except for *fairway* and *greens*, is not intended for economic activity, so it should be exempt from tax. The basis for taxing all buildings within the golf complex (greens, bunkers, bridges, sheds, etc.) is their value, and of buildings (home, club, hotel, etc.) – usable area.

Conclusions

Regular golfing generally fits into the context of sustainable development. It contributes to the achievement of Goal 3 of the 2030 Agenda, as it improves the physical and mental condition of players, also has a positive effect on social development and prolongs life. The advantages of this game make it popular among senior citizens, and it is also increasingly important in the rehabilitation of people with disabilities. In many countries, this discipline is part of the curricula of primary, secondary and higher education. Golfing also contributes to the achievement of Goal 8 fo the Agenda, as increases income, employment and wages in the economy and gives impetus for economic development although the effects vary across countries depending on the popularity of the discipline.

The most controversial is the impact of the discipline on the natural environment (Goal 15 of the Agenda). Threats mainly result from landscape changes, the use of artificial fertilizers and high water consumption. However, it should be emphasized that the main allegations were directed to the creation of golf courses in East Asia in the 90s of the last century. Currently, golf clubs operate more environmentally friendly. This is not only due to legal regulations and pressure of the environment, but also to improving the awareness of golfers themselves.

In the economy of sustainable development, taxes are included in the group of economic policy instruments and are intended, for example by reducing them, to stimulate specific actions for sustainable development (Cieślukowski, 2014, p. 197). A review of tax solutions in selected countries shows that the golf industry in question is not treated in a special way compared to other sectors. However, there are clear differences in taxation at the state level. The lowest taxation of turnover occurs in Slovenia and Poland, while the lowest taxation of income – in the Czech Republic and Estonia. Unfortunately, Poland offers, at a statutory level, definitely worse property tax conditions for golf courses particularly compared to the Czech Republic and Slovakia.

In view of applicable national regulations, exempting golf courses from property tax is the responsibility of the commune council. It should be noted, however, that municipalities can apply for only subject and not subjective property tax exemptions. Such an exemption should apply to sports infrastructure intended for public purposes, and thus available to the general public at all times free of charge or against payment. The type of field owner (private person, local government unit or association) should be irrelevant. The golf courses meet those criteria; however, the problem is that municipalities, for fear of losing revenue, do not want to consider the golf courses as sports infrastructure and exempt them from property tax. They consider them as business activity lands and impose the proper tax.

In the opinion of representatives of the golf sector in Poland, in particular, preferential taxation of golf courses with a real estate tax would give impetus to the development of the golf sector and popularization of the discipline (Sport, 2013). Especially that in 2016 golf returned to the Olympic program after a 112-year break.

References

10 Top Most Played Sports, http://www.pledgesports.org [10-04-2020].

2014 Economic Impact Study of Golf in Canada, 2014. The National Allied Golf Association, May.

2018 Golf Club Participation Report of Australia, 2019. Golf Australia.

Canadian Golf Consumer Behaviour Study, NAVICOM, The National Allied Golf Associations (NAGA), http://www.canadagolfs.ca [20-11-2019].

Cieślukowski, M., 2014. Podatki i sytem podatkowy w ekonomii zrównowazonego rozwoju. Studia Oeconomca Posnaniensa, 2(6), 276, 193-207.

Community Impact Study, 2017. Australian Golf Industry Council, September.

Data on taxation, http://www.europa.eu [15-11-2019].

Farahmand, B., et al. 2009. Golf: a game of life and death – reduced mortality in Swedish golf players. Scand J Med Sci Sports, 19, 419-24.

Future Links, http://www.golfinschools.golfcanada.ca [22-11-2019].

Golf and Environment, http://www.audubonintemational.org [21-11-2019].

Golf Australia, http://www.golf.org.au/schoolevents [22-11-2019].

Golf Club Participation Report of Australia 2017, 2018. Golf Australia, June.

Golf Course Environmental Profile, http://www.gcsaa.org [21-11-2019].

Golf Facilities in Canada, 2017. Golf Canada, The PGA of Canada.

Golf Participation Report for Europe 2016. Golf Advisory Practice in EMEA, KPMG.

Japanese playing golf 2016-2030, http://www.statista.com [17-11-2019].

Kelley, B., 2019. The Different Types of Goulf Courses, http://www.liveabout.com [25-11-2019].

Kowalczyk, A., 2010. Turystyka golfowa – kontrowersyjna z punktu widzenia idei turystyki zrównoważonej forma tyrystyki kwalifikowanej, In: Kowalczyk, A. (Ed.), Turystyka zrównoważona. Wydawnictwo Naukowe PWN, Warszawa, 272-289.

Kowalczyk, A., Derek, M., 2010. Zagospodarowanie turystyczne. Wydawnictwo Naukowe PWN.

Lewandowski, R., 2012. Pole goflowe a podatek od nieruchomości, http://www.podatki.biz [14-11-2019].

Lyu, S.O., Lee, H., 2013. Market segmentation of golf event spectators using leisure benefits. J Trav Tourism Market, 30, 186-200.

Mitukiewicz, M., 2004. Golf – sport globalny. Studia Regionalne i Lokalne, 4(18), 159-175.

Murray, A.D. et al. 2016. The relationships between golf and health: a scoping review, BJSM Online First, published on October 3, as 10.1136/bjsports-2016-096625, http://bjsm.bmj.com [14-11-2019].

NGF's 2017 Participation Report Golf, April 2017, http://www.thengfq.com [21-11-2019].

Pole Golfowe Zawarcie, http://www.golfzawarcie.pl [25-11-2019].

Sport, 2013. Wysokie podatki od pól golfowych hamują rozwój tej dyscypliny w Polsce, http://www.ceo.com.pl [10-05-2020].

Tee20, Strategic Plan, 2013. The Indian Golf Union, November.

The 2011 US Golf Economy Report, 2012. Golf 20/20, October.

The 2016 US Golf Economy Report, 2017. Golf 20/20, Teconomy.

The Australian Golf Industry Economic Report, 2010. Australian Golf Industry Council.

The Economic Impact of Golf on the Economy of Europe, 2013. Sports Marketing Surveys, February.

The environmental principles for golf courses in the United States, http://www.beyondpesticides.org [21-11-2019].

The Polish Golf Association, http://www.pzggolf.pl [04-11-2019 – 25-11-2019].

Top 100 golf courses, http://www.top100golfcourses.com [17-11-2019].

UNO, 2015. The 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly on 25 September 2015, http://www.un.org [08-05-2020].

Act of 11 March 2004 on tax on goods and services (Journal of Laws of 2018, item 2174, as amended).

Act of 12 January 1991 on local taxes and fees (Journal of Laws of 2019, item 1170).

Act of 12 January 1991 on local taxes and fees (Journal of Laws of 2018, item 1445).

Act of 15 November 1984 on agricultural tax (Journal of Laws of 2019, item 1256, as amended).

Act of 15 February 1992 on corporate income tax (Journal of Laws of 2019, item 865, as amended).

Act of 26 July 1991 on personal income tax (Journal of Laws of 2019, item 1387, as amended).

Wytyczne UE dotyczące aktywności fizycznej, Czwarty projekt skonsolidowany, 2008. Grupa Robocza UE „Sport i Zdrowie", Bruksela, 10 października.

Bernadeta GOŁĘBIOWSKA

ENERGY LITERACY IN POLAND

Bernadeta **Gołębiowska,** MSc (ORCID: 0000-0002-4200-0901) – *University of Warsaw*

Correspondence address:
Świętojerska Street 24/82, 00-202, Warsaw, Poland
e-mail: bgolebiowska@wne.uw.edu.pl

ABSTRACT: The aim of the study is to assess energy literacy in households in Poland. Energy literacy influences decisions related to electricity consumption. Low energy literacy contributes to the energy efficiency gap, and therefore it is important to examine its level, understand the determinants, and look for solutions that can increase literacy. Based on previous research, we designed the energy literacy questionnaire. Knowledge of energy prices, costs of using selected electrical appliances, beliefs about the impact of electricity consumption on the environment, and awareness of the consequences of climate change were taken into account. We analysed data from the computer-assisted web interviews conducted in December 2018. The quota sample of 1,000 respondents was representative of the Polish population with respect to location, education, age, and sex. Correlation analysis showed the relation between energy literacy and norms associated with the use of energy. To date, no such relationships have been analysed in Poland.

KEY WORDS: electricity consumption, energy efficiency, energy literacy, households

Introduction

World electric power production is mainly based on the use of fossil fuels (coal, crude oil, gas) whose combustion is one of the main causes of climate change (IEA, 2019). Mitigating climate change and reducing the use of fossil fuels are among the most pressing challenges facing humanity (IPCC, 2018). Climate change leading to ecosystem imbalances, along with growing energy needs, induces the search for new opportunities to improve energy efficiency.

The electric power market in Poland is changing dynamically – demand is rising, the share of renewable energy sources (RES) in the energy mix is increasing, more and more investments in micro-installations are appearing, and smart meters are planned to be introduced.

The development of the electricity market, technology, and renewable energy sources require the activation of a consumer side as part of modern intelligent power networks (ISE).

According to the "Polish energy policy until 2040" (Ministry of Energy, 2019), increasing the activity of end-users is of great importance. The document highlights:

- Broadening of information policy. The consumer should be able to compare offers available on the market, and the information attached to the invoice should be broader, however, presented in a clear manner.
- Equipping 80% of households with smart meters by 2028. They are a key element enabling both access to data and information as well as conscious energy consumption. Their installation is correlated with the construction of an intelligent network. It means enabling customers to take an active role in all markets, i.e. to generate energy electricity in their homes, selling this energy or sharing it within an energy community, providing DSR services (demand-side response), electricity storage. There are already on the market prosperous renewable energy prosumers who take active roles.

Improving energy efficiency indicators in the household sector is a huge challenge due to the number – over 13 million final recipients (Fortuński, 2016). Low energy literacy may be an obstacle to consumer activation. Therefore, it is crucial to study the energy literacy and its determinants.

Researchers assess energy literacy using questionnaires. They take into account knowledge of energy costs, the energy consumption of electrical appliances, understanding of the structure of energy bills, knowledge of possible ways to save energy, understanding of the energy-related concepts, knowledge of the functioning of the electric power system, and other aspects related to the consumption of electric power, such as awareness of the amount of own electricity consumption, understanding the relationship

between energy production and the state of the environment, habits associated with the use of energy. Energy literacy can be based on consumers' answers to knowledge questions – revealed literacy or self-reported measures – stated literacy.

According to European research, the level of energy literacy in households is low. For example, in the Netherlands, only 56% of consumers know their monthly electricity costs (Brounen et al., 2013), in another survey conducted among the consumers of Italy, Switzerland, and the Netherlands, only 27% of the consumers were able to determine the average price for electricity, 48% knew the total cost of using electrical appliances (Blasch et al., 2018). Some analyses for Poland indicate that customers do not know some of the services available on the energy market, they have problems understanding the concepts needed to make decisions, they do not know the electricity tariffs or the aspects on which the prices depend (for example Bator, Kukuła, 2016). The findings are bothering because energy literacy has an impact on consumption decisions (Craig and Allen, 2015).

The article aims to assess the energy literacy (including awareness of the effects of climate change) of households in Poland. The empirical part of the paper is the results of the questionnaire on energy literacy and knowledge about the effects of climate change carried out on a representative group of Polish residents. We designed a questionnaire based on research conducted abroad to determine the level of energy literacy of the Poles (Blasch et al., 2017; Blasch et al., 2019). The study takes into account knowledge of energy costs, beliefs about the positive effects of conscious electricity consumption, and also awareness of climate change. So far, no research has been conducted in Poland combining these aspects, testing knowledge and beliefs that make up energy literacy.

Higher consumer energy literacy and understanding of the relationship between energy consumption and climate change contribute to improving energy efficiency at the household level (Dwyer, 2011; Demeo et al., 2013; Blasch et al., 2017; Blasch et al., 2019). Projects to improve energy efficiency are part of the sustainable development policy, and it is worth conducting further research on the factors that contribute to its improvement.

Energy literacy

Energy literacy means knowing the costs of purchasing energy, knowing the energy consumption of appliances, and being aware of the impact of energy consumption on the environment. Energy literacy is considered as one of the main factors of sustainable electricity consumption (Lee et al.,

2019; Blasch et al., 2017). Raising consumer energy literacy may be key to ensuring sustainable development in the coming years, so it is important to evaluate it and identify factors that have a key impact on it. Until now, research has focused on knowing the costs of electricity and the energy consumption of electrical appliances. This paper also includes aspects related to beliefs and awareness of climate change. Previous analyses carried out in Poland did not combine price knowledge with consumer beliefs about electricity consumption. No tool has yet been developed to measure overall energy literacy.

Based on a literature review, van den Broek (2019) proposed a typology of energy literacy (van den Broek, 2019). The four main types of energy literacy are as follows:

- knowledge of energy consumption of appliances,
- ability to assess the impact of activities directed at energy saving at home,
- financial literacy which reflects the ability to make financially effective energy decisions,
- general (multi-faceted) energy literacy which includes all the aforementioned types and attitudes, values, and behaviours related to energy-saving (van den Broek, 2019).

The study applied a questionnaire for assessing energy literacy. In addition, awareness of the effects of climate change has been included in the indicator. Energy literacy is related to knowledge about the environment and attitude towards its protection. People who have the knowledge and are aware of environmental problems display responsible behaviour related to the environment and electricity consumption (Carmi et al., 2015; Echegaray and Hansstein, 2017; Pothitou et al., 2016; Pothitou et al., 2017).

Electric power is a unique good because of its impact on the economy and society. Electric power is a good purchased by everyone, needed for everyday functioning. Ensuring a stable electricity supply is a key factor for national security, and it is the basis for economic development. The consumption of electricity is not observed directly, which makes it difficult for end consumers to determine the quantity purchased. The production of electricity, in Poland mostly based on non-renewable resources, generates external effects, among others, it contributes to climate change as a result of CO_2 emissions. Lack of full control over consumption, ignorance of prices for energy supply services, and lack of knowledge about the external effects of production may lead to suboptimal decisions at the level of end customers (Lindén et al., 2006; Herrmann et al., 2018).

Consumer neoclassical theories use normative models of people's behaviour – decisions optimal for the decision-maker are sought, assuming that he can use available information and set precise goals based on the potential benefits of their implementation. The theory of rational choice, which under-

lies the mainstream microeconomics, assumes that people make decisions rationally and want to maximise their benefits, with a given expenditure of resources. This is tantamount to the principle of minimising the expenditure incurred to achieve the objectives. Rational behaviour can be understood as maximising the utility function – seeking a way to meet the largest number of needs at a given income. However, it should be remembered that decision-making processes are fraught with errors resulting from people's limited cognitive abilities, lack of access to information, or the costs of the decision-making process.

The consumption of electric power is an example of behaviour conditioned by many factors, and the assumption of rational choices is not always met, which shows the existence of an energy efficiency gap (Abrardi, 2019). Households are wasting some of their energy or not investing in energy-saving appliances, by the same – they are not using the potential for saving (Allcott and Taubinsky, 2015).

Households could achieve energy savings by investing in energy-saving appliances; however, through irrational choices, they incur higher electricity costs. Limited rationality in decision-making leads to suboptimal choices, thus contributing to the energy efficiency gap at the household level. The energy gap at the household level may result from a lack of knowledge of services related to the supply of electricity and basic concepts needed to make decisions about its consumption (Smyczek, 2014). Based on research in Switzerland (n = 5931), Blasch et al. (2017) conclude that increasing energy literacy leads to more optimal decisions related to the purchase of electrical appliances (Blasch, 2017). Also, the rationality of decisions related to the purchase of electricity may be determined by knowledge about the functioning of the electric power system and the external effects of electricity production. Knowledge about the impact of consumption on the environment and climate change is of particular importance. Understanding these relationships and knowledge of energy prices make up energy literacy. Greater energy literacy could help households make more optimal and, therefore, rational decisions.

In 2013, DeWaters and Powers developed criteria for measuring energy literacy among high school students. Their proposal deserves attention because it comprehensively describes the components of energy literacy. The authors included three dimensions of energy literacy:

- cognitive (knowledge, cognitive skills),
- affective (attitude, values, personal responsibility),
- behavioural (behaviour).

Behavioural and affective criteria (e.g. awareness of current energy-related events) were described in a general way, which allows the tool to be

adapted to the context. Cognitive criteria refer to skills and knowledge (e.g. knowledge of basic concepts, energy definition, energy units). As research shows, computing capabilities are a strong indicator of rational decisions related to the implementation of energy-saving technologies (Filippini et al., 2020).

Some economists question the impact of energy-saving on the total volume of demand, claiming that progress in energy use resulting in savings ultimately leads to increased energy consumption. They refer to the Jevons paradox: more efficient use of one resource – contrary to what would be expected – only leads to increased demand for this resource. Along with the increase in efficiency, further economic expansion occurs. The paradox, to which Jevons drew attention, was widely confirmed in economic terms, including in the form of Say's law, which states that supply creates its own demand. That is why, despite the growing energy efficiency and the increased share of renewable energy, the countries of the old European Union consume much more energy than, for example, new members, and energy consumption in most of these countries increased in 1991-2008. Increasing energy efficiency may result in increased demand, as some consumers will decide to spend the saved money on purchasing additional energy. However, some consumers are driven by non-financial motivation.

According to research results, the level of knowledge about energy is low in households, despite the positive attitude of people to energy-saving (van den Broek, 2019). For example, in the Netherlands, 56% (n = 1721) of the respondents were able to determine their monthly energy expenditure (Brounen et al., 2013). The energy literacy of the Dutch significantly depended on their attitude towards the environment and towards energy-saving. Socio-demographic variables were less important in explaining energy expenditure awareness (age impact was demonstrated as significant). As for the rationality of consumption decisions – according to the results, environmental attitudes did not have a significant influence; however, the impact of education was demonstrated.

An example of a method of raising energy literacy is the initiative CLEAN – The Climate Literacy and Energy Awareness Network – started in the United States. It provides communication of a wide community of experts, which makes it a valuable source of knowledge about the climate and the use of energy (Ledley et al., 2014). Increasing energy literacy is a constant element of the U.S. policy, and it is particularly reflected in youth education programmes (NOAA, U.S. Department of Energy, 2017). Attention is paid to the role of energy education for conscious consumption, and thus the improvement of energy security while maintaining sustainable development.

Households in Poland consume as much as about 30% of all energy used in all sectors of the national economy. Therefore, the issue of saving potential in the household sector should be more supported as one of the E.U. priorities in energy policy. The use of energy-saving devices and the increase in the use of renewable energy resources had the greatest impact on the energy efficiency index of households in recent years.

Based on recent studies, one can observe a growing energy literacy among the Poles, but there is still an efficiency gap, that is unused potential. The results from 2011 (Sidorczuk-Pietraszko, Zawistowska, 2011) suggest that the Poles know various methods of saving – from the simplest and cheapest to the more expensive ones, although they primarily implement the former one. When asked about ways to save energy, the respondents mainly indicated the following ones: extinguishing lighting, replacing light bulbs with energy-saving ones and thermo-modernization of buildings. According to the results, more expensive solutions in a longer time perspective and related investments are still less frequently chosen (Sidorczuk-Pietraszko, Zawistowska, 2011). A report from 2013 indicates that the Poles relatively rarely invested in energy-saving appliances (RWE Polska, 2013). Every tenth Pole possessed it at home. More than half of the respondents (54%) said they knew how to save electricity, while 18% declared that they did not have such knowledge and 30% never wondered if they could reduce electricity consumption. The results suggest that the Poles were moderately interested in electricity.

Similar results were obtained in 2015 in a study conducted by the ClientEarth Foundation (Bator, Kukuła, 2016). In addition, it was shown that the Poles are not aware of their rights (less than 40% declared knowledge of the rights of energy consumers). The authors pointed out that the charging system in force in Poland based on an electricity consumption forecast increases the ambiguities regarding the price of energy. The bill structure is complex and varies depending on the energy supplier. Most respondents (90%) declared that they were trying to save electricity. Financial reasons were mentioned more often than the improvement of the state of the environment (IPSOS, 2015). Most respondents (74%) were not ready to pay more for energy consumption, even if it came from environmentally-friendly renewable energy sources. The Poles try to reduce consumption mainly by switching off appliances that are not in use and by using energy-saving light bulbs (IPSOS, 2015).

In Poland, energy consumption per flat was decreasing in 2008-2017 at a rate of 1% per year – from 1.61 to 1.46 toe/flat (Central Statistical Office, 2019b). The lowest consumption in this period was recorded in 2017. However, this does not apply to electricity, which consumption per capita is stead-

ily increasing. In recent years, the highest dynamics of the increase in electricity consumption are shown by households that manage around 20% of annual electricity production (Kott, 2015; Central Statistical Office, 2019c). According to the research carried out to date, the Poles are characterised by a lack of awareness of the problem of wasting electricity and the associated consequences (Bator, Kukuła, 2016). This means that they do not invest in high energy efficiency appliances. In addition, consumers are often not aware of how much electricity they consume, and they do not control the meter usage. According to one recent study, the consumers in Poland are characterised by low awareness about their energy consumption; they lack knowledge and commitment to energy-saving (Kowalska-Pyzalska, Byrka, 2019). The number of households in Poland in 2018 was 14.4 million (Central Statistical Office, 2019a). One-person and two-person households were the largest groups (23.3% and 25.9%), the average number of persons belonging to a household was 2.6. Over the past several years, the area and volume of flats have been systematically increasing, while the average number of persons in a household has been falling. The observed changes in lifestyle contribute to a systematic increase in demand for electricity in the household sector (Maj, 2015). Satisfying domestic demand at peak times often requires the mobilisation of power reserves and contributes to an increase in wholesale energy prices. Households have the potential to save energy, however low energy literacy contributes to not using it. According to recent research, ecological literacy is growing in Poland (Głowacki, 2018). There is an increased concern about the state of the environment in society, both on a local and global scale. In a 2018 survey, 29% of the respondents said that they perceived climate change as one of the biggest threats to modern civilisation (Głowacki, 2018). Only 3% of the respondents said that climate change is not dangerous at all, and 1% that such a phenomenon does not exist.

Awareness of the relationship between climate change and electricity consumption could encourage households to save energy. Research shows that increasing energy literacy can improve the effectiveness of programmes that motivate people to change their habits of using electricity (Mogles, 2018). This is particularly important in the development of electricity demand management programmes. Managing electricity demand increases the efficiency of the power system, thereby reducing production costs transferred to energy consumers (Bayer and Rączka, 2017).

Energy literacy study of households in Poland

Sample and data collection method

The study was part of a scientific project dedicated to managing electricity demand. It was implemented in 2019 by the CAWI method by a professional public opinion research centre. The quota sample consisted of 1,000 respondents and was representative of the Polish population with respect to location, education, age, and sex (table 1). In order to examine energy literacy in households in Poland, a questionnaire was constructed for analysis. Questions about energy literacy were displayed to the respondents after they completed the experimental part related to the selection of a contract for the purchase of electricity. The study also assessed social and personal norms related to the use of electricity (single-choice questions, answers on the Likert scale).

Table 1. Characteristics of the sample

	Share [%]	Mean	Std. Dev.	Min	Max
Women	53.16				
Age [years]		46.5	15.43	18	80
Stated net monthly income [PLN]		3,791.25	1,542.6	500	10,500
Net monthly household income [PLN]		5,765.14	1,981.17	500	10,500
Education:					
Primary and secondary	5.15				
Upper secondary education	58.46				
Higher	36.39				
Place of residence					
Village	40.61				
Town up to 500,000 inhabitants	48.53				
Town above 500,000	10.86				

Source: author's work.

Energy literacy questionnaire

Knowledge of energy costs (the main component of energy literacy) was measured based on a tool proposed by Blasch et al. (2018). The questions were adapted to the Polish conditions. Three aspects of knowledge about electricity were examined: price per kWh, cost of using a washing machine and a vacuum cleaner, potential energy savings associated with replacing conventional light bulbs with energy-saving ones. According to the data from

2018, 95% of the households are equipped with a washing machine, and 94% have a vacuum cleaner (Piskiewicz, Radziukiewicz 2018; Central Statistical Office 2019). Questions about beliefs concerning climate change and its effects have been developed based on similar studies (Ibtissem, 2010). Table 2 presents the questions being the basis for calculating the indicators.

Table 2. Measurement of Poles' energy literacy – tool structure.

Variable	Questions	Points
Knowledge of energy costs (single selection, 5 options)	1. What is the average price in Poland for the consumption of one kilowatt-hour (1 kWh), including tax? 2. What is the cost of electricity associated with using a standard vacuum cleaner (1500W power) for 30 min.? 3. What is the cost of electricity associated with using an A-class washing machine for one hour (standard washing, 90 min., 60 degrees, 4 kg load)? 4. What energy consumption can be saved by replacing a standard halogen bulb (100W) with an energy-saving LED bulb?	0-2 (0 points for an incorrect answer, 1 point for a minor error, 2 points for the correct answer)
Beliefs about the positive aspects of conscious electricity consumption	1. Better electricity management is the best way to combat global warming. 2. Saving energy helps to reduce the rate of global warming. 3. The quality of the environment will improve if we use less energy. 4. Saving electricity in households will bring a lot of benefits to Poland. 5. Saving electricity in households will bring a lot of benefits for my family and me.	1-7 (from strongly disagree to strongly agree)
Awareness of the effects of climate change	Global climate change 1. ... will cause extreme weather fluctuations and other natural disasters in Poland (e.g. floods or droughts). 2. ... will cause a rise in winter temperatures in Poland, thanks to which I can save on heating. 3. ... will contribute to saving millions of Polish zlotys spent on healthcare in Poland, by reducing the occurrence of diseases associated with low temperature and lowering the mortality rate due to body cooling. 4. ... will pose a serious problem for various animal and plant species and their natural environment. 5. ... will have a positive impact on food production in Poland (new plant species can be grown, the growing season will be longer). 6. ... will have a negative impact on my health and well-being. 7. ... will have a negative impact on the health and quality of life of people in my region. 8. ... will create new business opportunities. 9. ... will generally be a very serious problem for my family and me. 10. ... will generally be a very serious problem for entire Poland.	1-7 (from strongly disagree to strongly agree)

Source: author's work.

As regards the scale of beliefs and awareness about climate change, the answers: "I don't know"/"It's hard to say" were treated as the middle of the scale. Answers to the questions about climate change have been scaled so that a higher score means higher literacy. The higher the score on the scales of knowledge of energy costs and awareness of the effects of climate change on the scale of beliefs about the positive aspects of conscious electricity consumption, the higher the level of energy literacy.

The sample consisted of 1,000 respondents representative of the Polish population in terms of sex, education, age, place of residence (the structure of the sample is summarised in table 3).

Table 3. Structure of the sample

		Frequency [%]
Sex	Female	54
Subjective income: with your current income you are doing well ...	With great difficulty	3.5
	With difficulty	12.6
	With some difficulty	45.2
	Rather easily	33.3
	Easily	5.4
Net income	< 2,000	6.8
	2,001 – 3,000	22.9
	3,001 – 4,000	32.2
	4,001 – 5,000	17.2
	5,001 – 6,000	7.2
	> 6000	8.6
Education	Primary/lower secondary	2.9
	Vocational/incomplete secondary	24.5
	Secondary	55.7
	Higher	26.9

		Frequency [%]
Professional situation	Full-time job	55.9
	Part-time job	7.8
	Pensioner	18.4
	Student	3.3
	Work at home	5.4
	Own business	3.7
	Unemployed	5.5
Size of locality	< 20,000	11.8
	20,000 – 100,000	19.7
	100,000 – 500,000	17.2
	> 500,000	12
Type of building	Flat	46.1
	Terraced house	11.4
	Detached house	42.5
Type of heating	Electricity	2.2
	Central heating	49.7
	Coal	29.8
Responsibility for household bills	Bill payer	94.9
Electric power usage	Greater than the average for the given district	36.1
	Average	737 kWh (SD=692)
	min.	16.5
	max.	9210

N = 1,000
The average age in the sample is 46 years (SD = 15.3).
Source: author's work.

Results

The results of the study conducted in 2019 show the level of energy literacy in Poland, including three aspects: energy costs, beliefs about positive aspects of energy saving, awareness of the effects of climate change (table 4).

Table 4. The level of energy literacy of the Poles measured by a questionnaire

	Mean	St. dev	min	max
Knowledge of energy costs indicator	3	2	0	8
Beliefs about the positive aspects of conscious electricity consumption	27.3	6	5	35
Awareness of the effects of climate change	47.5	8.4	17	70

N = 1,000

Source: author's work.

The lowest results were obtained on the scale of knowledge of energy costs. Only 1.1% of the respondents obtained the maximum score of 8 points. Figure 1 illustrates the distribution of results on the scale of knowledge of energy costs in the studied sample. The results suggest that the respondents had low knowledge about the price of energy and the costs of using electricity-drawing appliances.

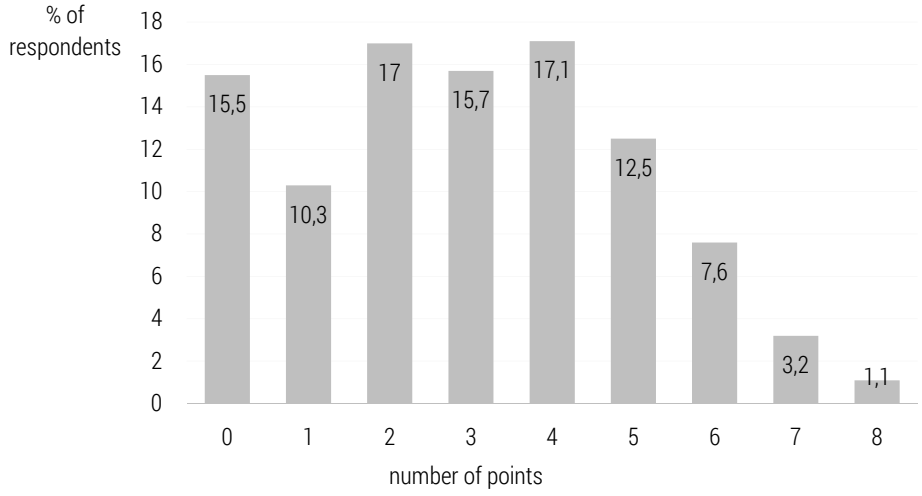


Figure 1. Knowledge of energy costs indicator – distribution of results

Source: author's work.

Relatively high results were observed on the scale of beliefs about positive aspects of conscious electricity consumption; 12.5% of the respondents obtained the maximum possible result (figure 2). The respondents recognised positive issues related to energy saving.

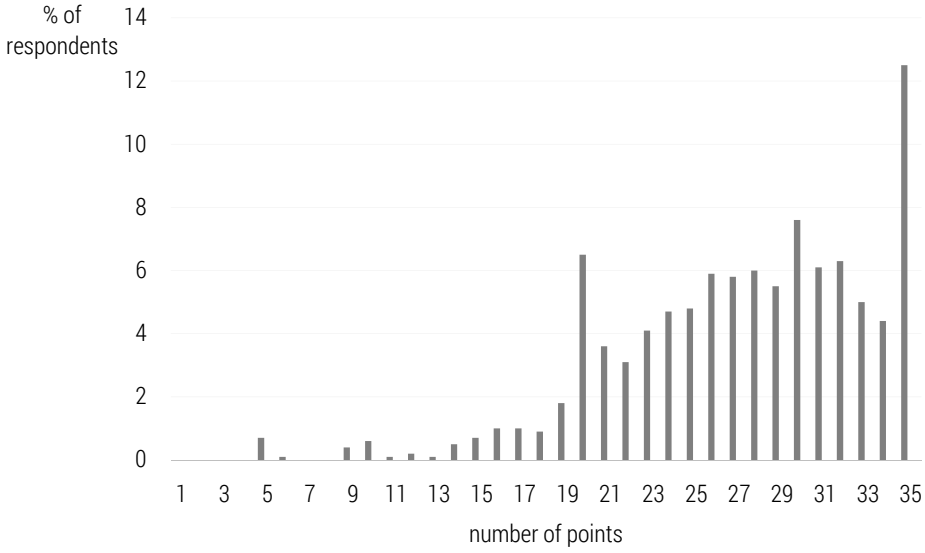


Figure 2. Beliefs about the positive aspects of conscious electricity consumption – distribution of results

Source: author's work.

Among questions testing beliefs about the consumption of electricity, two were directly related to climate change:

- Better electricity management is the best way to combat global warming.
- Saving energy helps to reduce the rate of global warming.

Most of the respondents agreed with these statements (71%, 72.8%, respectively). 30.1% of the respondents strongly agree that better electricity management is the best way to combat global warming, and 33.8% of the respondents strongly agree that saving energy helps to reduce the rate of global warming.

Most respondents declare that they are aware of the effects of climate change, as evidenced by the results on the third scale (figure 3). The respondents moderately agreed with climate change statements. Only as regards the results on this scale, the distribution of the responses is consistent with the normal one ($\chi^2 = 3.67$; $p > 0.1$).

T-student statistics was used to show differences in energy literacy based on gender. Men obtained statistically higher results on the scale of knowledge of energy costs t = -7 2722; $p < 0.001$). Women obtained statistically higher results on the scale of beliefs about positive aspects of conscious electricity consumption (t = 2.7714; $p < 0.001$). Women scored significantly higher on the climate change awareness scale (t = 11.7694; $p < 0.001$).

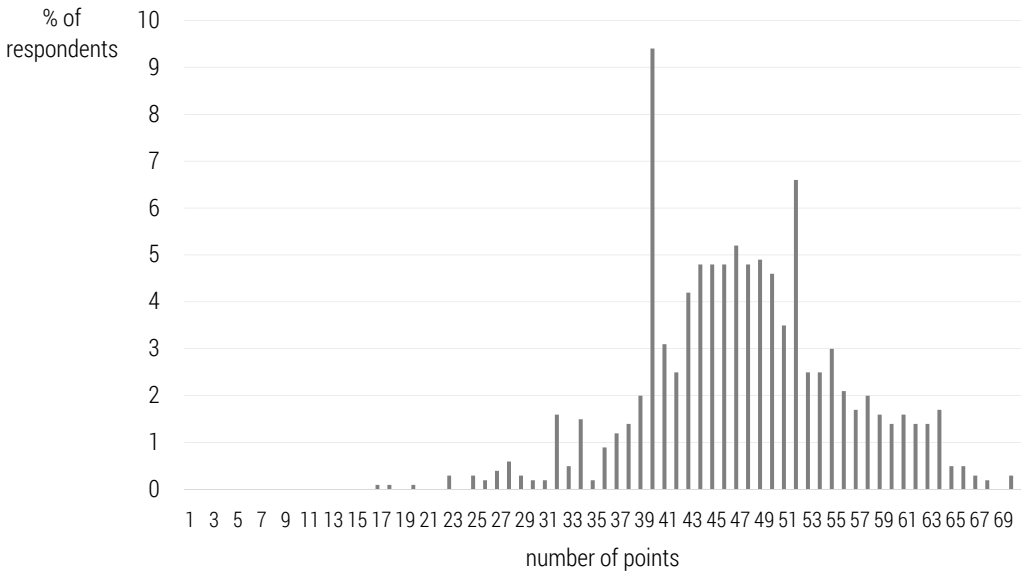


Figure 3. Climate change impact awareness indicator – distribution of results

Source: author's work.

The correlation analysis did not show any correlation between the results on the energy literacy scales and socio-demographic variables such as age, education, occupational situation, income, town size, province (table 4). Similarly, there was no relationship between the results on the energy literacy scales and the annual electricity consumption (table 5).

Table 5. Correlation coefficients for the energy literacy indicators and socioeconomic variables

	annual electricity consumption	age	number of persons in the household	Income[1]	size of locality[1]	education[1]
Knowledge of energy costs indicator	0.03	0.07**	0	-0.02	0.03	0
Beliefs about the positive aspects of conscious electricity consumption	0.04	0.2***	0.08**	0.08**	0.04	0.09**
Climate change impact awareness indicator	0.07**	0.13***	0.09**	0.03	0.02	0.07**

[1] – due to the nature of the variables, the r-Spearman's correlation coefficient was calculated

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$

Source: author's work.

We examined the relationship between energy literacy indicators and the norms (table 6).

Table 6. Correlation coefficients for the energy literacy indicators and norm indicators

	Descriptive norms indicator[1]	Injunctive norms indicator[2]	Personal norms indicator[3]
Knowledge of energy costs indicator	0.02	0.06*	0.03
Beliefs about the positive aspects of conscious electricity consumption	0.38***	0.78***	0.64***
Climate change impact awareness indicator	0.06**	0.48***	0.30***

* p < 0.1, ** p < 0.05, *** p < 0.001

1 – In this study, this was consistent with the statements: People control their electricity consumption; People save electricity as much as possible; People care about the state of the environment; People are interested in the issue of energy security in Poland.

2 – In this study, this was consistent with the statements: People should control their electricity consumption; People should save electricity if possible; People should care for the state of the environment; People should be interested in the issue of energy security in Poland.

3 – In this study, this was consistent with the statements: I feel obliged to save electricity no matter what other people do; I feel guilty when I waste electricity; I'm worried about saving electricity only if it can lower my electricity bill

Source: author's work.

A strong positive relationship between the positive aspects of conscious electricity consumption indicator and the results on the injunctive norms scale was demonstrated, and a moderate positive relationship between the positive aspects of conscious electricity consumption indicator and the results on the personal norms scale. We found a moderate positive correlation between climate change impact awareness indicator and injunctive social norms. Injunctive norms refer to beliefs about how people should use electricity. People with higher energy literacy recognise conscious consumption and care for the environment as a duty. People with higher energy literacy had a stronger sense of personal responsibility for controlling electricity consumption (personal norms). A correlation with the descriptive norms indicator suggests a weak positive relationship. Observation of other people's behaviour associated with the use of energy has a weak relationship with energy literacy.

Discussion of results

According to the results, annual electricity consumption is not related to energy literacy. Polish studies show that saving electricity is mainly financially motivated (Urbaniec, 2017). People with higher energy literacy may make more optimal consumption decisions, but this does not necessarily lead to savings. Probably, households that care about low energy costs will save regardless of the prices they perceive. The level of consumption does not show how households use energy and whether there is potential to increase energy efficiency. Behavioural economists point to the limitations of the human mind and question the assumption of rationality in making decisions (Simon, 1955). Perhaps consumers with greater energy literacy are unable or unwilling to use their knowledge, e.g. because of cognitive costs, the time that must be spent on optimising decisions.

Socio-economic variables, such as income, education, are unrelated to energy literacy. The problem of billing illiteracy and the energy efficiency gap can occur in all types of households. However, differences in the energy literacy of women and men were observed. Men are better informed about energy prices, while women are more aware of the positive effects of conscious consumption and the effects of climate change. Energy literacy is related to social and personal norms. The belief that consumers should consciously use electricity is stronger in people who have higher energy literacy. This relationship can be explained by the theory of cognitive dissonance (Festinger, 1957). According to the theory, people adapt their views to behaviour in order to be consistent. People who are unaware of energy prices are not convinced of the positive effects of conscious consumption and the negative effects of climate change (to which emissions in the electricity production process also contribute), maintain that society is not responsible for sustainable consumption and energy security. Thus, these people eliminate the tension that could arise as a result of the divergence of their beliefs and behaviour. It is probably more difficult for people with lower energy literacy to admit that energy should be saved wherever possible. In this light, it is easier to understand the weak relationship of energy literacy with descriptive norms. The belief about how other people behave has no clear connection with energy literacy.

Conclusions

Improving energy efficiency in households in Poland responds to the growing demand for energy. The energy transformation in Poland may lead to the increased involvement of end consumers, improvement of energy effi-

ciency, and thus a fairer power system that responds to the needs of society and environmental requirements (Bator, Kukuła, 2016). Energy security means the condition of the economy which enables full coverage of the customer's ongoing and prospective demand for fuels and energy in a technically and economically justified manner, with the observance of the environment protection requirements (Act on the Energy Law, Article 3 par. 16). End users can contribute to improving energy security as part of demand-side management. An essential element of managing electricity demand is increasing energy literacy in households by influencing real consumer choices. The conscious use of electricity is a factor for sustainable development, which is why it is important to identify the factors that favour it.

According to research, among the factors that affect the consumption of electricity in households in Poland, the financial ones are the most important (Urbaniec, 2017). Expenditure on energy in households in Poland over the last 20 years accounted for around 10-12% of total expenditure for using a flat (Central Statistical Office, 2019c). At the same time, according to recent studies, most people in Poland do not control consumption or plan to purchase electricity (Kowalska-Pyzalska and Byrka, 2019). This behaviour is not consistent with the theory of rational choice, according to which people make decisions based on available information, guided by the principle of optimisation. Lack of energy literacy can be one of the reasons for irrational consumption decisions and the existence of an energy efficiency gap.

In this study, relatively low energy literacy (measured by knowledge of energy prices, environmental effects of consumption, and knowledge about climate change) was observed in Polish households. The Poles do not know well the prices for electricity consumption, nor do they have a good orientation as to the costs of using energy-consuming appliances. On the other hand, it has been shown that they are convinced of the positive effects of conscious consumption and are aware of the dangers of climate change. Most respondents (72.8%) noticed the relationship between electricity consumption and climate change. Given the awareness of the dangers of climate change, it can be expected that such beliefs motivate to save energy.

This study demonstrates the relationship between energy literacy and social and personal norms related to energy consumption. People who think that conscious electricity consumption has positive effects believe that it is a duty to use electricity in a sustainable way (injunctive social norms). They feel responsible for electricity saving (personal norms). It would be interesting to determine how energy literacy and three types of norms interact with each other. This study could be a starting point for further research.

Poor knowledge of the energy consumption of electrical devices can be a barrier to the efficient use of electricity. Increasing knowledge of energy

prices and energy consumption of appliances in households in Poland could lead to more rational decisions regarding consumption and, as a consequence, improvement of energy efficiency. Increasing energy literacy can reinforce the impact of social and personal norms conducive to sustainable electricity consumption.

Acknowledgements

This research was funded by Narodowe Centrum Nauki (National Science Centre), as a part of the project: "Consumers' preferences for Demand-Side Management in Poland", grant number 2017/25/N/HS4/01458. Funding support is gratefully acknowledged.

References

Abrardi, L., 2019. Behavioral barriers and the energy efficiency gap: a survey of the literature. Journal of Industrial and Business Economics, 46(1), 25-43, https://doi.org/10.1007/s40812-018-0107-z.

Allcott, H., Taubinsky, D., 2015. Evaluating behaviorally motivated policy: Experimental evidence from the lightbulb market. American Economic Review, 105(8), 2501-2538, http://dx.doi.org/10.1257/aer.20131564.

Bator, A., Kukuła, W., 2016. Rola konsumenta w transformacji energetycznej. Fundacja ClientEarth Prawnicy dla Ziemi, Warszawa, https://www.documents.clientearth.org/library/download-info/rola-konsumenta-w-transformacji-energetycznej/ [11-10-2019].

Bauer, D., Papp, K., 2009. Book Review Perspectives: The Jevons Paradox and the Myth of Resource Efficiency Improvements. Sustainability: Science, Practice, & Policy, 5(1), https://doi.org/10.1080/15487733.2009.11908028.

Bayer, E., Rączka, J., 2017. Jak rozwinąć potencjał DSR w Polsce i obniżyć koszty systemu energetycznego. Regulatory Assistance Project, https://www.cire.pl/pokaz-pdf-%252Fpliki%252F2%252F2017%252Ffr_jak_rozwinac__potencjal_dsr_30a110eE.pdf [12-07-2018].

Blasch, J. et al., 2018. Empower the consumer! Energy-related financial literacy and its socio-economic determinants. CER-ETH–Center of Economic Research at ETH Zurich, Working Paper, 18, 289, https://doi.org/10.3929/ethz-b-000263429.

Blasch, J. et al., 2017a. Explaining electricity demand and the role of energy and investment literacy on end-use efficiency of Swiss households. Energy Economics, 68, 89-102, https://doi.org/10.1016/j.eneco.2017.12.004.

Blasch, J. et al., 2017b. Narrowing the energy efficiency gap: The impact of educational programs, online support tools and energy-related investment literacy. Online Support Tools and Energy-Related Investment Literacy, http://www.cer.ethz.ch/content/dam/ethz/special-interest/mtec/cer-eth/cer-eth-dam/documents/working-papers/WP-17-276.pdf [21-09-2017].

Blasch, J. et al., 2018. Empower the consumer! Energy-related financial literacy and its socio-economic determinants. CER-ETH–Center of Economic Research at ETH Zurich, Working Paper, 18, 289, https://www.researchgate.net/publication/

325748064_Empower_the_Consumer_Energy-Related_Financial_Literacy_and_its_Socioeconomic_Determinants/link/5b288e3ea6fdcca0f09c5bc6/download [12-11-2019].

Blasch, J. et al., 2019. Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. Resource and Energy Economics, 56, 39-58, https://doi.org/10.1016/j.reseneeco.2017.06.001.

Brounen, D. et al., 2013. Energy literacy, awareness, and conservation behavior of residential households. Energy Economics, 38, 42-50, https://www.researchgate.net/publication/256967505_Energy_literacy_awareness_and_conservation_behavior_of_residential_households/link/5c258995458515a4c7fcca62/download [10-10-2018].

Carmi, N. et al., 2015. Transforming environmental knowledge in to behavior: The mediating role of environmental emotions. J. Environ. Educ., 46(3), 183-201, https://www.researchgate.net/publication/279298028_Transforming_Environmental_Knowledge_Into_Behavior_The_Mediating_Role_of_Environmental_Emotions/link/5591c33908aed6ec4bf84b21/download [12-10-2019].

Central Statistical Office, 2019a. Budżety gospodarstw domowych w 2018 r., Warszawa, file:///C:/Users/Admin/Downloads/budzety_gospodarstw_domowych_w_2018.pdf [03-01-2020].

Central Statistical Office, 2019b. Efektywność wykorzystania energii w latach 2007-2017, Warszawa, file:///C:/Users/Admin/Desktop/2020/analfabetymz_rozli/energy_efficiency_in_poland_in_years_2007_2017.pdf [03-01-2020].

Central Statistical Office, 2019c. Zużycie energii w gospodarstwach domowych w 2018 r., Warszawa, https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-energii-w-gospodarstwach-domowych-w-2018-roku,2,4.html [03-01-2020].

The Climate Literacy and Energy Awareness Network (CLEAN), https://cleanet.org/index.html [12-01-2020].

Craig, C.A., Allen, M.W., 2015. The impact of curriculum-based learning on environmental literacy and energy consumption with implications for policy. Utilities Policy, 35, 41-49, http://www.sciencedirect.com/science/article/pii/S0957178715300084 [12-11-2019].

Demeo, A.E. et al., 2013. A human ecological approach to energy literacy through hands-on projects: An essential component of effectively addressing climate change. Journal of Sustainability Education, 4, 1-16, http://www.susted.com/wordpress/content/a-human-ecological-approach-to-energy-literacy-through-hands-on-projects-an-essential-component-of-effectively-addressing-climate-change_2013_02/ [03-12-2019].

DeWaters, J., Powers, S., 2013. Establishing Measurement Criteria for an Energy Literacy Questionnaire. Journal of Environmental Education, 44(1), 38, https://doi.org/10.1080/00958964.2012.711378.

Dwyer, C., 2011. Relationship Between Energy Literacy and Environmental Sustainability. Low Carbon Economy, 123-137, https://www.researchgate.net/publication/265983356_The_Relationship_between_Energy_Literacy_and_Environmental_Sustainability/link/54721f060cf216f8cfae8178/download [04-12-2019].

Echegaray, F., Hansstein, F.V., 2017. Assessing the intention-behavior gap in electronic waste recycling: the case of Brazil. J. Clean. Prod., 142,180-190, http://marketanalysis.com.br/wp-content/uploads/2018/09/Assessing_the_intention-behavior_gap_in.pdf [10-12-2019].

Festinger, L., 1957. Cognitive dissonance theory. 1989 Primary Prevention of HIV/AIDS: Psychological Approaches. Newbury Park. Sage Publications, California.

Filippini, M. et al., 2020. Energy-related financial literacy and bounded rationality in appliance replacement attitudes: Evidence from Nepal. CER-ETH Economics working paper series 19/315, CER-ETH – Center of Economic Research (CER-ETH) at ETH Zurich, https://www.ethz.ch/content/dam/ethz/special-interest/mtec/cer-eth/cer-eth-dam/documents/working-papers/WP-19-315.pdf [09-12-2019].

Fortuński, B. 2016. Konsumpcja energii elektrycznej przez gospodarstwa domowe w Unii Europejskiej, In: Łangowska-Szczęśniak, U., Dudek, A.M. (Eds.), Konsumpcja we współczesnej gospodarce rynkowej. Wydawnictwo Uniwersytetu Opolskiego, Opole, 97-111.

Głowacki, A., 2018. Polacy wobec zmian klimatu. Fundacja Centrum Badania Opinii Społecznej, Warszawa, https://www.cbos.pl/SPISKOM.POL/2018/K_158_18.PDF [04-01-2020].

Herrmann, M.R. et al., 2018. Watts your usage? A field study of householders' literacy for residential electricity data. Energy Efficiency, 11(7), 1703-1719, https://doi.org/10.1007/s12053-017-9555-y.

Ibtissem, M.H., 2010. Application of value beliefs norms theory to the energy conservation behaviour. Journal of Sustainable Development, 3(2), 129, https://www.researchgate.net/publication/320087119_Application_of_Value-Belief-Norm_Theory_to_Responsible_Post_Consumption_Behaviors_Recycling_and_Reuse/link/5e30b9af299bf1cdb9f9458d/download [08-10-2018].

The Intergovernmental Panel on Climate Change (IPCC), 2018. SPECIAL REPORT. Global Warming of 1.5 ºC, https://www.ipcc.ch/sr15/ [29-01-2019].

International Energy Agency (IAE), 2019. Global Energy & CO2 Status Report 2019, https://www.iea.org/geco/ [29-01-2019].

IPSOS, 2015. Konsumenci energii elektrycznej w Polsce. Raport z badania OMNIBUS Przygotowany dla Fundacji Client Earth Poland, https://www.documents.clientearth.org/wp-content/uploads/library/2016-12-07-konsumenci-energii-elektrycznej-w-polsce-raport-ipsos-ext-pl.pdf [29-01-2019].

Jaffe, A.B., Stavins, R.N., 1994. The energy-efficiency gap: What does it mean? Energy Policy, 22(10), 804-810, https://doi.org/10.1016/0301-4215(94)90138-4.

Kott, M., 2015. Zużycie energii elektrycznej w gospodarstwach domowych dla wybranych krajów UE. Zeszyty Naukowe Wydziału Elektrotechniki i Automatyki Politechniki Gdańskiej, (42), 163-166, http://webcache.googleusercontent.com/search?q=cache:IEFCuSszXdwJ:yadda.icm.edu.pl/yadda/element/bwmeta1.element.baztech-21dc375e-a496-424c-938a-5fd2873d715e/c/36__ZN_WEiA_PG_42.pdf+&cd=1&hl=pl&ct=clnk&gl=pl&client=firefox-b-d [29-01-2019].

Kowalska-Pyzalska, A., Byrka, K., 2019. Determinants of the willingness to energy monitoring by residential consumers: A case study in the city of Wroclaw in Poland. Energies, 12(5), 907, https://www.mdpi.com/1996-1073/12/5/907/ [25-01-2020].

Ledley, T.S., 2014. Moving toward Collective Impact in Climate Change Literacy: The Climate Literacy and Energy Awareness Network (CLEAN). Journal of Geoscience Education, 62(3), 307-18, http://search-1ebscohost-1com-10000b56u435b.han.buw.uw.edu.pl/login.aspx?direct=true&db=eric&AN=EJ1143138&lang=pl&site=eds-live&scope=site [10-12-2019].

Lee, L.S. et al., 2019. A study of energy literacy among nursing students to examine implications on energy conservation efforts in Taiwan. Energy Policy, 135, 111005, DOI: 10.1016/j.enpol.2019.111005.

Lindén, A.L. et al., 2006. Efficient and inefficient aspects of residential energy behaviour: What are the policy instruments for change? Energy Policy, 34(14), 1918-1927, https://doi.org/10.1016/j.enpol.2005.01.015.

Maj, R., 2015. Efektywność energetyczna w gospodarstwie domowym jest niedoceniana czy przeceniana? Analiza na przykładzie zużycia energii elektrycznej. Pracodawcy Rzeczypospolitej Polskiej, Warszawa, http://www.cbia.pracodawcyrp.pl/files/Analiza_Radosaw_Maj.pdf [03-02-2020].

Ministry of Energy, 2019. Polish energy policy until 2040. Warsaw, file:///C:/Users/Admin/Desktop/2020/analfabetymz_rozli/PEP2040_projekt_v21_08-11-2019z.pdf [03-02-2020].

Mogles, N. et al., 2018. A Computational Model for Designing Energy Behaviour Change Interventions. User Modeling & User-Adapted Interaction, 28(1), 1-34, https://doi.org/10.1007/s11257-017-9199-9.

National Oceanic and Atmospheric Administration (NOAA). Climate. U.S. Department of Energy – Energy Literacy and Energy Education Initiatives, https://www.climate.gov/teaching/climate-youth-engagement/case-studies/us-department-energy-%E2%80%93-energy-literacy-and-energy [29-01-2020].

Piskiewicz, L., Radziukiewicz, M., 2018. Zasoby dóbr trwałych w gospodarstwach domowych. Wiadomości Statystyczne, 10, 37-55, http://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.desklight-79f9c25a-a8c0-4a8c-8c31-6933631980bf [28-01-2019].

Pothitou, M. et al., 2016. Environmental knowledge, pro-environmental behavior and energy savings in households: An empirical study. Appl. Energy, 184, 1217-1229, https://doi.org/10.1016/j.apenergy.2016.06.017.

Pothitou, M. et al., 2017. Linking energy behaviour, attitude and habits with environmental predisposition and knowledge. Int. J. Sustain. Energy, 36(4), 398-414, https://www.researchgate.net/publication/275035102_Linking_energy_behaviour_attitude_and_habits_with_environmental_predisposition_and_knowledge/link/55303afa0cf27acb0de85603/download [28-01-2020].

RWE Polska, 2013. Świadomość energetyczna Polaków (Raport), Warszawa, https://www.innogy.pl/pl/~/media/Innogy-Group/Innogy/Polska/Dokumenty/Swiadoma-energia/Raport_Swiadomosc_Energetyczna_Polakow.pdf [28-01-2020].

Ščasný, M. et al., 2017. Public acceptability of climate change mitigation policies: a discrete choice experiment. Climate Policy, 17(sup1), S111-S130, https://doi.org/10.1080/14693062.2016.1248888.

Sidorczuk-Pietraszko, E., Zawistowska A., 2011. Stan gospodarowania energią w gminach w świetle wyników badań. Wyższa Szkoła Ekonomiczna w Białymstoku, Białystok, http://www.energia.wse.edu.pl/data/uploads/sidorczuk_zawistowska.pdf [14-06-2020].

Simon, H.A., 1955. A behavioral model of rational choice. The Quarterly Journal of Economics, 69(1), 99-118, https://doi.org/10.2307/1884852.

Smyczek, S., 2014. Edukacja rynkowa konsumentów na rynku energii elektrycznej, In: Czarnecka, M. (Ed.), Konsument na rynku energii elektrycznej. Wydawnictwo CH. Beck, Warszawa, 4-5.

U.S. Department of Energy, 2017. Energy Literacy Essential Principles and Fundamental Concepts for Energy Education, https://www.energy.gov/sites/prod/files/2017/07/f35/Energy_Literacy.pdf.[27-01-2020].

Urbaniec, M., 2017. Prognozowanie zużycie energii elektrycznej w gospodarstwach domowych. Przegląd Elektrotechniczny, 93.

van den Broek, K.L., 2019. Household energy literacy: A critical review and a conceptual typology. Energy Research & Social Science, 57, 101256, https://doi.org/10.1016/j.erss.2019.101256.

DISCUSSION AND REVIEWS

RECENZJE OMÓWIENIA, PRZEGLĄDY

Eugeniusz KOŚMICKI

The review of the book THE WORLD OF CONTEMPORARY ORNAMENTAL PERENNIALS AND GARDENS. Establishing, caring for and transforming perennial beds and gardens

Christian Kress, Meine Welt der Stauden. Staudenbeete anlegen, pflegen und verändern (My perennial world. Setting up, looking after and changing the perennial bed), 224 pages, 220 colorful photos, Stuttgart (Hohenheim) 2017, Verlag Eugen Ulmer, ISBN 978-3-8001-0834-3, www.ulmer.de

Christian Kress is one of the most famous perennial gardeners in Central Europe. Ch. Kress's perennial horticulture under the name "Sarastro Stauden". ("Sarastro Perennials") was founded in 1995. "Sarastro perennials" means the man-made changes in existing botanical perennials to excellent ornamental garden perennials. This is similar to the process of transformation of the evil Sarastro priest into a noble ruler. The most important perennials grown by Ch. Kress are shade-loving plants, alpine plants and bedding perennials. The most famous plants include wood anemone (*Anemone nemorosa*), barrenwort (*Epimedium*), yanhusuo (*Corydalis*), snowdrop (*Galanthus*), funkia (*Hosta*). The well-known plants of Ch. Kress also include flowerbed perennials and prairie perennials. It is necessary to mention here such species of perennials as yarrow (*Achillea*), giant hyssop (*Agastache*), ornamental garlics (*Allium*), not yet known yet long-lived bluestar (*Amsonia*), many species of asters, mainly of North American origin, as well as baptisia (*Baptisia*), spurges and geraniums, peonies, sage, daylilies, catnips, European goldenrods, stonecrops, houseleeks, delospermas (*Delosperma*). Ch. Kress's favorite

 https://doi.org/10.34659/2020/2/21

perennials also include the so-called wild perennials (botanical perennials), such as: burnets (*Sanguisorba*), knotweeds (*Persicaria*), goat's beard (*Aruncus*), Solomon's seals (*Polygonatum*). Very characteristic is a large collection of floxes (*Phlox paniculata*, garden flox).

The Sarastro Stauden perennial garden has a show garden where you can admire the perennials grown there. The presentation of perennials takes place on a relatively narrow bed, over 60 m long and only 2 m wide. The garden blooms from early spring (snowdrop) to summer perennials until late autumn, when asters and grasses are still blooming. The garden and horticulture of Ch. Kress is a sightseeing site (it is on the border between Bavaria and Austria)[1].

His rich botanical and gardening experience was presented by Ch. Kress in "My World of Perennials. Establishing, caring for and changing the perennial bed". Ch. Kress's book is extensive (224 pages) and richly illustrated (220 colour photographs). A study by Ruth Wegerer entitled "A Brave Man in the Perennial Garden: Christian Kress" has an introductory character. The author of the introduction emphasizes the peculiarity and uniqueness of "Sarastro Stauden" gardening and its founder. Frost-free perennials are grown there in conditions close to nature. For example, there is the "Museum of Phloxes" with many varieties, including Russian ones. Four basic parts of the study can be mentioned: "Fascination and vocation (pp. 9-44); "Practical knowledge about perennials" (pp. 45-116); "Most personally favourite perennials". (pp. 117-142); "Several experiences and examples of planting plants" (pp. 143-216), as well as "Service" (pp. 217-224).

In the first part ("Fascination and vocation"), the author presents the common day of his perennial horticulture, as well as natural stands for his favourite perennials. This section presents: the characteristics of his own perennial horticulture; the characteristics of a perennial gardener throughout the year; the breeding and selection of perennials; and the discovery of perennials under natural conditions. Since 1995, Ch. Kress has been involved in the propagation of perennials, shaping their assortments and advising clients. More than 2000 species and varieties of perennials are grown in "Sarastro Stauden" horticulture. This is characterized by a passion for harvesting perennials; old varieties and a new range of perennials are important; the gardener is dependent on the tastes of the customers. In Kress's view, small specialized perennial horticulture is still a viable option alongside large garden centres. Perennial horticulture is characterized by the following seasons: peace before the storm: January; slow-progressing development of activities: February; cold and urgent potting of plants: March; the season affects us: April; much to do in May and June; summer: work for all; second spring for the perennial gardener; preparation for frost and winter.

In the opinion of Ch. Kress, many exciting varieties of perennials were found as random seedlings (e.g. the bellflower 'Sarastro' and the stonecrop 'Matrona'). Many of the perennials in Kress' horticulture come from the surrounding area, where many inter-

[1] Christian H. Kress "Sarastro Stauden" Ort 131, A-4974 ORT/INNKREIS/Austria.

esting plants were found. The International Union of Perennials has contributed to the spread of many perennials. However, the collection of seedlings and parts of plants from the natural environment requires a great deal of care. Many interesting perennials have been discovered in mountainous areas, such as the Czech Republic, Slovakia and Slovenia: Many interesting perennials have been discovered in mountainous areas such as the Dinar Alps and the Olympus in Tessalia, Northern Greece. Many perennials come from Turkey, Iran, the Himalayas and China. Relatively few cultivated plants come from the Southern Hemisphere.

The part entitled "Practical knowledge about perennials" is devoted to the use of perennials (different life spans of perennials); soil relations; the size and forms of discounts; the problem of planning discounts; basic rules for the use of perennials; the influx of new varieties; the need to abandon the most expansive perennials; the problem of using edible and poisonous plants to avoid poisoning; the issue of growing perennials until late life; measures for appropriate soil conditions; proper care of perennials (basic work in the first year, care in the rhythm of the year, cutting old parts of plants); culture of perennial rejuvenation; possibilities of perennial propagation. According to Ch. Kress, the most important perennials for flowerbeds include aconites, wolfsbanes, phloxes, irises, lilacs and black bugbanes. Many perennials are marked with longevity and live for more than 10 years. Some perennials, however, are very expansive. These include plume poppy (*Macleaya*), knotweeds (*Fallopia sachalinensis, F. japonica*), some dwarf bamboo and even autumn-flowering anemones. Only a few plants, including perennials, are extremely poisonous. Weeds are a major threat to perennial beds. One of the most dangerous weeds is the field horsetail (*Equisetum arvense*). There are already numerous methods of weed control.

The part titled "The most personally favourite perennials" has a very personal character. The following sections can be distinguished here: alpine perennials and rock gardens; perennials in semi-shaded areas; or perennial beds. It would be difficult to list all the perennials discussed here. Alpine perennials and rock gardens include, among other things, the Schwarz wulfenia (*Wulfenia x schwarzi*), the characteristic Prophet's flower (*Arnebia pulchra*), the beautifully fragrant carnation (*Dianthus plumarius* 'Ohrid', the radiant beauty of Arizona Hamenoxys scaposa, the *Stachys lavendulifolia*) and the Schwarz wulfenia (*Wulfenia x schwarzi*). There is a wide selection of plants for semi-shaded areas, among others: anemone 'Rotkäppchen', green-and-gold of Virginia (*Chrysogonum virginianum* 'Andre Viette'), various corydalis species (*Corydalis elata*, *Corydalis*' Craighton Blue' or *C. solida* 'George Baker'), different species and varieties of snowdrops, stinking hellebore (*Helleborus foetidus*), common hepatica, many varieties of pilewort, and original Tibetan orchid (*Pleione limprichtii*). In autumn, rockfoiles *Saxifraga fortunei* flower, as well as the large-flowered Himalayan meadow-rue (*Thalictrum reniforme*).

Ch. Kress grows many attractive flowerbeds. These include the flower chive (*Allium schoenoprasum* 'Forescate'), a relatively unknown amsonia from the prairie area (*Amsonia illustris*), the beautifully flowering aster variety (*Aster dumosus* 'Augenweide', *A.x frikartii* 'Wunder von Stäfa', *A. novi-belgi* 'Nannis Liebling'), and the abundantly flowering bergenia (*Bergenia* 'Eroica'). The "flagship" of Ch. Kress's perennials remains the

Campanula "Sarastro" bellflower. The beautiful flowerbed plants include: Korean reed (*Calamagrostis brachytricha,* diamond grass), chrysanthemum *Chrysanthemum* 'Poesie', the long-flowering erodium *Erodium x hybridum*. The following flowerbed perennials belong to this group: spurges *Euphorbia amygdaloides*' Purpurea', *Euphorbia griffithii*' Fern Cottage', and *Euphorbia cornigera* 'Goldener Turm'), geraniums – beautiful varieties (*Geranium x oxonianum* 'Königshof', and *Geranium psilostemon* with interesting varieties), sneezeweeds (especially *Helenium* 'El Dorado'), Austrian lilacs (especially an attractive variety is *Hamerocallis*' Haller Kardinal'), beautiful varieties of perennial phloxes (*Phlox paniculata*) among others, 'Düsterlohe' (K. Foerster's variety), 'Drakon' (Russian variety), 'Ostinato' (discovered by Ch. Kress). The gardens must also have such perennials as *Sanguisorba* 'Scapio' burnet, *Thalictrum* 'Elin' meadow-rue, *Sedum* 'Matrona' stonecrop and *Solidago* 'Hiddigeigei' goldenrod – beautiful yellow leaves, as well as *Solidago* 'Loysder Crown' with sulfur-yellow flowers.

The last part of Ch. Kress's book is devoted to his own gardening experience and examples of (most characteristic ones) plantings of perennials. There are presented here problems such as: the dynamics and statistics of planting; species diversity and minimalism; the extent of sustainability of shaded gardens; major challenges – dry shaded areas; wet shaded areas; beds with changing humidity in full sun; climate change features – gravel and steppe gardens; extreme positions – between asphalt and communication; extreme positions – perennials on roofs; plant world richness in alpine and rock gardens; mutual planting of vegetables and perennials; perennial richness in pots, crates and containers.

When gardens reach the stage of maturity, they remain alone without excessive human interference. This is particularly true for shaded gardens. Trees are of great importance here: tupelo trees (*Nyssa sylvatica*), maple trees (*Acer rubrum* 'October Glory', *A. triflorum*), whitebeem trees, viburnum (*Viburnum plicatum* 'Mariesii'), ornamental varieties of elderberry and coniferous trees. The most beautiful shady garden in the spring presents itself, among others, barrenworts, hellebores (*Helleborus*), many shadow grasses, primroses, and Solomon's seals. Dry shaded gardens are inhabited by numerous species of barrenworts, large-flowered comfrey, white-brown ground elder (very popular in the United States), very weather-resistant big root geranium (numerous varieties) (*Geranium macrorrhizum*). There is also no shortage of plants for damp centipede gardens. One can mention such perennials as thyroid astilboides (*Astilboides tabularis*), colorful primulas from the Himalayas, majestic skunk cabbage (*Lysichiton*), as well as many species of grasses and fern. Irises and eupatoriums (*Eupatorium*) grow on beds that are variable in terms of humidity. Gravel and steppe gardens are increasingly being established in climate change conditions. The English gardener Beth Chatto has a great deal of merit in creating gravel and steppe gardens. Most of the cultivated plants come from European Pannonian areas, Central Asia, dry prairies of North America and Mediterranean areas. They are doing without irrigation systems. Nowadays, many plants can be grown in gravel gardens (p.191); a similar situation applies to extreme positions in cities (the so-called communication islands). Creating alpine and rock gardens requires imitation of nature. Many interesting plants can be cultivated here.

Ch. Kress's book "My World of Perennials. Establishing, caring for and changing the perennial bedding" deserves the attention of Polish readers. It presents well the state of the theoretical foundations and practices in the field of perennial cultivation and the creation of gardens. Numerous colour photographs make reading easier. The author uses his own horticultural and botanical experience in a comprehensive way. This book deserves wide popularization in Poland as a valuable help for specialists – gardeners and a wide range of plant and garden lovers. It would be worth translating this well-written book into Polish as well. It contains many interesting considerations in the conditions of climate change.

Eugeniusz Kośmicki, Prof.

SUMMARIES IN POLISH

STRESZCZENIA POLSKOJĘZYCZNE

Barbara FURA

METODYCZNE PODSTAWY PROJEKTU „INICJATYWY ŚRODOWISKOWE A CZYNNIKI KONKURENCYJNŚCI PRZEDSIĘBIORSTW"

STRESZCZENIE: Artykuł prezentuje podstawy metodyczne projektu „Inicjatywy środowiskowe a czynniki konkurencyjności przedsiębiorstw" o nr rej. 2016/23/D/HS4/03007. Projekt ten jest finansowany ze środków Narodowego Centrum Nauki w ramach konkursu SONATA 12. Celem projektu jest określenie relacji pomiędzy inicjatywami środowiskowymi a konkurencyjnością przedsiębiorstw. Do realizacji celu projektu wykorzystano zarówno pierwotne, jak i wtórne dane statystyczne. W artykule przedstawiono główne założenia projektu, tezę badawczą, sposoby pozyskania, jak i statystycznej analizy zgromadzonych danych empirycznych. Zwrócono również uwagę na wynikłe na etapie badań trudności i ograniczenia.

SŁOWA KLUCZOWE: inicjatywy środowiskowe, czynniki konkurencyjności, przedsiębiorstwa

Ryszard JANIKOWSKI

TRANSFORMACJA W KIERUNKU GOSPODARKI O OBIEGU ZAMKNIĘTYM W POLSKICH SIŁACH ZBROJNYCH

STRESZCZENIE: W pracy przedstawiono wyniki analizy zastanego stanu gospodarki określanej jako gospodarka o obiegu zamkniętym w siłach zbrojnych w czasach pokoju. Wskazywana jest ona jako model docelowy nie tylko w obszarze cywilnym, ale także jako model działania w „Planie działania w zakresie obrony europejskiej". Przeprowadzone analizy wskazują, że niektóre europejskie siły zbrojne, w tym także polskie siły zbrojne materializują zasady gospodarki o obiegu zamkniętym, czyli tworzenie zamkniętych pętli przepływu materiałów; spowolnienie przepływu materiałów; jak i pomniejszanie ilości przepływu materiałów. Niektóre z tych działań są swoiste dla sektora militarnego, jak choćby cywilne wykorzystanie „przedatowanej" amunicji. Potwierdza to zachodzącą transformację w kierunku gospodarki o obiegu zamkniętym w siłach zbrojnych w czasie pokoju. Metodą badawczą artykułu jest krytyczna analiza literatury.

SŁOWA KLUCZOWE: gospodarka o obiegu zamkniętym, rozwój zrównoważony, siły zbrojne, transformacja

Demetrio Miloslavo BOVA, Jerzy ŚLESZYŃSKI

WSKAŹNIKI TRWAŁEGO ROZWOJU – WŁOSKIE PODEJŚCIE DO PROBLEMU RÓWNOŚCI I TRWAŁOŚCI ROZWOJU ZASTOSOWANE NA POZIOMIE LOKALNYM

STRESZCZENIE: Celem artykułu jest przedstawienie zarówno metod pomiaru zrównoważonego dobrostanu na poziomie lokalnym, jak i poprawa zgodności pomiaru z subiektywnym odczuwaniem dobrostanu przez badaną społeczność. Pierwsza część artykułu przedstawia założenia i uwarunkowania, znane również z literatury przedmiotu, których uwzględnienie pozwala właściwie dokonać pomiaru rozwoju zrównoważonego na poziomie lokalnym, ze szczególnym uwzględnieniem roli subiektywnej percepcji. Założenia te stanowią podstawę systemu sprawiedliwych i zrównoważonych wskaźników dobrostanu (B-BES) stosowanego we Włoszech do pomiaru rozwoju lokalnych społeczności. Ten właśnie system zastosowano w małym włoskim miasteczku Ceccano i uzupełniono innowacyjną ankietą, tzw. wirtualny budżet, ukierunkowaną na pomiar subiektywnych preferencji. Dzięki wirtualnemu budżetowi możliwe było zidentyfikowanie różnic między subiektywnymi preferencjami respondentów a wynikami ex ante modelu B-BES. Zastosowane podejście pozwala na lepsze zastosowanie wskaźników na poziomie lokalnym poprzez poprawę spójności i zgodności stosowanych wskaźników z lokalną specyfiką, preferencjami i aspiracjami.

SŁOWA KLUCZOWE: trwały rozwój, wskaźniki trwałego rozwoju, wskaźniki dla lokalnej społeczności, subiektywny dobrobyt

Piotr MAŁECKI

ROZWÓJ OPŁAT ZA UMIESZCZANIE ODPADÓW NA SKŁADOWISKU I ICH WPŁYW NA GOSPODAROWANIE ODPADAMI KOMUNALNYMI

STRESZCZENIE: Dynamiczny rozwój opłat za korzystanie ze środowiska w Polsce nastąpił po 1989 roku, czyli od momentu rozpoczęcia transformacji systemowej. Wtedy wprowadzono m.in. opłaty za składowanie odpadów będące odpowiednikiem obecnie obowiązujących opłat za umieszczanie odpadów na składowisku. Stawki tych opłat odniesione do niektórych rodzajów odpadów, m.in. odpadów komunalnych, wzrastały w wybranych latach nie proporcjonalnie do wskaźnika inflacji – w przeciwieństwie do pozostałych opłat za korzystanie ze środowiska. Miało to na przykład miejsce pomiędzy rokiem 2008 a 2009, kiedy to stawka opłaty za niesegregowane odpady komunalne wzrosła z 15,71 do 75 zł za Mg. W roku 2018 stawka ta została podniesiona o ok. 20 zł w stosunku do roku poprzedniego. Celem artykułu jest odpowiedź na pytanie, czy i na ile radykalny wzrost stawek za umieszczanie odpadów na składowisku miał wpływ na gospodarowanie odpadami komunalnymi w kontekście ograniczenia ich masy deponowanej na składowiskach. W artykule zostanie przeprowadzona analiza porównawcza pomiędzy rozwojem opłat a wielkościami odpadów komunalnych kierowanych na składowiska w reprezentatywnym okresie. Przeprowadzona analiza zaprzeczyła zasadniczo tezie, że bardzo wysokie opłaty za odpady w latach bezpośrednio po ich wprowadzeniu spowodują znaczne zmniejszenie ich umieszczania na składowisku.

SŁOWA KLUCZOWE: opłaty ekologiczne, odpady komunulane, składowanie odpadów

Gabriela HANUS

EKOLOGIZACJA W ZACHOWANIACH ŻYWIENIOWYCH POLAKÓW – WYNIKI BADAŃ EMPIRYCZNYCH

STRESZCZENIE: Głównym celem badań jest zidentyfikowanie i scharakteryzowanie zjawiska ekologizacji w zachowaniach żywieniowych polskich konsumentów oraz czynników je kształtujących. Badania zostały przeprowadzone w 2018 roku na całym terytorium Polski. Narzędziem pomiarowym w badaniu podstawowym był kwestionariusz. Zebrane dane analizowane są za pomocą analizy czynnikowej, współczynnika Alfa Cronbacha, uporządkowanych modeli logitowych, współczynników Pearsona $\chi 2$ i Cramera v, a także statystyk opisowych i wskaźników strukturalnych. Z analiz wynika, że zjawisko ekologizacji jest wyraźnie widoczne w zachowaniach żywieniowych polskich konsumentów, zwłaszcza osób starszych. Wiąże się ono z wyższą świadomością żywieniową Polaków, a przejawia się przede wszystkim w stosunkowo częstych zakupach produktów ekologicznych i wprowadzaniu ich do codziennej diety. Najważniejszymi czynnikami kształtującymi postawę konsumentów względem żywności ekologicznej są wiek, poziom wykształcenia i miejsce zamieszkania.

SŁOWA KLUCZOWE: ekologizacja; nowe trendy; zachowania żywieniowe Polaków; żywność organiczna

Aleksandra PAWEŁKO

ŻYCIE W CZYSTYM ŚRODOWISKU JAKO DOBRO OSOBISTE

STRESZCZENIE: Celem niniejszego artykułu jest ocena pojawiającego się w Polsce trendu dochodzenia roszczeń podyktowanych nieodpowiednim stanem środowiska, opartego na koncepcji dóbr osobistych. Rozważania rozpoczęto od klasyfikacji życia w czystym środowisku na arenie międzynarodowej. Następnie poruszono temat określenia charakteru prawa do życia w czystym środowisku w polskim porządku prawnym. W pierwszej kolejności ocenie zostały poddane regulacje konstytucyjne w tym zakresie. Dalej rozważania ogniskują się w tematyce życia w czystym środowisku traktowanego jako dobro osobiste, co ma ścisły związek z ustaleniami poczynionymi w części dotyczącej konstytucyjnego ujęcia prawa korzystania ze środowiska naturalnego. W ramach tych rozważań poruszono także kwestię adresowania ewentualnych roszczeń. W pracy dokonano ogólnej oceny egzekwowania prawa do życia w czystym środowisku poprzez formułowanie roszczeń opartych na koncepcji naruszenia dóbr osobistych, a w szczególności tych, których treścią są żądania finansowe.

SŁOWA KLUCZOWE: środowisko, zdrowie, dobro osobiste, rekompensata

Maciej CIEŚLUKOWSKI

OPODATKOWANIE PÓL GOLFOWYCH W POLSCE I WYBRANYCH KRAJACH W KONTEKŚCIE ZRÓWNOWAŻONEGO ROZWOJU

STRESZCZENIE: Celem artykułu jest przedstawienie gry w golfa w kontekście zrównoważonego rozwoju oraz ocena krajowych warunków podatkowych do rozwoju tej dyscypliny na tle rozwiązań wybranych krajów Europy Środkowej i Wschodniej. Aktualna literatura przedmiotu nt. kompleksowego oddziaływania golfa na zrównoważony rozwój jest bardzo ograniczona, omawia przede wszystkim aspekty zdrowotne i turystyczne tej dyscypliny. Artykuł ma charakter literaturowo-empiryczny. Wpływ golfa na zrównoważony rozwój został zbadany na podstawie przeglądu literatury krajowej i anglojęzycznej, analizy materiałów źródłowych różnych organizacji i federacji golfowych oraz analizy danych statystycznych internetowych baz danych. Przeprowadzono przy tym analizę porównawczą sektorów golfowych w wybranych krajach. Warunki podatkowe oceniono na podstawie analizy regulacji prawnych i porównania stawek podatkowych między wybranymi krajami. Artykuł pokazuje, że golf pozytywnie wpływa na zdrowie ludzkie i przyczynia się do rozwoju gospodarczego, natomiast ciągle dyskusyjny jest jego wpływ na środowisko naturalne. Golf nie jest bardzo popularny w Polsce, a sektor golfowy jest słabiej rozwinięty w porównaniu z takimi państwami jak Czechy, Estonia, Słowenia i Słowacja. W szczególności opodatkowanie nieruchomości nie sprzyja rozwojowi tej dyscypliny. W Polsce sektor golfowy ma niewielki wpływ na zrównoważony rozwój.

SŁOWA KLUCZOWE: gra w golfa, rynek golfa, zrównoważony rozwój, opodatkowanie pól golfowych

Bernadeta GOŁĘBIOWSKA

ŚWIADOMOŚĆ ENERGETYCZNA W POLSCE

STRESZCZENIE: Celem badania jest ocena świadomości energetycznej w gospodarstwach domowych w Polsce. Świadomość energetyczna wpływa na decyzje związane z konsumpcją energii elektrycznej. Niska świadomość energetyczna przyczynia się do luki efektywności energetycznej, dlatego ważne jest określnie jej poziomu, zrozumienie determinant, poszukiwanie rozwiązań, które mogą zwiększać świadomość. Na podstawie dotychczasowych badań zaprojektowaliśmy kwestionariusz świadomości energetycznej. Uwzględniono znajomość cen energii, kosztów korzystania z wybranych urządzeń elektrycznych, przekonania o wpływie konsumpcji energii elektrycznej na środowisko oraz świadomość dotyczącą konsekwencji zmiany klimatu. Analiza była oparta o dane z badania ankietowego przeprowadzonego przez internet w 2018 roku. Próba losowa złożona z 1000 respondentów była reprezentatywna pod względem lokalizacji, wykształcenia, wieku i płci. Analiza korelacji wykazała relację między świadomością energetyczną a normami związanymi z korzystaniem z energii. Dotychczas w Polsce nie analizowano opisanych zależności.

SŁOWA KLUCZOWE: efektywność energetyczna, gospodarstwa domowe, konsumpcja energii elektrycznej, świadomość energetyczna

Authors are invited to submit Academic Papers on theoretical and empirical aspects of Sustainable Development and Environmental Management as well as on Environmental Economics and Natural Resources. Papers submitted for review should be in the form of Articles, Research Reports, Discussions or Reviews of Books, information on Academic Conferences, Symposia or Seminars.

Submissions should have up to 25.000 characters excluding abstract, footnotes, and reference list, with a clearly defined structure (Introduction, Chapters, Sub-chapters, Ending/Conclusions). Please strictly observe the number of characters. Each additional 1.000 characters of the text is charged (25 PLN or 6 EUR net).

Articles should be sent by e-mail to: czasopismo@fe.org.pl, in compliance with the official form published on the website of the journal (www.ekonomiaisrodowisko.pl). A model form can be found in TEMPLATE. The references cited have to be in alphabetical order, unnumbered. Plans, drawings and schemas (black & white only) should be prepared using Microsoft Word with all elements grouped in a single element group. Graphic elements (e.g. JPG) and schemas (e.g. in Excel) should be submitted additionally as separate files.

Papers will be submitted to Peer Review and only original (previously unpublished) papers will be accepted. Papers not complying with Editorial Recommendations will be returned to the Author for correction.

The article, after taking into account the comments of our reviewers, is treated as final text. Possible corrections resulting from the editorial composition can only be made on pdf files sent for our approval. Any corrections should concern only the errors resulting from the work on the text during the composition (e.g. changes in subscript/upload indices, drawing errors and other technical errors).

Please proofread your texts before sending them to us, as only the papers without any grammatical and spelling errors will be accepted. The Author have to sign the STATEMENT, that the article has been checked by the native speaker or professional translator. Please use correct scientific English. The Editorial Office may publish abridged versions of papers or change titles.

Authors of a submitted manuscript must sign a CONTRACT, confirm that the paper has not been published previously and transfer the propriety copyrights concerning the work to the Publisher.

Author's Fees: PLN 1500 or 350 EUR.

The fee is charged after accepting the paper for publication.

Editorial Office Contact Details:

FUNDACJA EKONOMISTÓW ŚRODOWISKA I ZASOBÓW NATURALNYCH

Journal "Ekonomia i Środowisko"

Correspondence address:
FUNDACJA EKONOMISTOW SRODOWISKA I ZASOBOW NATURALNYCH
Sienkiewicza 22, 15-436 Białystok, POLAND
e-mail: czasopismo@fe.org.pl