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Rambabu **LAVURI** • Eddy **JUSUF** • Ardi **GUNARDI**

GREEN SUSTAINABILITY: FACTORS FOSTERING AND BEHAVIOURAL DIFFERENCE BETWEEN MILLENNIAL AND GEN Z: MEDIATING ROLE OF GREEN PURCHASE INTENTION

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ABSTRACT: This exploratory study examines the factors that promote green purchasing intentions and understand the differences between the two generations, such as millennial and Generations Z, on green purchasing behaviour. Data collected from 372 respondents from two generations from three southern Indian states. Purposive and snowball samplings were adopted in the selection of respondents. The data was analyzed using the IBM SPSS 23.0 package using Factor Analysis, Pearson Correlation, Multiple Regression, and t-test. Subjective norms (SNs) had no significant association with Green purchase intentions (GPI). Variables such as media exposure (ME), environmental concern (EC), environmental knowledge (EK), and attitude (EA), Perceived Behavioural Control (PBC) had a significant impact on the GPI. Shopper's purchase intention substantially impacted their buying behaviour of green products, and these results supported the TPB model. The ME, SNs, and PBC variables did not show any behavioural differences between the two generations. Still, variables such as EK, EC, EA, and GPI showed a behavioural difference in purchasing green products.

KEYWORDS: Environmental Knowledge, Perceived behavioural, Environmental concern, Generation Z, Millennial, Subjective Norms

Introduction

Over the last few decades, society is facing an ecological situation and environmental security as tough challenges. Ecological issues such as global warming and exhaustion of natural resources affect consumers' decisions in purchasing a product directly or indirectly. The enthusiasm in humans and the desire to get the maximum with the least effort resulted in destroying the fundamental supporting frameworks of life, i.e., air, water, and land (Smith, 2009). Businesses and human life have had a great deal of impact on environmental issues. Green promotion paved the way for finding the reasoning behind ecological problems such as global warming, biodiversity depletion, ozone degradation, pollution, and deforestation. Awareness among the consumers towards the environmental issues and green items is improving at a greater rate (Mahesh & Gomathi, 2016). Green marketing means the marketing of goods with more sustainable standards, such as improvements in the manufactured process, products, and packaging to make them more affordable and offer a different form of advertising (Sheikh, Mirza, Aftab & Asghar, 2014). The World Health Organization report stated that every year in India, 5,27,700 deaths are due to air contamination, and 21% of the transmittable diseases are getting spread because of Water pollution (Mannarswamy, 2011). Sixty-nine percent of the general public agrees that pollution and environmental problems affect their everyday lives (Schlegelmilch, Bohlen & Diamantopoulos, 1996). Consumers are gradually choosing products based on their ecological impact (Grove, Fisk, Pickett & Kangun, 1996). Customers mainly drive the company's environmental programs and eco-marketing strategy. Companies are now pursuing an eco-marketing plan that incorporates corporate and advertising priorities with ecological protection (Smith & Brower, 2012).

The Theory of Planned Behaviour (TPB) is the cornerstone of the theoretical approach for green product usage. In many research studies on the green consumption of goods, TPB has been used to estimate humans' different behaviours, specifically in the context of green consumption (Paul, Modi & Patel, 2016; Liobikienė, Mandravickaitė & Bernatonienė, 2016; Kumar, Manrai & Manrai, 2017; Shin, Im, Jung & Severt, 2018). The most famous theoretical paradigm is explaining the intentions and behaviour of purchasing factors. This model provides an excellent conceptual framework for improving consumers' preferences for buying green products and understanding the various reasons for individuals' behaviour. The extended model includes media exposure, environmental knowledge, and environmental concerns as variables.

Public consciousness and environmental issues are rising in India. Various studies have shown the willingness of Indian consumers to purchase green goods. Such developments contribute to increasing research interest in green marketing, green goods, green advertising, and green consumer behaviour. Currently, there is limited research on green consumers in India and green marketing. The study's centrality focused on factors that foster green buying intentions and examined green purchase behaviour differences between the selected two generations, such as Millennial and Generations Z. Based on the TPB approach, the research study seeks to expand the TPB to include three additional variables environment concern, knowledge, and media exposure.

Theoretical Framework

TRA (Fishbein & Ajzen, 1975) and TPB are two vital theoretical constructs that may help understand this analysis. Theory of Reasoned Action (TRA) is the predecessor to Theory of Planned Behaviour (TPB). TRA reveals that the intention to execute the behaviour determines the specific behaviour to be taken. It implies a behavioural sense that arises from two factors, the behavioural attitude and the SNS. The TPB model is an extension of the TRA (Ajzen & Madden, 1986), proposed by Ajzen (1985), to enhance the Rational Idea of Action. It integrates PBC so that behavioural actions derive from behavioural attitudes, SNs, and BC. TPB ranked as the best model for predicting intentions (Yadav & Pathak, 2016) and, thus, for predicting behavioural intentions. This model is widely used by social psychologists (Fielding, McDonald & Louis, 2008). The intention is a deliberate action plan that includes explicit behaviour and a choice to act (Patch, Tapsell & Williams, 2005). Previous studies concluded that intent and general opinion are the strongest predictors of behaviour and completely mediate the effects of Attitude, SNs, and PBC (Gracia & De Magistris, 2007; Liobikienė et al., 2016). Some research studies have endorsed the TPB model, PI, and PB as the main predictors in the TPB model (Liobikienė et al., 2016; Yadav & Pathak, 2017). PI is also a critical factor in adopting Green goods (Rezai, Teng, Mohamed & Shamsudin, 2012). Paul et al. (2016) have shown how this can contribute to environmental sustainability. Environmental sustainability refers to the ability to preserve qualities of significant value in the physical environment (Jones, Comfort & Hillier, 2011), but the TPB model partly supported Chou, Chen, and Wang (2012); Kim, Njite & Hancer (2013) studies. The extended model includes media exposure, environmental knowledge, and environmental concerns as variables. Research hypothesis framed, as shown in figure 1. The figure shows the association of the selected variables.

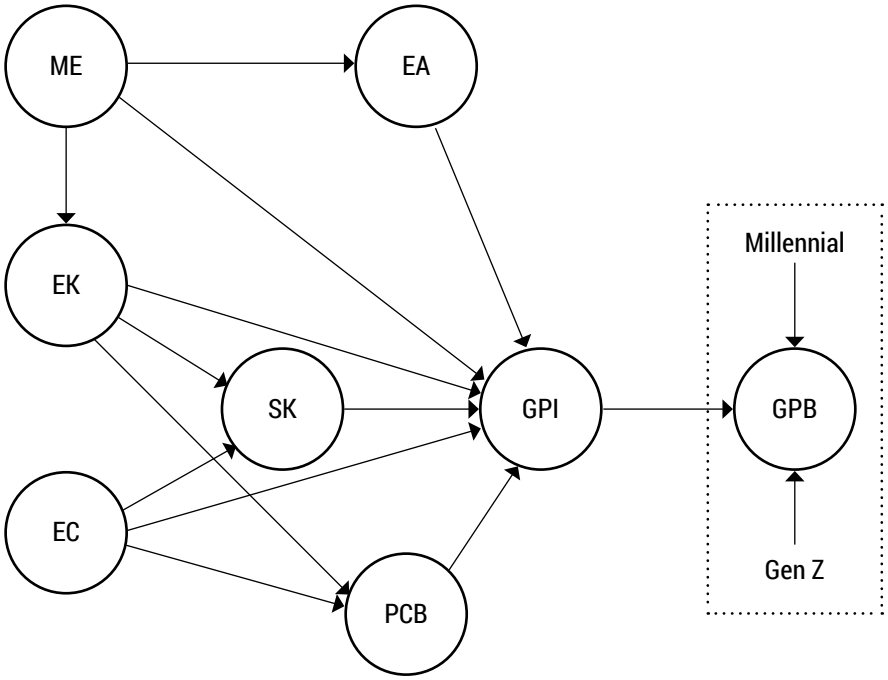

Figure 1. Conceptual framework of research study

Source: author's work.

Review of literature

Concept of millennial and generation-Z

Generations refer to the assembly of individuals influenced by a given time and whose characteristics were identical over a specified period. Several scholars agree about five main generations (Urbain, Gonzalez & Gall-Ely, 2013), such as silent generation, Baby Boomers, gen-X, gen-Y (Millennial), and gen-Z (Baycan, 2017).

The concept of Gen Y has no definitive proof of Generation Y period coverage. Some of the authors reveal that the people born in between 1978-1994 years; others find individuals who conceived as in between 1980-2000. Therefore, Generation-Y is called "millennial" (Howe & Strauss, 2003). This generation's people had witnessed childhood in a world-changing financially, ecologically, politically, socially, and technologically (Urbain et al., 2013). Generation Y developed with the Internet launch and technological advances that fostered globalization (Djamasbi, Siegel, Skorinko & Tullis, 2011). These people would quickly adapt and exploit innovation from multiple perspec-

tives (Viswanathan & Jain, 2013). This generation has self-positive feelings, Free-thinking people who are open to ethnic diversity (Yolbulan & Yalman, 2013), well-educated and informed (Urbain et al., 2013), and easy access to information.

The concept of the Gen -Z covers the people born in 1994 and after; on the other hand, people born after 2000 are Generation Z (Geck, 2007; Göksel & Güneş, 2017). In the digital age, this generation opened its eyes to the world. In this way, the names given to this generation are "Generation I," "Versatile Generation," "Performing multiple tasks," and "Digital Age" (Göksel & Güneş, 2017). From a very young age, these people are beginning to use digital technology platforms and have a high data capacity to access information (Taş, Demirdöğmez, & Küçükoğlu, 2017). Technology has become part of their daily lives to share views and build an efficient partnership between people and the Internet and the social networks (Göksel & Güneş, 2017; Taş et al., 2017).

Purchasing Attitude of generations

Millennial: This generation has a significant proportion of the world's population. From the last few years, it has higher buying power relative to the remaining generations. Millennials are more interested in spending money on new goods and brands (Viswanathan & Jain, 2013), but not showing brand loyalty (Noble, Haytko & Phillips, 2009) and a cautious attitude towards green purchases (Lu, Bock & Joseph, 2013). Consumer expectations to use eco-friendly goods differ from generation to generation. The results conclude that Generation Y had a solid intention to buy green goods more than Generation Z (Göksu, Koska & Erdem, 2017). Lu et al. (2013) found a strong relationship between customer purchasing preferences and expectations concerning green product characteristics such as biodegradability, recycling, and health contribution, which determine the quality of goods, impacting the purchaser's green purchasing conduct. Thus, this generation has a marketing research target (Baycan, 2017).

Generation Z: Generation Z research remains very small because they are young, linked to luxury shopping, technology, and the Internet, and mostly prefer online shopping rather than offline. Generation Z people are not addicted to brands and like to buy products displayed for themselves (Veiga-Neto, Ferreira, Nodari & Barreto, Miranda, 2018). These purchasers prefer more gluttonous goods than Generation Y. This generation of people has a better attitude towards green goods and a more significant commitment to the environment. Knowledge has been collected from formal and informal education sources; SNs have a considerable stimulus to their decision-making processes and affect the GPI and GPB (Noor, Jumain, Yusof,

Ahmat, & Kamaruzaman, 2017). Sarıtaş and Barutçu (2016) proposed that companies would organize pre-sales and networking efforts for Gen Y and Gen Z purchasers through social media.

Media Exposure (ME)

Several research studies agreed that media exposure played a pivotal role in disseminating information on ecological concerns. The whole and sort of media exposure on the environmental issues regularly have been turned into a significant public issue in society (Lowe & Rudig, 1986; Mitchell, 1990). Schultz and Lauterborul (1993) explained that media exposure is a combination of various media vehicles which allows viewers and readers to hear and see the message. It is a crucial driver for the communication of information. It has a significant impact on the purchase intention of shoppers (Bass, 1969). The most critical influence of media exposure on distribution is that it rapidly spread awareness of technologies to broad audiences (Rogers, 2003). There is no question as to whether such media can contribute to a change in drive and feeling (DeFleur & Dennis, 1998). Qader and Zainuddin (2011) found that access to media publicity has a significant impact on customers' buying intention. It will raise public awareness regarding environmental concerns by growing the media's share. It is changing shoppers' attitudes towards sustainability and eco-green products and eco-greening the effect of green packaging studies on young consumers' ecological obligations (Yilmaz & Ilter, 2017; Kardos, Gabor & Cristache, 2019) and shown impact on the purchase intent (Lavuri & Susandy, 2020). Therefore, ME has a solid factor for construct EK, EA towards GPI. Thus, the following hypotheses are framed.

H1a: ME has a positive association with EK
H1b: ME has a positive association with EA
H1c: ME has a positive association with GPI

Environmental knowledge (EK)

Many consumers have inadequate environmental knowledge to act appropriately towards the environment (Kempton, Boster & Hartley, 1995). EK refers to the understanding of shoppers about the effect of product use on the environment (D'Souza, Taghian & Khosla, 2007), revealing how the product is manufactured in an ecologically sustainable way (Lim, Yong & Suryadi, 2014). It includes the reality, values, and relationships with crucial ecosystems, such as environmental knowledge; and individuals' ecological obligation, contributing to sustainable growth (Taufique, Siwar, Chamhuri & Sarah, 2016). Individual EK has a significant impact on environmental problems and is linked to EA and PBC. Constructive action is a strong view of ecological

issues (Laroche, Bergeron & Barbaro-Forleo, 2001). Exact data on environmental issues should make individuals more informed (Schahn & Holzer, 1990). Osman, Othman, Salahudin, & Abdullah (2016) said that consumers have positive knowledge of green marketing and green products due to a high level of eco-friendly products. Bradley, Waliczek, and Zajicek (1999) students with good environmental attitude high degree of awareness despite low information levels. EK is a significant contributor to consumers' buying intent (Laroche, Toffoli, Kim & Muller, 1996; Lavuri & Susandy, 2020). Previous studies have shown that EK has a tremendous and positive association with EA (Granzin & Olsen, 1991; Lavuri & Susandy, 2020) and GPI and GPB (Kaiser & Gutscher, 2003; Lavuri & Susandy, 2020). EK is also increasing in India (Chaudhuri, 2014). Achieving a higher degree of EK leads to much better environmental performance (Rokicka, 2002; Lavuri & Susandy, 2020). It has a good effect on GPI (Wang, Liu & Qi, 2014). However, some research studies have described EK's impact on attitudes as inaccurate (Bogner, 1998). SNs affect the user's decision because it is motivated to act on the knowledge they have (Bradley et al., 1999). Yang and Kahlor (2013) suggested that people who behave as per social norms should have paid close attention to information about the environment and therefore built a more robust knowledge. With an adequate understanding of the environment, monitoring people's PBC has improved (Kumar et al., 2017; Asif, Xuhui, Nasiri & Ayyub, 2018; Lavuri & Susandy, 2020). Therefore, the below-given hypotheses followed.

H2a: EK has a positive association with EA
H2b: EK has a positive association with SNs
H2c: EK has a positive association with PBC
H2d: EK has a positive association with GPI

Environmental Concern (EC)

EC refers to peoples' knowledge about ecological issues, ability, and interest in resolving environmental problems (Hu, Parsa & Self, 2010). A green buyer is an individual who maintains a strategic distance from any item that could harm any aspect of ecological existence (Elkington, 1994). EC is a significant element in customers' decision-making process (Diamantopoulos, Schlegelmilch, Sinkovics & Bohlen, 2003). A growing number of EC customers would increase both the GPI (Aman, Harun & Hussein, 2012; Lavuri & Susandy, 2020) and the GPB (Hutchins & Greenhalgh, 1997). Thus, the Individual EC was a great incentive to buy.

Likewise, the studies of Prakash and Pathak (2017) and Paul et al. (2016) have shown that EC has a substantial impact on the design of green packaged items. Individual EC affects the other GPI through the exercise of SNs, such as friends, peer groups, and family. They concluded that there was a strong cor-

relation between EC and GPI. Khan and Mohsin (2017) study shows that interest, social value, and environmental values positively affect consumer preference for green products. Most researchers have mentioned that EC has a positive and significant impact on the EA and GPI (Albayrak, Aksoy & Caber, 2013; Yadav & Pathak, 2016; Lavuri & Susandy, 2020). In Canada, EC has a strong effect on EA towards GPB (Hanson, 2013; Lavuri & Susandy, 2020). EA of customers has a direct and indirect impact on the EC, and thus EC influences EA and GPI on the GPB (Hartmann & Apaolaza-Ibáñez, 2012).

SN is affected by an EC increase which reduces the sense of trouble. Consequently, EC affects the behaviour of friends, peer groups, and family who support or oppose GPB (Paul et al., 2016; Lavuri & Susandy, 2020). EC has positive effects on SNs and PBC for decision-making, which have been highly experienced by EC students rather than by low-level students (Bamberg, 2003). Many customers revisit green hotels because EC, SN, and PBC have indirectly influenced their intentions (Chen & Tung, 2014). Therefore, the hypotheses were followed.

H3a: EC has a positive association with GPI
H3b: EC has a positive association with EA
H3c: EC has a positive association with SN
H3d: EC has a positive association with PBC

Subjective Norms (SNs)

A subjective norm refers to the perceived social pressure to perform or not to perform a specific behaviour (Ajzen, 1991; Han, Hsu & Sheu, 2010). It is an individual opinion that has a strong effect on that individual's buying decision and behaviour (Park, 2000). Past studies show that family members, peer groups, friends, and colleagues set SNS; and their optimistic perception has a significant impact on the decision and attitudes of individuals to purchase green (Teng & Lu, 2016; Paul et al., 2016; Singh & Verma, 2017; Du, Bartels, Reinders & Sen, 2017; Yilmaz & Ilter, 2017; Hansen, Sørensen & Eriksen, 2018), organic products (Dean, Raats & Shepherd, 2012), and most of the clients are re-visiting to green hotels (Teng, Wu, & Liu, 2015; Chen & Tung, 2014). Many studies have shown that subjective norms affect green consumption immensely (Zukin & Maguire, 2004). The family members' values and norms are closely correlated with the green purchasing intention in Thailand (Wiriyapinit, 2007). In the Indian scenario, subjective norms significantly affect buying preferences for green goods (Yadav & Pathak, 2017). However, the Khare (2015) study found that there is no association between SNs and GPB. Paul et al. (2016) and Lavuri and Susandy (2020) studies concluded that there is no significant association between subjective norms and

GPI Intention. Thus, subjective norms are an essential factor in promoting green purchasing intentions. Therefore, the following hypothesis was framed:

H4a: SNs has a positive association with GPI

Environmental Attitude (EA)

Attitude refers to the psychological pattern reflected by determining some degree of favour or disfavour for a specific person (Bonne, Vermeir, Bergeaud-Blackler & Verbeke, 2007). EA is a pro-environmental deciding factor (Wesley, Lee & Kim, 2012; Nagar, 2015). Shoppers who have EA feel like they are part of the World (Zelezny, Chua & Aldrich, 2000). Previous studies have shown that positive EA is a critical factor (Uddin & Khan, 2016), directly affecting the GPI and GPB (Nguyen, Lobo & Nguyen, 2017; Lavuri & Susandy, 2020). The EA of shoppers has a massive effect on GPI and GPB (Zhao, Gao, Wu, Wang & Zhu, 2014; Lavuri & Susandy, 2020) with a strong correlation (Uddin & Khan, 2016; Lavuri & Susandy, 2020). Particularly, Shoppers EA has a good relationship with ecological concern (Straughan & Roberts, 1999; López & Cuervo-Arango, 2008; Lavuri & Susandy, 2020), apparel buying behaviour (Butler & Francis, 1997), and GPB (Tilikidou, 2007; Lavuri & Susandy, 2020). EA is a significant variable that affects GPB based on literary reviews. Therefore, the hypothesis was followed.

H5a: EA has a positive association with GPI

Perceived Behavioural Control (PBC)

PBC refers to the perception of performing particular conduct is easy or difficult (Ajzen, 1991). A specific behaviour happens if a person is motivated and capable of acting instead of simply having one or no reasons (Zhou, Thøgersen, Ruan & Huang, 2013). According to the TPB model, the formation of prior intention is critical for creating perceived behavioural control. The perceived allowances are perceptive evidence that customers have or using while purchasing goods. Olsen (2004) noted that significant PBC variables, such as convenience and efficiency, affect consumers' purchasing of food. Many studies have shown that PBC has the best human predictor. PBC had a positive connection with the consumer intent (Baker, Al-Gahtani & Hubona, 2007), such as organic products /foods (Moser, 2015) and green hotels (Bryła, 2016; Kapuge, 2016; Savita & Verma, 2017; Oroian et al., 2017; Maichum, Parichatnon & Peng, 2017; Asif et al., 2018; Lavuri & Susandy, 2020). The role of PBC is assessing purchasing intention and behaviour of customers towards green purchases (Paul et al., 2016; Yadav & Pathak, 2017; Lavuri & Susandy, 2020).

H6a: PBC has a positive association with GPI

Green purchasing intention and behaviour (GPI & GPB)

Intention refers to a person's willingness to execute a specified behaviour (Yadav & Pathak, 2017) and a motive, like readiness to act. According to TPB, performance is a result of intentions when the behaviour is voluntary. SNs and EA action positively impact the PI to PB (Shashi, Kottala, & Singh, 2015; Singh & Verma, 2017; Savita & Verma, 2017). In the Yadav and Pathak (2017) study, the relationship between intentions and green purchasing behaviour is positive and strong.

In recent years, it has raised the number of shoppers' willingness to purchase green items. GPB has been measured by some of the ecological concern factors (Lee, 2008; Akehurst, Afonso & Gonçalves, 2012), such as Ecological Attitude (Joshi & Rahman, 2015; Uddin & Khan, 2016), shoppers personality characteristics (Gayathree, 2016), ecological knowledge (Lee et al., 2009), green marketing approaches, product quality and ecological issues (Joshi & Rahman, 2015; Manongko & Kambey, 2018). These were investigated as factors affecting shoppers' GPB (Khan & Kirmani, 2015; Kirmani & Khan, 2016; Adnan, Ahmad & Khan, 2017; Lavuri & Susandy, 2020). Motivating factors, such as social obligation, awareness, ecological concern, social influence, and consumer interests, are the driving factors for green buying behaviour (Arli, Tan, Tjiptono & Yang, 2018; Lavuri & Susandy, 2020).

H7a: GPI has a positive association with GPB

Methods

The present research study has been conducted to understand the factors that foster green purchase intentions and examine the behavioural differences between two generations related to green purchases. We have used an offline survey method and an online survey method (e-mails) administered to a non-probability sample of 372 Indian respondents to evaluate the hypothesized relationship in this study. We used snowball and purposive sampling methods to collect data from the specified sample areas, i.e., three States of India (Telangana, Andhra Pradesh, and Tamil Nadu). Initially, a structured questionnaire has used to test the quantitative analysis to assess the proposed models' relationship. The questionnaire was evaluated by a pilot study of 105 respondents from the two study generations; who experienced purchasing eco-sustainable products. After a pre-test, the questionnaire was finalized with few changes to reduce the sample population's complexity. The questionnaire consists of two parts. The first part has five questions relating to the demographic status of two generations. The second part has 29 items divided into eight constructs, such as ME, EA, EK, EC, SNs, PBC,

GPI, and GPB. To grasp the exposure impact on the green respondents, five items of the ME scale adopted from the studies of Qader and Zainuddin (2011) and Lavuri and Susandy (2020). Similarly, four items assess the respondent's EA, and the scale was adopted from Anbukarasi and Dheivanai (2017); Lavuri and Susandy (2020). Four items scale was adopted to measure the respondent's EK level, and the scale was adopted from Asha and Rathiha (2017) and Lavuri and Susandy (2020). Four items of the EC scale was adopted from the studies of Asha and Rathiha (2017) and Lavuri and Susandy (2020). SNs, PBC, GPI, and GPB variables have three items for each, and the scales were adopted from (Demirtas, 2019; Lavuri and Susandy (2020). The researcher used the five-point Likert scale, ranging from 5 = strongly disagree to 1 = strongly agree, to measure green purchasing intentions and purchasing behavioural differences. Overall, 611 questionnaires have distributed under non-probability sampling in the three states of India, and 60.8% (372) of the respondents provided feedback. 61.8% of the Telangana; 59.5% of the Andhra Pradesh; 60.4% of the Tamil Nadu**.** The following techniques, such as descriptive statistics, Pearson correlation, multiple regressions, and independent t-test, were used to evaluate the data. The researcher used MS-Word, Excel, and SPSS version 23.0 software to analyze the data.

Results

Demographic statistics samples

This section included the sample demographic state over two generation's variables such as gender, educational background, occupation, and income rates in the participant's demographic profiles.

Table 1. Generations of demographic statistics

Variables	Millennial		Generation Z		Total	
	F	%	F	%	F	%
Gender (n=372)						
Male	88	23.7	75	20.1	163	43.8
Female	105	28.2	104	28.0	209	56.2
Total	***193***	***51.9***	***179***	***48.1***	***372***	***100.0***
Education (n=372)						
Intermediate	7	1.9	3	0.80	10	2.7
Degree	88	23.7	87	23.3	175	47.0
PG	42	11.2	41	11.1	83	22.3

Variables	Millennial		Generation Z		Total	
	F	%	F	%	F	%
Above PG	56	15.0	48	12.9	104	27.9
Total	***193***	***51.9***	***179***	***48.1***	***372***	***100.0***
Occupation (n=372)						
Govt. Employee	33	8.8	17	4.6	50	13.4
Private employee	61	16.4	171	46.0	232	62.4
Business	2	0.6	6	1.6	8	2.2
Homemaker	31	8.3	29	7.8	60	16.1
Student	9	2.4	13	3.5	22	5.9
Total	***193***	***51.9***	***179***	***48.1***	***372***	***100.0***
Monthly Income level (n=372)						
Below 50,000	24	6.4	30	8.1	54	14.5
50,001-1,00,000	36	9.7	41	11.0	77	20.7
1,00,001-1,50,000	111	29.8	80	21.5	191	51.3
1,50,001-2,00,000	13	3.5	13	3.5	26	7.0
2,00,001 and above	9	2.4	15	4.1	24	6.5
Total	***193***	***51.9***	***179***	***48.1***	***372***	***100.0***
Family type (n=372)						
Nuclear Family	***148***	***39.8***	***147***	***39.5***	***295***	***79.3***
Joint family	***45***	***12.1***	***32***	***8.6***	***77***	***20.7***
Total	***193***	***51.9***	***179***	***48.1***	***372***	***100.0***

Source: author's work.

Table 2. Eco-green items recently purchased by consumers

Eco-Friendly Green Products	Sample	Useable feedback	Per cent
Recyclable paper items	67	41	13.7
Compostable paper plates	42	39	12.9
Health and Beauty items	37	26	08.6
Electronic applicants	83	86	28.5
Green packaging bags	64	53	17.6
IT types of equipment	79	56	18.7
Total	372	301	80.9

Note: (n= 80.9 percent; 301 out of 372).
Source: author's work.

Reliability and validity

The Cronbach alpha test has been conducted to track the sample component's internal consistency to award the amount of reliability. Alpha Cronbach would be higher than 0.7 (DeVellis, 2016); when alpha levels are more than 0.7 – appropriate and 0.8 and above are favoured. The outcomes of the reliability, mean, and standard deviation of the investigations were: reliability of MS, EA, EK, EC, SNs, PBC, GPI, and GPB were 0.786, 0.730, 0.822, 0.860, 0.718, 0.721, 0.872, and 0.780. The mean values of the scale were 3.9543, 3.9704, 3.6720, 3.8192, 3.4740, 3.5403, 4.2554, and 3.4597 for MS, EA, EK, EC, SNs, PBC, GPI, and GPB. Similarly, scale Std. Deviation values for respected variables were 0.75032, 0.75197, 0.89421, 0.79062, 0.91389, 0.98894, 0.82210 and 0.96005 (see table 3).

Table 3. Scale construction

Variables	Items	DC	Mean	Std. Deviation	CA (> 0.7)
MS	5	5 point LK	3.9543	0.75032	0.786
EA	4	5 point LK	3.9704	0.75197	0.730
EK	4	5 point LK	3.6720	0.89421	0.822
EC	4	5 point LK	3.8192	0.79062	0.860
SNs	3	5 point LK	3.4740	0.91389	0.718
PBC	3	5 point LK	3.5403	0.98894	0.721
GPI	3	5 point LK	4.2554	0.82210	0.872
GPB	3	5 point LK	3.4597	0.96005	0.780

DC: Descriptive of scale; LK: Likert Scale; CA: Cronbach Alpha.
ME: Media Exposure; EK: Environmental knowledge; EC: Environmental Concern; EA: Environmental Attitude; SNs: Subjective Norms; PBC: Perceived behavioural control; ***GPI:*** Green purchase intention; ***GPB:*** Green purchase behaviour.

Source: author's work.

Factor analysis

Factor analysis has been used for the detection of factors influencing the actions of consumers buying green goods. The statistical approach consists of finding a way to condense information in various initial variables into more minor variables with zero information loss.

The estimation of the KMO sample is an indicator of the factor analysis's adequacy to be tested. The broad (0.5-1.0) significance makes the study of the factor acceptable, as the data is internally consistent with important var-

iables (ME: KMO=0.775; X^2 = 525.166; DF = 5 and P<0.001; EA: KMO = 0.749; X^2 = 293.554; DF = 6 and P<0.001; EK: KMO = 0.790; X^2 = 532.076; DF = 6 and P<0.001; EC: KMO = 0.672; X^2 = 420.391; DF = 6 and P<0.001; SNs: KMO = 0. 719; X^2 = 386.112; DF = 3 and P<0.001; PBC: KMO= 0. 724; X^2 = 524.031; DF = 3 and P<0.001; GPI: KMO = 0.729; X^2 = 582.188; DF = 3 and P<0.001; GPB: KMO = 0.703; X^2 = 306.549; DF = 3 and P<0.001) have been noted as good. The sphericity check by Bartlett shows the strength of the interaction between variables. The degree of significance measured was 0.000. The strength of the relation between the variables was high. Therefore, data was reasonable to analyze the elements. The pivot of Varimax was monitored through 29 dimensions relating to 8 unique factors, which were ME (5 items), EA (4 items), EK (4 items), EC (4 items), SNs (3 items), PBC (3 items), GPI (3 items), and GPB (3 items) (see table 4).

Table 4. Exploratory Factor Analysis (EFA)

Variables	KMO (NI)	X^2; DF	EV	%Var	FL
Media exposure (ME)					
ME1	0.775 (5)	525.166; 5 (P<0.001)	2.717	54.338	.784
ME2					.811
ME3					.727
ME4					.636
ME5					.714
Environmental Attitude (EA)					
EA1	0.749 (4)	293.554; 6 (P<0.001)	2.219	55.481	.709
EA2					.770
EA3					.784
EA4					.714
Environmental Knowledge (EK)					
EK1	0.790 (4)	532.076; 6 (P<0.001)	2.611	65.265	.835
EK2					.836
EK3					.840
EK4					.713
Environmental concern (EC)					
EC1	0.672 (4)	420.391; 6 (P<0.001)	2.322	58.045	.782
EC2					.693
EC3					.833
EC4					.733

Variables	KMO (NI)	X^2; DF	EV	%Var	FL
Subjective Norms (SNs)					
SNs1	0. 719 (3)	386.112; 3 (P<0.001)	2.201	73.358	.756
SNs2					.759
SNs3					.754
Perceived behavioural control (PBC)					
PBC1	0. 724 (3)	524.031; 3 (P<0.001)	2.345	78.170	.755
PBC2					.803
PBC3					.794
Green purchase Intentions (GPI)					
GPI1	0. 729 (3)	582.188; 3 (P<0.001)	2.398	79.923	.864
GPI2					.906
GPI3					.911
Green purchase Behaviour (GPB)					
GPB1	0. 703 (3)	306.549; 3 (P<0.001)	2.085	69.499	.831
GPB2					.828
GPB3					.842

Note: X^2: Chi-square; DF: Degree of freedom; EV: Eigenvalues; %Var: Percent of variance; FL: Factors Loading; NI: No. of items.

Source: author's work.

The exploratory factor analysis (EFA) consists of eight variables, and the 1st variable (ME) in EFA with an eigenvalue of 2.717%, with a total variance of 54.338. The following variables followed: 2nd, 3rd, 4th, 5th, 6th, 7th and 8th with an eigenvalues of 2.219, 2.611, 2.322, 2.201, 2.345, 2.398 and 2.085; Likewise, these eight variables have an explanatory variance of 55.481%, 65.265%, 58.045%, 73.358%, 78.170%, 79.923% and 69.499%. These factors had a strong effect on green purchase intention (see table 4).

Pearson Correlation

The correlation test determines the linear association among the chosen variables. It providing significance from +1 to -1; +1 implies perfect correlation, -1 shows a negative correlation, and 0 does not imply any relationship in this situation. The numerical coefficient values represent the extent of the interaction between variables.

The use of Pearson analysis measures the direct relationship between selected variables such as ME, EA, EK, EC, SNs, PBC, GPI, and GPB. The analysis was accurate, with a coefficient ranging from 0.366 to 0.832 for variables

and the results of the Pearson correlation (n=372) between the eight selected variables. The correlation coefficient statistics reflect the degree of association between each construct, fostering green purchasing intention and purchasing. The results show that ME had positive relationship with EK(r = 0.490**; p<0.01) and EA (r = .525**; p<0.01); had strong relationship with GPI (r = .720**; p<0.01) at 1% significance level, these results were supported by the Schultz and Lauterborul (1993) study. EA is a key factor (Uddin & Khan, 2016) and had a significant impact on the GPI (r = .665**; p<0.01) at a 1% significance point, which had confirmed by these findings (Nguyen et al., 2017). EK had significant effect on PBC (r = .832**; p<0.01); GPI (r = .715**; p<0.01) and GPB (r = .708**; p<0.01) at a 1% significance point, and these findings were confirmed by Mostafa (2009) and Birgelen, Semeijn, and Keicher (2009). Likewise, EC had a measurable impact on the GPI (r = .715**; p<0.01) and GPB (r = .715**; p<0.01) at 1% of significance level, and these results supported the study of Albayrak et al. (2013) and Yadav and Pathak (2016). SNs had positive effect on GPB (r = .518**; p<0.01) and GPI (r = .504**; p<0.01), which were endorsed by Yilmaz and Ilter 2017; Hansen et al. (2018); Yadav and Pathak (2017). PBC had strong and substantial effect on GPI (r = .530**; p<0.01) and GPB (r = .510**; p<0.01) confirmed by the Yadav and Pathak studies (2017) and Paul et al. (2016). GPI had a strong impact on the GPB (r = .785**; p<0.01) at 1% of the significance level, as confirmed by Yadav and Pathak (2017) (see table 5).

Table 5. Pearson Correlation

	ME	EA	EK	EC	SNs	PBC	GPI	GPB
ME	1	.525** S	.490** S	.479** S	.556** S	.544** S	.720** S	.581** S
EA		1	.419** S	.421** S	.435** S	.457** S	.665** S	.554** S
EK			1	.561** S	.437** S	.832** S	.715** S	.708** S
EC				1	.366** S	.674** S	.585** S	.617** S
SNs					1	.439** S	.504^{NS}	.518** S
PBC						1	.530** S	.510** S
GPI							1	.785** S
GPB								1

Note: **: p< 0.01(2 tailed); S: Significant

Source: author's work.

Multiple Regression

Multiple Regressions clarify the relationship and assistance of predictors and dependent factors to understand the predictors' consistency effect and dependent factors.

Table 6. Multiple regression Results

Model	*IV*	*DP*	R^2	*F*	*B*	*t*	*Sig.*	Relationship
1	EA	MS	.364	105.737	.387	8.493	.000	Supported
	EK				.275	7.161	.000	Supported
2	EA	EK	.303	53.207	.387	7.148	.000	Supported
	SNs				.168	2.571	.011	Supported
	PBC				.201	3.424	.001	Supported
3	EA	EC	.405	83.391	.311	7.019	.000	Supported
	SNs				.207	3.888	.000	Supported
	PBC				.230	4.795	.000	Supported
4	ME	GPI	.508	62.767	.231	3.063	.002	Supported
	EK				.262	2.879	.004	Supported
	EC				.560	5.681	.000	Supported
	EA				.455	4.890	.000	Supported
	SNs				.124	1.700	.081	Not supported
	PBC				.169	3.080	.002	Supported
5	GPI	GPB	.340	15.595	.235	3.949	.000	Supported

Note: IV: Independent variable, DP: Dependent Variable.
Source: author's work.

This section shows the summary results of multiple regressions. Five models were designed to explore the relationship between study variables in this research, such as ME, EK, EC, EA, SNs, PBC, GPI, and GPB. The results showed that the F-values of the five models were statistically significant at 105.737 (M-1), 53.207 (M-2), 83.391 (M-3), and 62.767 (M-4) and 15.595 (M-5). Model 1 indicates that ME had significant effect on EA (b = 0.387, p≤0.001) and EK (b = 0.275, p≤0.001) and causes 36.4% variance independent variables. Likewise, Model 2 reveals that EK had strong effect on the EA (b = 0.387, p≤0.001) and PBC (b = 0.201, p≤0.001) of 53.2% of the variance induced by independent variables. Model 3 reveals that the EC had major

influence on the EA (b= 0.311, p≤0.001) and PBC (b = 0.230, p≤0.001) the 40.5% of variance explained by the independent variable. For the estimated regression model-4, the overall R2 was 0.508. This means that the predictor explained 50.8% of the variance of the dependent variable. It is evident that EC emerged as the most important variable and had a significant impact on the GPI (b = 0.560, p≤0.001). Likewise, EA had statistical significance on the GPI (b = 0.455, p≤0.001) and EK (b = 0.262, p≤0.001). Still, SNs were not statistically significant and had no impact on the GPI (b = 0.124, p≥0.001), its sig. Value was more than *p*-value. As a result, it can be inferred that EC significantly impacted the GPI towards green products. The amount of consumer EA and EK had a significant impact on the GPI towards green products. Concerning model 5 shows that the overall R2 was 0.340. This means that 34% of variance explained by a predictor, and the F value (15.595) statistically significant at a 1% significance level. GPI had a positive impact on the GPB, and it was seen as statistically significant (b= 0.235, p≤0.001) (see table 6).

Independent sample t-test

An independent t-test can detect the statistical difference between the group's means. It has been conducted to describe the significance of the mean difference in ME, EK, EC, EA, SNs, PBC, and GPI between the two generations, i.e., Millennial and Generation-Z their GPB.

H8: ME, EK, EC, EA, SNs, PBC, and GPI have significant mean differences with GPB between Millennial and Generation Z.

This section shows that variables such as ME, EK, EC, EA, SNs, PBC and GPI had significant mean difference in GPB of the two generations. The results showed that the sig. (2 tailed) values of ME (t = .616; p = 0.138); SNs (t = 0.525; p = 0.060) and PBC (t = .514; p = 0.077) were more than p-value (>0.05), which means that there was no significant mean difference with GBP between the two-generations. Thus, the findings concluded that the ME, SNs and PBC variables had similar effects on the GPB of millennial and the Gen-Z generations. Similarly, the p values of EK (t = 0.425; p = 0.032); EC (t = 1.240; p = 0.016); EA (t = .520; p = 0.024) and GPI (t = .677; p = 0.015) were statistically significant (2 tailed), because these variables sig. values were smaller than the p-value (<0.05), which means that there was significant mean difference between two generations. Hence, the findings concluded that the EK, EC, EA and GPI variables had different effects on the GPB of two generations (see table 7).

Table 7. Independent sample t-test result

Variables	Generations	N	Mean	St. D	St. EM	t -value	Sig.
ME	Millennial	193	3.9946	.73678	.05417	.616	.138
	Gen-Z	179	3.9465	.76793	.05616		
EK	Millennial	193	3.6919	.89919	.06611	.425	.032
	Gen-Z	179	3.6524	.89123	.06517		
EC	Millennial	193	3.8703	.78932	.05803	1.240	.016
	Gen-Z	179	3.7687	.79077	.05783		
EA	Millennial	193	3.5135	1.00240	.07370	.520	.024
	Gen-Z	179	3.5668	.97741	.07148		
SNs	Millennial	193	3.7122	.69249	.05091	.525	.060
	Gen-Z	179	3.6738	.71646	.05239		
PBC	Millennial	193	3.8338	.65608	.04824	.514	.077
	Gen-Z	179	3.7981	.68024	.04974		
GPI	Millennial	193	3.8189	.73743	.05422	.677	.015
	Gen-Z	179	3.8676	.64928	.04748		

Note: St.D: Standard deviation; St.EM: Standard Error Mean.
Source: author's work.

Discussions and Conclusions

Environmental issues are increasing rapidly in India. Eco-consciousness has become a new Mantra of Victory, and people from every life stage are looking at it. This study examines the factors that foster green buying intentions and buying behavioural differences between millennials and the Z generation of green goods. Researchers used eight key variables such as ME, EK, EC, EA, SNs, PBC, GPI, and GPB, with 29 items affecting mainly two-generation behaviour in six cities of three states in India. Based on the TPB approach, the research study seeks to expand the TPB to include three additional variables environment concern, knowledge, and media exposure. The findings of the study have shown that consumers are ecologically conscious and concerned about environmental sustainability. Consumers are exposed to media exposure, such as television, newspapers and magazines, the outdoors, and the Internet. It plays a critical role in communicating about environmental issues and green goods.

Concerning the study's findings, media exposure had a significant impact on EK (H1a), EA (H1b) and directly impacts the GPI and these results and the results confirmed by the studies of Schultz and Lauterborul (1993) and Lavuri and Susandy (2020). In the same way, a high degree of EK leads to a much better environmental performance. Individual EK had a significant impact on environmental problems and was linked to EA and PBC. The findings show that it had a strong impact on the EA (H2a), SNs (H2b), PBC (H2c) and GPI (H2d) and these results confirmed by Chaudhuri (2014), Wang et al. (2014) and Lavuri and Susandy (2020). The findings show that there was a positive relationship between EC, PBC, SNs and GPI. EC had a positive impact on the EA (H3b) and PBC (H3d) and had a powerful impact on the GPI (H3a), these results confirmed by the studies of Granzin and Olsen (1991), Kim, Yun, and Lee (2014) and Lavuri and Susandy (2020). But SNs did not impact GPI (H4), and this results supported by the Lavuri and Susandy (2020). At the same time, EA (H5), PBC (H6) had a significant impact on the GPI (H5) and the result supported by the studies of Uddin and Khan (2016); Lavuri and Susandy (2020). Finally, study factors such as ME, EC, EA, EK, and PBC had significant effects on customers GPI. These findings sugges t that these factors had a strong incentive to GPI towards GPB. These findings supported the studies of Nguyen et al. (2017); Yadav and Pathak (2017); Lavuri and Susandy (2020). Finally, these findings reveal that these variables had vital fostering for GPI users towards GPB. GPI had a significant and substantial impact on the GPB (H7) and was supported by the research of Yadav and Pathak (2017); Lavuri and Susandy (2020).

Regarding the associations of behavioural variations between generations, the ME, SNs, and PBC variables did not show any significant mean difference between the two generations of GPB. This finding indicated that these factors had a comparable impact on the GPB of two generations. Similarly, the variables EK, EC, EA, and GPI showed a large mean difference between the two generations of GPB.

The research results concluded that the variables EK, EC, EA, and GPI had different effects on the GPB of the two generations. In contrast, the remaining variables did not indicate any difference to GPB. Research focuses on factors that explore green purchasing behaviour. This context will help policymakers and managers develop and implement strategies to promote green awareness and stimulate customer purchase behaviour. This study encourages academics to understand the nature and purpose of the research study and the factors that impact green purchasing behaviour on shoppers. This study enables them to develop a new, innovative model for consumer buying actions.

Implications, limitations, and future directions

Research implications: The research study had significant implications for the corporate administrators in promoting green products in South India. The research findings will increase understanding among marketers of two generations of behavioural intentions to buy sustainable goods. Because PBC is closely connected with the GPI, marketers must make attempts to enhance their understanding of all the variables selected in the model proposed. EC found to impact the EA, SNs significantly, and PBC in the Expected Behaviour Model may help marketers target marketers with a strong GPI and GPB response. The GPI has dramatically influenced MS, EK, EC, EA, and PBC among six TPB predictors. This influence can also be made to improve the attitudes of consumers towards GPB. Likewise, suppose green products can be readily accessible with minimal efforts to reach customers. In that case, it can boost customer interest and encourage marketing professionals to increase green demand. As a result, the GPI and the GPB have substantially correlated with PBC.

In this way, marketers may consider expanding green options by enhancing R&D accessibility and opening alternative distribution channels (Paul et al., 2016) to improve the accessibility of green goods. Thus, the problem of purchasing sustainable goods is reduced, and consumer perception control is improved. SNS does not affect the GPI. Policymakers need to form societal attitudes about green goods being helpful. Campaigns and ads showing worsening environmental conditions can enhance awareness of ecological concerns, which may contribute to green consumption.

This will profit in the long run by making green consumption a socially acceptable norm and behaviour that affects individuals' intentions, attitudes, and behaviours towards green goods. As part of CSR activities, organizations are entitled to participate in these activities, which allow them to benefit dually from improved external reputation and increased green product sales. The business will have a business strategy that incorporates green sustainability, which will also lead to organizations' sustainable competitiveness. Finally, this research will help policymakers develop policies and strategies to promote the adoption of GPUs. It helps to ensure environmental protection through a better understanding over two generations of GPI and GPB factors.

Limitations of the study: The study›s geographical area is limited to only six selected cities from three South Indian states. Consequently, the findings and conclusions of the study have their limits. The research used the information continuum with a purposive and snowball approach that does not necessarily generalize the analysis findings. The rural sector has not

been considered in this research study. In the future, it is possible to discuss the role of green marketing in rural areas.

Future directions: The researchers carefully chose the sample, but the scope for further research exists. The present study only measured two generations of respondents (Millennial and gene Z) deliberately targeting environmentally friendly green products. Future research may be done on the various cultural and social contexts. It will be possible to investigate the influence of consumer demographic situations such as altruism, psychological factors, and eco-knowledge on eco-green products. Cross-cultural studies and demographic measures could be helpful for more profound insights across different generations.

The contribution of the authors

Rambabu Lavuri – 60% (conception, literature review, acquisition of data, analysis and interpretation of data).

Eddy Jusuf – 20% (conception, literature review, acquisition of data, analysis and interpretation of data).

Ardi Gunardi – 20% (conception, literature review, acquisition of data, analysis and interpretation of data).

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APPENDIX 1

The scale of perception: Tick the one answer for every question that comes closest to your view: (Strongly Disagree: 1, Disagree: 2, Neutral: 3, Agree: 4, Strongly Agree5)

Variables	Dimensions	Sources
Media Exposure (MS)	TV	Qader and Zainuddin (2011); Lavuri and Susandy (2020).
	FM Radio	
	Newspaper & Magazine	
	Outdoor	
	Internet	
Environmental Attitude (EA)	Green goods use less agro-chemical.	Anbukarasi and Dheivanai (2017); Lavuri and Susandy (2020).
	Green items with Eco-packaging.	
	Eco-branding & labelling are Green items.	
	Green items are safer and healthier	
Environmental knowledge (EK)	Sustainability of the ecosystem	Asha and Rathiha (2017); Lavuri and Susandy (2020).
	Bio-degradable	
	Recyclable	
	Eco friendly	
Environmental Concern (EC)	Green goods help build a sustainable environment	Asha and Rathiha (2017); Lavuri and Susandy (2020).
	Earth Friendly procurement of environmentally friendly goods	
	Reduce waste and recycle	
	The use of green goods makes you feel happy	
Subjective norms (SNs)	My family thinks it's a good idea to buy Green items.	Demirtas (2019); Lavuri and Susandy (2020).
	Good opinion of my friend encourages me in buying green items.	
	I would rather buy green goods from people whose views I respect.	
Perceived behavioural Control (PBC)	I believe that I have the capacity to buy ecological products.	Maichum, Parichatnon, and Peng (2016); Demirtas (2019); Lavuri and Susandy (2020).
	I have the time, the resources and the willingness to buy green goods.	
	I assume that in the future I will be capable to buy green goods.	
Green Purchase intention (GPI)	I shall consider purchasing green goods because in the coming days they are less polluting.	Maichum et al. (2016); Demirtas (2019); Lavuri and Susandy (2020).
	I shall consider changing to eco-friendly brands with respect to ecological issues,	
	I prefer to spend more than average on ecologically friendly goods.	
Green Purchase behaviour (GPB)	I've frequently purchased green goods	Demirtas (2019); Lavuri and Susandy (2020).
	I have a green habit purchasing products for my daily needs.	
	I've had a green buying conduct for the previous six months.	

ENVIRONMENTAL POLICY AND MANAGEMENT

POLITYKA EKOLOGICZNA I ZARZĄDZANIE ŚRODOWISKIEM

Agnieszka **BARAN**

SUSTAINABLE INNOVATIONS – SELECTED ASPECTS

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ABSTRACT: The article aims to analyse the state of art in the field of sustainable innovation in Poland and identify barriers to developing this type of innovations. The article describes the main barriers in the implementation of sustainable innovations and related problematic issues. Eco-innovation may help European entrepreneurs develop sustainable solutions, allowing better use of valuable resources and reducing the economy's negative impact on the environment. Awareness of the benefits brought by environmental technologies is still low. Implementing environmental innovation requires a strategic approach, and introducing them to the company's existing structures is difficult and time-consuming. Contemporary challenges, such as climate change and the depletion of natural resources, require new solutions. Modern economies are based on intangible assets protected by intellectual property rights, intellectual property management is now an integral part of any effective business strategy.

KEYWORDS: sustainable innovations, innovations, sustainable development, protection of intellectual property

Introduction

Poland is not a country with a high level of innovation. As shown by the innovation report in Europe for 2020, Poland is in the 33rd spot (European Innovation Scoreboard, 2020). Our country has been low in this ranking for many years, and only recently has it moved up from the group of the least effective innovators. The innovation level of an economy is measured through the number of granted patents. The significant innovation criteria are the number of registered inventions, registered patents, and the number of cited patents. The number of filed patent applications shows the need to protect inventions, while the number of granted patents points to the invented solutions' quality. The literature indicates that the number of patents can be used as an indicator of innovative activity in the environmental field. Similarly, as for innovation in general, patents of ecoinventions can be used to measure research and invention activities and study the directions of research in a given technological field (Oltra et al., 2008).

After the Paris Agreement (UNFCCC, 2015), sustainable development innovations became more significant in political debates. The agreement stressed the importance of the transfer of green technologies to developing countries as an element of supporting and fulfilment of the agreement's conditions. Sustainable innovation and green technologies are essential to Europe's future and at the heart of the European Union's policies. The EU's economic prosperity is intrinsically linked to its natural environment, and the global demand for resource-efficient solutions will also be a source of jobs. The Environmental Policy for 2030 (Environmental Policy 2030, 2019) lists the promotion of Polish environmental technologies and supporting this sector internally and internationally. Research and development work will be supported alongside implementation work in the area of innovative environmental technologies.

The article aims to analyse the state of art in the field of sustainable innovation in Poland and identify barriers to developing this type of innovations. The article describes the main barriers in the implementation of sustainable innovations and related problematic issues.

Sustainable innovations – theoretical issues

There are different terms used in the literature to describe innovations that have a reduced negative impact on the environment: "green", "eco", "environmental", and "sustainable" (Díaz-García et al., 2015).

Sustainable innovation combines long-term economic success with environmental protection and the social responsibility of business. There is no

single, precise definition for sustainable innovations. In author opinion, the correct definition is proposed by Charter and Clark, who claims that sustainable innovation is a process in which aspects of sustainable development are taken into account at every stage of the company's activity, starting with the idea, through research and development, up to commercialisation. It refers to products, services and technologies, new forms of economic activity and organisation models (Charter, Clark, 2007). *Sustainable innovation is the creation of something new that improves performance in the three dimensions of sustainable development: social, environmental and economic. Such improvements are not limited to technological changes, and may relate to changes in processes, operational practices, business models, thinking and business systems* (Kneipp et al., 2018). The concept of "sustainable innovation" refers to the concept of sustainable development, and authors often argue that this term is an alternative to the equivalent concept of "eco-innovation" (Gałązka, 2017).

The Commission of the European Communities defined the term of environmental technology in 2004 as a technology that is less harmful to the environment than other similar technologies. This is a broad definition, including resource collection methods, soil, water and air protection, global climate change prevention, sustainable production, sustainable consumption, and sustainable logistic systems. Eco-innovative solutions are used in such technologies, which can be technological solutions themselves or solutions that are non-technological, such as new products, services or new business practices, which reduce the negative environmental impact (CC, 2004). Agenda 21 contains the definition of environmentally sound technologies, describing them as less polluting, using resources more sustainably, recycling more waste and products, and managing production waste in a more balanced and acceptable way than the technologies which they replaced. The usage of such technologies can yield beneficial environmental effects and financial benefits to the organisation that should implement such technologies. Environmentally sound technologies are "technologies related to processes and products", which generate a small amount of waste or do not generate waste at all to prevent pollution. These include the end-of-pipe technologies for the treatment of waste after their production (Agenda 21, 1994).

Literature and strategic European Union documents use the terms of eco-innovations and sustainable innovations interchangeably. The framework programme for innovation and competitiveness defines eco-innovation as *any form of innovation, which helps achieve sustainable development through the decrease of environmental impact, increase of resistance to environmental pressure or more effective usage of natural resources* (EP, 2006). According to the definition formed by the OECD an innovation is defined as

the *implementation of a new or significantly improved product (item or service), process, new marketing method or new organisation method in business practice* (OECD, 2005). Eco-Innovation is any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving more efficient and responsible use of natural resources (CC, 2011). According to the Ecoinnovation Observatory, eco-innovation is any innovation, which reduces the use of natural resources and reduces the release of harmful substances in the entire life cycle. As with all innovations, eco-innovations mean the introduction of a new product (item or service) into the market or the implementation of a new solution in production processes or organisation processes of a business. However, unlike other innovations, eco-innovations yield not only economic benefits but also environmental ones. Such environmental benefits can include the reduction of natural resource usage and the reduction of the release of harmful substances per production unit over the entire life cycle (Eco-innovation Observatory, 2011). It can be stated that eco-innovations are a specific type of innovation and that all new processes, which are more resource-effective, are eco-innovations. Everything can be an eco-innovation, provided it is more environmentally sound than other solutions (Kemp, Mainguy, 2011). Environmental innovations are defined as a tool for supporting sustainable development in the form of *new products and processes, which ensure value to business clients, while, at the same time, decreasing their influence on the environment* (Olejniczak, 2015). Distinguishing eco-innovations from innovations requires showing that as a result of their application, the negative impact on the environment decreases in relation to the effects of another solution (Kemp, Pearson, 2008).

The Polish Agency for Enterprise Development (PARP) defines pro-ecological innovations as *any innovation, implemented according to the law, which benefits the natural environment – especially in the form of reducing the usage of natural resources per unit of produced goods and reducing the release of harmful substances into the environment during the production and usage of a product as well as after its use* (PARP, 2011). In the 'Europe 2020' strategy, eco-innovation was defined as *relating to all forms of innovation – technological and otherwise – which create the opportunity for businesses and are beneficial to the environment through the prevention of negative environmental impact or reducing it, or through the optimisation of resource usage. These innovations help production companies to transition from 'end-of-pipe' solutions to 'closed-circuit' solutions, which minimise the energy and resource flow by changes in products and production methods, and, as a result, providing a competitive edge to many companies and areas of business* (EC, 2012).

Sustainable innovations development barriers

Modern-day challenges, such as climate change or the depletion of natural resources, require new solutions. In the face of the significant impact of climate change and resource depletion, the European Union has decided that the financing system is the main issue that requires being reworked to become a part of the solution for a greener and more sustainable economy. The predicted actions include the mobilisation of private capital for sustainable projects, especially in infrastructure, which is responsible for over 60% of greenhouse gas production. After 2020 the European Union proposes establishing a single investment fund that would integrate all EU market instruments to support the increase of investment support further. Implementing this plan will require legislative steps, which will ensure unified definitions and the possibility of providing reliable and comparable information relating to sustainable investments (CC, 2018).

According to the Central Statistical Office of Poland data, in 2019, gross domestic expenditure on R&D (Research and Development) increased by 18.1% compared to the previous year and exceeded PLN 30 billion. The R&D intensity index, which is the share of gross domestic expenditure on R&D activity in GDP (Gross Domestic Product), increased to 1.32%, a clear increase compared to 2018 (1.21%) (Statistical Offices, 2019). This is the result of reforms undertaken in recent years to increase the level of innovation, mainly those aimed at creating a legal framework that encourages entrepreneurs to undertake research and development works. In the European Union, expenditure on research and development (R&D) amounted to 2.19%. In relation to GDP (Eurostat, 2019). Poland, with the rate of 1.32%, was below the EU average. Often, the entrepreneur decides to use an existing solution that is more popular and less costly. Polish companies suffer from a lack of funds for innovations. Small and medium-sized companies' innovative activities are based on their own capital, which often is insufficient to introduce meaningful, innovative changes. Small and medium-sized companies in Poland do not seem to be highly innovative, with only 10-20% being considered innovative; innovative activities are undertaken mainly in large companies. The majority of Polish entrepreneurs are small companies employing just a few persons. Such small organisations are not at all interested, due to lack of capital, in investing in innovation. This is also linked to the strategic approach to intellectual property protection. Strong competition forces companies to search for new production methods, introduce new products or improve the existing ones. However, it is essential for companies to be aware of their intellectual and human capital, which can be of significant value. The strategy of managing intellectual property should be a part of the general strategy of

a company's growth. It should be unique, relating to a company's specific goals, size and business profile, which may, in turn, require more effort placed on a specific type of protection of individual intangible assets. There are many benefits of patenting which can be gained by the entrepreneurs, such as exclusive rights, strong market position, higher return of investment, possibility of licensing and selling of the invention/innovation, stronger negotiation position, positive company image, obtaining business partners (Kacprzak, 2018).

Barriers in the development of eco-innovations are also related to an uncertain market in environment protection. There is a lack of information on the benefits of using environmental technologies in Poland. Additionally, the low awareness of entrepreneurs in relation to how their businesses influence the environment is one of the causes of such a low number of environmental technologies being implemented. There are no developed rules for cooperation between the world of science and business, which may result from a lack of faith in the abilities of Polish scientists (Report of the European Commission, 2019). Additionally, it is easier and faster to purchase ready solutions, usually from abroad, than use ideas which are still being in development by the domestic science centres. However, it needs to be stressed that the environmental protection industry's development will result in new workplaces. Access to appropriate training courses in eco-innovations needs to be more significant to ensure the employers' necessary, qualified workforce. New knowledge and skills may ensure access to newly-created, innovative employment possibilities and make it easier to transfer from areas which are losing importance to the new environmental sectors.

Currently, a strong stimulant for eco-innovation development are the legal obligations that the EU puts in front of their member states, such as climate protection. With a certain degree of diversity in the socio-economic situation of EU member states, these stimulants can pose serious barriers for some of the countries. It is stressed that to stimulate innovation, the form of the regulations is less important than their adaptability – understood as the openness to non-standard solutions to environmental issues – and predictability (Szpor, Śniegocki, 2012). However, executing such regulations is not without meaning for environment protection, as it is difficult to hope for a pro-environmental attitude of entrepreneurs, including expenses on eco-innovations, without such regulations.

Sustainable innovations – selected problematic issues

Among the pro-innovation instruments and conditions, the expense amount on research and development, highly skilled human capital, system

of tax incentives, cooperation of science and business, developed technological infrastructure, availability of venture capital funds, strong market competition, as well as the implemented legal solutions for patent protection are mentioned (Czerniak, 2007).

Patents are crucial to the development of an economy based on modern technologies. Original technologies allow to development of competitive industry and profit from licence agreements. The current patent system is under scrutiny, and it is discussed how much does it really do to stimulate the development of new technologies. Such a system should support innovative entrepreneurs, protect companies and their innovative solutions from appropriation and exploitation of intangible assets. The development of modern technologies is strongly linked to invention activities, which results in an increasing number of granted patents. According to the World Intellectual Property Organisation data, the number of filed patents in 2019 decreased worldwide by 3%, and the total number of filed inventions was 3.2m (WIPO, 2020). However, the number of patents in the world rose by 7% to a number of 15m in 2019 (World Intellectual Property Indicators Report, 2019). In its annual report for 2019, the Polish Patent Office listed 3946 filed patents for inventions from Poland and foreign countries, which is a decrease in comparison to the previous year (2018- 4269). In 2019 a total of 3042 patents were granted (domestic and foreign entities), which is an increase compared with the previous year (2018-2980).

The solution to global environmental issues requires modern technologies. *Inventions in environment protection technology are an important factor of green growth in an eco-friendly economy. They contribute to the rational usage of natural resources, limitation of the negative impact of production and services on the environment, they can also lead to the creation of new products, workplaces, improvements in technologies, and, as a result, to an increasingly competitive economy. Patents create the basis for efficient management of knowledge in the field of technology and support the development potential of an innovative economy* (Statistical Offices, 2020). According to a Polish Patent Office report, there were 86 patents granted in 2019 to domestic concerns in relation to environmental protection technologies. Over the last 5 years, there was no visible increase in this area (2015-66, 2016-86, 2017-69, 2018-90) (Annual Report Patent Office of Poland, 2019). In 2019, the European Patent Office granted to Polish concerns 39 patents relating to environment protection technologies (the largest number since the year 2000). These constituted 10.7% of the total number of patents granted to Polish concerns. Compared with the previous year and the year 2000, this participation increased by 0.6 percentage point and 1.1 percentage point respectively. In 2019, in EU countries, the European Patent Office granted 6,000 patents relating to environment protection technologies, constituting 10.6% of the

total number of granted patents. The highest number was granted in Germany – 2286 (38.3% of the total of granted patents relating to environment protection technologies in the EU) and France – 1000 (16.8%). With a share of 0.7% of the total number of patents relating to environment protection technologies in the EU, Poland was placed 12th among the member states (Statistical Offices, 2020). A few reasons for such a low number of environmentally sound patents can be given. In Poland, it is mainly the large companies that can have success in implementing their innovative solutions. In this group of companies, the increase in expenditure on innovative activities is visible. The lowest innovative activity is seen in companies which employ 10-49 persons. Typically, industrial companies are more active with innovations (Statistical Office, 2019). Small and medium-sized companies often have low innovative potential, which, combined with complicated procedures and high patent protection costs, effectively discourages even the most innovative of these companies to file any patent applications. However, a patent protects the basic technology of a company. It ensures a competitive edge and income from licensing, which makes the company more attractive for buyers and investors.

A question needs to be formed, whether patents can be the preferred instrument encouraging innovation? Does the current system of intellectual property law help or hinder the designing and implementation of sustainable technologies? Patent protection creates monopolies and, in the literature, there is a view that intellectual property law can also negatively impact innovation and that too broad a range of legal protection can lead to legal uncertainty in relation to prior arts and whether the invention being filed for a patent does not infringe on anyone's rights (Miąsik, 2012). Some view the monopoly resulting from the protection of exclusive rights in a positive light, stating that the only goal of patent protection should be the innovative activity's support. This goal can be reached by ensuring, for a specific period, an exclusive right to use the innovations by their inventors. The perspective of significant income can encourage innovators to spend more on research (Czerniak, 2007). At the same time, despite the financial benefits, the innovator may have to spend more to benefit from innovations patented by others. In today's world, a new innovation often requires the use of many already existing inventions. In such a case, the patent monopoly will be a barrier to the development of innovations. It is also stressed that the increase of patent protection does not influence the development of innovations to such a degree as better expenses management for research and development within a company does (Boldrin, Levine, 2012). In 2008, during the European Patent Forum, the dependence between intellectual property rights and climate protection was discussed. It was stated that industrialised countries usually protect intellectual property rights as an indispensable element stim-

ulating the growth of innovation. On the other hand, according to developing countries' representatives, intellectual property rights are an obstacle in the transfer of technologies from developed countries to the developing regions of the world. The majority of technologies harmless to the climate is not protected by patents, which is a positive factor.

Additionally, developing countries seldom mention intellectual property rights as a significant issue. A larger issue is the cost of such protection, which is similar worldwide (EC, 2008). In 2019 the European Union Intellectual Property Office (EUIPO) and the European Patent Office (EPO) published the results of analyses relating to economic areas that intensively utilise the intellectual property rights in the EU. This report's goal was to analyse the contribution of various types of intellectual property rights in the building of the EU economy. The analysed sample was the 'sectors which intensively utilise intellectual property rights', in which there is an above-average number of patent-protected intellectual properties per single employee. The analysis shows that the sectors which use intangible assets have a beneficial influence on the building of the innovative economy of the EU (Kostrzewa, 2020). In 2020, the EU proposed Action Plan on Intellectual Property. The plan aims to help small and medium-sized companies (SMEs), make the most of their intangible assets. The plan proposed to ensure that innovators have access to fast, effective and affordable protection tools such as IP Helpdesks and by regularly monitoring the support available to small businesses. The goal of EU action is to provide intellectual asset management skills rather than increase IP rights registration, ensure links between IP specialist support and general business support, and ensure that support is coordinated at the national and EU levels. By 2021, the Commission wants to secure the unitary patent system's launch to create a one-stop-shop for patent protection and enforcement across the EU (Action Plan on Intellectual Property, 2020).

To sum up, the problem of patent monopolisation is unsolved, and, at the same time, it is most frequently discussed in the literature. Attempts to resolve it are made primarily through legislation.

Conclusions

The implementation of environmentally friendly innovations directly influences sustainable development. It helps find solutions to global environmental issues by reducing the negative impact of economic activity on the natural environment by lowering energy consumption, reducing natural resource usage or reducing the emission of harmful substances (Pakulska, 2020). The use of environmental technologies improves the effects of economic activities by reducing costs and increasing sales and, at the same time,

helping to adjust to increasingly stricter legal requirements relating to environmental protection. In the author opinion, civil service should create an environment friendly for business in relation to eco-innovations and environmental technologies. In turn, the business should generate interest in such solutions, and the science should generate them based on the needs of domestic, EU and worldwide economy. In Poland, there is still no significant interest in pro-ecological innovations. The main barriers are implementation costs, costs of introduction to the market, lack of partners for cooperation, unwillingness to take risks related to introducing new technologies and lack of cooperation with research and development centres. Modern economies are based on intangible assets protected by intellectual property rights, and intellectual property management is currently an indispensable part of any successful business strategy. It can be concluded that patents are a double-edged sword, with a positive and a negative side. They often contribute to enhance incentives to invent, disclose and trade technology. However, they also generate costs to society in terms of monopoly rents and barriers to access and knowledge use (Encaoua et al., 2007).

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ENVIRONMENTAL POLICY STRINGENCY AND ITS IMPACT ON AIR POLLUTION IN POLAND

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ABSTRACT: The article aims to assess the level of severity of the environmental policy in Poland compared to the selected EU countries and the impact of this level on the SO_2, NO_X, VOCs, CO_2, and GHG emissions and premature mortality due to exposure to PM2.5. In the research based on OECD and Eurostat data, multiple regression analysis is used. The results of regression analysis do not allow for drawing unequivocal conclusions. The use of one of the selected measures of environmental policy stringency confirms the impact of this stringency on all the studied variables characterising air pollution. In contrast, in the other measure, this relationship was found only for two variables. The reason for different results may be the adoption of different research periods (1990-2012 and 1994-2018) due to the availability of data.

KEYWORDS: environmental policy, air pollution, environmental taxes, expenditures on environmental protection

Introduction

The environmental policy pursued by individual countries is characterised by various types of instruments used and their motivational power, consisting of smaller or greater financial burdens for companies that damage the environment. The scope and scale of financial support for companies undertaking pro-environmental projects are also different. Different levels of stringency can therefore typify environmental policy. Environmental policy stringency can be defined as 'the strength of the environmental policy signal – the explicit or implicit cost of environmentally harmful behaviour, for example, pollution' (OECD, 2016, p. 3).

The more restrictive the environmental policy instruments that directly increase the costs of environmentally harmful behavior (such as emission standards or taxes), the more stringent environmental policy is. In the case of subsidy instruments (e.g., environmental R&D subsidies, feed-in tariffs for renewable energy) that reward environmentally-friendly behaviour, higher subsidies are interpreted as more stringent environmental policies because they increase the opportunity cost of pollution, thus giving an advantage to "cleaner" activities (Botta, Koźluk, 2014, p. 14).

Researchers in the field of economics are interested in analysing the impact of strict environmental policy on improving the quality of the environment, human health, changes in patterns of trade, foreign direct investment, economic growth, companies competitiveness, or new plant locations (Brunel, Levinson, 2013, p. 6; Jakubów, 2018, p. 10; Kulawik, 2016, p. 3). There is no generally accepted measure of environmental policy severity in the economic literature. Various methods of quantifying this severity are used in research practice what makes it difficult to draw clear conclusions about the effectiveness of environmental policy and its impact on the economy (Caspar, 2014, p. 1; Galeotti et al., 2020, p. 2; Lin et al., 2018, p. 483).

The article aims to assess the level of severity of the environmental policy in Poland compared to the selected EU countries and the impact of this level on sulphur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOCs), carbon dioxide (CO_2), and greenhouse gases (GHG) emissions and premature mortality due to exposure to particulate matters less than 2.5 microns (PM2.5).

Measurement of environmental policy stringency

Assessment of various environmental policy contexts (including stringency) typically involves using a series of tests and analyses usually carried out for many years (Malik, 2012, p. 375). Measuring environmental policy

stringency is a challenging task mainly due to the multi-dimensional nature of the policy manifested, among others, by the multitude of instruments used and their design and implementation features. Another problem is the difficulty in correctly assessing the extent to which the expected effects of stricter regulation (e.g. lower pollution level) can be attributed to the stringency of environmental policy and to which to other government economic policies or other country-related variables (OECD, 2016, p.12; Brunel, Levinson, 2013, p. 6-8).

In the literature, various, often overlapping, classifications of environmental policy severity measures are used. For example, Sauter distinguishes four groups of indicators of environmental policy stringency (Sauter, 2014, p. 2-3):

- survey indicators,
- monetary indicators,
- policy specific indicators, and
- performance indicators.

Survey indicators are based on the opinions and perceptions of different respondents (most often managers) regarding the severity of the applied environmental protection instruments in a given state. The main disadvantage of these measures is the subjectivity of the respondents. An example of a measure based on surveys is the indicator of environmental regulatory stringency developed by the World Economic Forum, obtained from Executive Opinion Survey responses.

Monetary indicators may include, e.g. public expenditures for environmental protection, pollution abatement costs, capital expenditures and operating costs in environmental protection activities. Sauter (2014, p. 2) points to companies' difficulties in isolating the costs of pollution abatement from the total costs and the tendency of companies to overstate them as a limitation of the use of these indicators in the assessment of environmental policy strictness.

Policy specific indicators are based on the presence of a particular environmental regulation, the number of adopted or abolished instruments of environmental policy, changes in strictness of regulations or the target group of environmental instruments (Knill et al., 2012, p. 430). Policy specific indicators may refer to the ratification of international treaties in environmental politics, i.e. the severity of a country's environmental policy is determined by the timing or ratification of a specific international agreement on environmental protection (Sauter, 2014, p. 3).

Performance indicators are based on emission, energy consumption or, more generally, environmental performance data. As Sauter (2014, p. 3), rightly points out, by construction these indicators 'quantify the problem

environmental policies try to solve and not the stringency of the policies themselves'.

According to Galeotti et al. (2020, p. 2-3) indicators of environmental policy stringency proposed and applied in the literature can be divided into four main categories:

- variables measuring pollution abatement efforts,
- direct assessments of regulations,
- measures based on ambient pollution, emissions, or energy use, and
- composite indexes.

Indicators relating to abatement efforts include measures of both private and public efforts to control pollution. The latter examples are governmental environmental R&D expenditures, revenues from environmental taxes and the implicit tax rate on energy. These indicators measure the commitment of governments to spend public money to support pollution or emissions control. Galeotti et al. (2020, p. 2) notice that private and public types of proxies of environmental policy stringency are generally characterised by very poor country coverage in terms of data availability.

Direct assessments of regulations at the sector or country level are difficult due to multidimensionality and simultaneity of adopted (abolished) environmental policy instruments. Examples of these indicators include using the lead content of gasoline or standardised air quality limits as the measure for overall environmental regulatory severity. Measures based on ambient pollution, emissions, or energy use include information on the level of (or the change in) emissions and energy use at the country or sector level, totally or per capita. Galeotii et al. (2020, p. 3) rightly point out that these indicators can differ across countries for many reasons other than environmental policy stringency, such as, e.g. differences in industrial composition and in the degree of trade openness or changes in factor prices. Composite indexes may be constructed simply from counts of regulations, non-governmental environmental organisations, international treaties signed or based on statistical aggregation techniques using a set of environmental policy indicators.

Another classification of environmental policy stringency indicators can be found in the OECD study (OECD, 2016, p. 10-11), where the following measures are identified:

- measures related to environmental policy instruments, including indicators of the existence of single policies, their levels (e.g. tax rates) or changes as well as composite measures that aggregate selected information on individual instruments,
- measures attempting to capture perceptions of the stringency of environmental policies, based on dedicated survey questionnaires,

- measures relating to changes in agents' behaviour, especially consequences of environmental regulations such as firms' costs, actions and production choices,
- measures relating to changes in environmental outcomes, i.e. the variation in the environmental performance of firms, sectors or countries.

The OECD classification is similar to that given by Sauter (presented above).

Increasingly, in empirical research in the field of economics (e.g. Albrizio et al., 2017; De Santis et al., 2021; Sadik-Zada, Ferrari, 2020; Sterlacchini, 2020; Wang et al., 2019), the composite EPS index (environmental policy stringency index – EPSI) developed by the OECD is used as a measure of the severity of environmental policy. The EPSI is derived by aggregating information on selected environmental policy instruments, primarily related to climate and air pollution. The environmental policy instruments included in the EPSI are divided into:

- market-based instruments (environmental taxes, trading schemes, and feed-in tariffs in renewable energy sources),
- non-market-based instruments (emission standards and renewable energy subsidies).

The EPSI is the arithmetic mean of sub-indices calculated for market and non-market instruments (the market EPSI and the non-market EPSI, respectively). The instruments are scored on a 0-6 scale increasing in stringency. The country scores are then aggregated by instrument type (taxes, trading schemes, emission standards and others), instrument category (market-based and non-market-based) and further on using equal weights at each stage (OECD, 2016, p. 2 and 5). A detailed description of the calculation of the EPSI can be found in the study by Botta and Koźluk (2014).

Research methods

The following measures were selected to assess the level of environmental policy stringency in Poland:

- the OECD EPS index (retrieved from OECD database),
- the share of environmental taxes in the gross domestic product (GDP) (retrieved from OECD database),
- the share of national environmental protection expenditure in GDP (retrieved from Eurostat database).

The OECD database on the EPS index in the UE countries contains data on 19 of them (including also the United Kingdom, which left the EU in 2020). Among these countries, Slovenia was excluded from the analysis due to the too short time series of available data, covering only 2008-2012. The final

sample included the following 18 EU states: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden and the UK (hereinafter referred to as 'the EU-18'). The same sample was used in the analysis, taking into account the other two environmental policy stringency measures. The EPS index's available data cover the years 1990-2012 for most countries, and for some countries also the years 2013-2015.

Multiple linear regression was used to analyse the impact of environmental policy stringency on air pollution in Poland. The following were assumed as dependent variables:

- SO_2 emissions (in thous. tonnes),
- NO_x emissions (in thous. tonnes),
- CO_2 emissions (in mln tonnes),
- GHG emissions (in thous. tonnes CO_2 equivalent),
- VOCs emissions (in thous. tonnes),
- mortality due to PM2.5 (per 1 mln inhabitants).

Renewable energy production (REP), expressed in thousand toes, was selected as the control variable. Data on dependent variables and renewable energy production were retrieved from OECD database.

A total of 24 multiple regression models were used in the analysis of the role of environmental policy severity for air pollution, i.e. six each for four independent variables:

- the EPS index (EPSI),
- the market EPS index (MAR_EPSI),
- the non-market EPS index (NMAR_EPSI),
- the share of environmental taxes in GDP (ET).

Due to the availability of data on both independent and dependent variables, the models used include a different analysis period:

- 1990-2012 in models with the variables EPSI, MAR_EPSI and NMAR_EPSI,
- 1994-2018 in models with the variable ET.

Incomplete data on national environmental expenditure made it impossible to use them in regression analysis (table 4).

Results of the research

The level of environmental policy stringency for Poland and the EU-18 in the years 1990-2012, measured using the OECD index, is presented in table 1. The value of Poland's environmental policy stringency index in the analysed period increased from 0.65 to 2.58. There was also an upward trend in all other EU-18 countries. Figure 1 shows the development of the EPSI in Poland and, for example, in Denmark, Finland, France and the UK (for the last two

countries, the available OECD data cover the period 1990-2015). In the EU-18 countries, the average EPSI value, amounting to 0.82 in 1990, increased over 23 years to 2.84.

Table 1. Environmental policy stringency index

Year	Poland	EU-18			
		Mean	Standard deviation	Minimum	Maximum
1990	0.65	0.82	0.31	0.35	1.67
1991	0.79	0.94	0.44	0.48	2.13
1992	0.83	1.06	0.48	0.52	2.13
1993	0.88	1.10	0.47	0.52	2.23
1994	0.88	1.14	0.48	0.52	2.23
1995	0.88	1.16	0.48	0.52	1.98
1996	0.88	1.20	0.47	0.52	1.98
1997	0.88	1.23	0.50	0.52	1.98
1998	0.92	1.30	0.56	0.56	2.56
1999	0.92	1.30	0.56	0.52	2.40
2000	0.92	1.43	0.56	0.83	2.60
2001	1.19	1.55	0.54	0.81	2.74
2002	1.19	1.70	0.51	0.85	2.58
2003	1.19	1.87	0.49	1.10	2.54
2004	1.27	2.03	0.52	1.10	2.75
2005	2.13	2.48	0.43	1.78	3.13
2006	2.26	2.66	0.44	1.78	3.28
2007	2.08	2.35	0.42	1.40	2.86
2008	2.26	2.55	0.45	1.53	3.23
2009	2.96	2.94	0.55	2.08	4.07
2010	2.96	2.99	0.54	2.22	4.13
2011	2.96	2.99	0.51	2.27	3.98
2012	2.58	2.84	0.56	2.05	3.85

Source: author's work based on https://stats.oecd.org/viewhtml.aspx?datasetcode=EPS&lang=en [08-01-2021].

In the analysed years 1990-2012, a decrease in the diversity of states' sample in terms of environmental policy stringency can be observed. This is evidenced by the variation coefficients (the ratio of standard deviation to the mean) indicating initially (until 2005) the average variability of this feature's stringency and low variability.

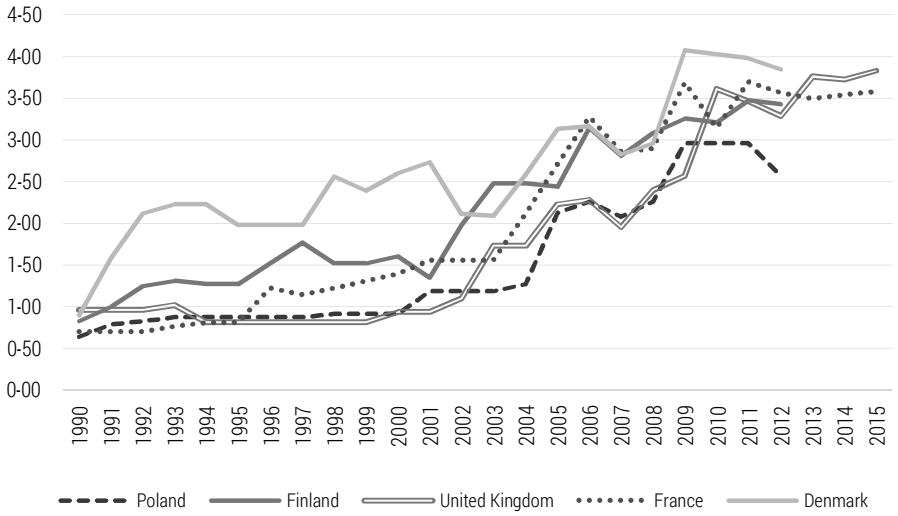

Figure 1. Environmental policy stringency index in Denmark, Finland, France, Poland and the UK

Source: https://stats.oecd.org/viewhtml.aspx?datasetcode=EPS&lang=en [08-01-2021].

According to the EPSI, Denmark can be regarded as the country with the highest environmental policy stringency level. In this country, the difference between this indicator's level at the beginning and at the end of the analysed period is 2.95 (the highest value among the EU-18). Moreover, in terms of the average EPSI level in 1990-2012 (2.61), Denmark is in the first place. Besides in the years 1992-2001, 2005, 2009, and 2011-2012, the maximum values of EPSI in the analysed sample occurred in Denmark. The loosest environmental policy was pursued by Ireland and the Slovak Republic (the average value of the EPSI is 1.24 and 1.25 respectively).

Except for 2009, Poland's level of environmental policy stringency has always been below the EU-18 average. A noticeable increase in this stringency can be noticed after Poland joined the EU.

The stringency level in the analysed European countries is usually lower for market instruments than for non-market environmental policy instruments (table 2). Only for three years (1990, 2008 and 2011), the value of

market EPSI of the Polish environmental policy instruments was slightly above the EU-18 average. In the case of non-market instruments, except for 2009-2010, their severity in Poland was lower than the average level in the analysed sample.

Table 2. Market and non-market environmental policy stringency indices

Year	Market EPSI					Non-market EPSI				
	Poland	EU-18				Poland	EU-18			
		Mean	Standard deviation	Min	Max		Mean	Standard deviation	Min	Max
1990	0.42	0.38	0.21	0.08	1.08	0.88	1.26	0.64	0.50	3.00
1991	0.33	0.49	0.37	0.17	1.75	1.25	1.39	0.76	0.50	3.00
1992	0.42	0.62	0.33	0.33	1.33	1.25	1.50	0.77	0.50	3.00
1993	0.50	0.63	0.34	0.33	1.33	1.25	1.56	0.74	0.50	3.13
1994	0.50	0.79	0.47	0.33	1.83	1.25	1.48	0.72	0.50	3.13
1995	0.50	0.84	0.45	0.42	1.83	1.25	1.47	0.63	0.63	2.63
1996	0.50	0.88	0.48	0.33	1.75	1.25	1.52	0.65	0.63	2.63
1997	0.50	0.88	0.50	0.33	1.75	1.25	1.58	0.74	0.63	3.13
1998	0.58	1.02	0.58	0.42	2.00	1.25	1.58	0.74	0.63	3.13
1999	0.58	1.05	0.68	0.42	2.50	1.25	1.55	0.69	0.63	2.63
2000	0.58	1.03	0.70	0.33	2.42	1.25	1.83	0.70	1.00	3.13
2001	1.00	1.20	0.73	0.25	2.60	1.38	1.90	0.68	1.00	3.13
2002	1.00	1.26	0.68	0.33	2.50	1.38	2.15	0.84	1.38	4.00
2003	1.00	1.28	0.59	0.33	2.50	1.38	2.46	0.84	1.38	4.63
2004	1.17	1.30	0.59	0.33	2.50	1.38	2.76	0.89	1.38	4.63
2005	1.63	1.95	0.59	1.05	2.80	2.63	3.00	0.63	2.00	4.63
2006	1.90	2.12	0.70	1.05	3.43	2.63	3.20	0.76	2.00	5.25
2007	1.53	1.59	0.64	0.38	2.60	2.63	3.12	0.87	1.63	5.25
2008	1.90	1.81	0.54	0.92	2.67	2.63	3.28	0.85	1.63	5.25
2009	2.17	2.19	0.57	1.07	3.13	3.75	3.69	0.92	1.75	5.38
2010	2.17	2.29	0.67	1.05	3.98	3.75	3.69	0.94	2.25	5.50
2011	2.17	2.14	0.59	1.12	3.68	3.75	3.84	0.84	2.25	5.38
2012	1.90	1.92	0.57	0.85	3.33	3.25	3.76	0.93	2.25	5.38

Source: author's work based on https://stats.oecd.org/viewhtml.aspx?datasetcode=EPS&lang=en [08-01-2021].

Table 3. Evironmental taxes as a percentage of gross domestic product

Year	Poland	EU-18			
		Mean	Standard deviation	Minimum	Maximum
1994	1.90	2.77	0.57	1.86	4.06
1995	1.73	2.76	0.62	1.73	4.34
1996	1.88	2.83	0.65	1.88	4.57
1997	1.82	2.79	0.66	1.82	4.60
1998	1.84	2.85	0.78	1.84	5.28
1999	2.11	2.88	0.77	2.06	5.37
2000	2.13	2.73	0.67	2.12	5.00
2001	2.10	2.67	0.66	2.01	4.91
2002	2.31	2.72	0.68	2.09	5.10
2003	2.41	2.74	0.63	2.11	4.88
2004	2.57	2.78	0.67	2.08	5.09
2005	2.54	2.75	0.69	2.03	5.07
2006	2.51	2.68	0.68	1.95	4.81
2007	2.60	2.61	0.67	1.90	4.85
2008	2.49	2.52	0.60	1.76	4.32
2009	2.37	2.54	0.54	1.73	4.08
2010	2.39	2.57	0.55	1.76	4.12
2011	2.35	2.60	0.57	1.71	4.14
2012	2.47	2.61	0.61	1.73	4.04
2013	2.33	2.63	0.61	1.97	4.05
2014	2.43	2.60	0.65	1.88	4.02
2015	2.46	2.59	0.66	1.92	3.99
2016	2.53	2.62	0.66	1.86	3.91
2017	2.39	2.56	0.68	1.63	4.04
2018	2.49	2.44	0.84	0.24	3.79

Source: author's work based on https://data.oecd.org/envpolicy/environmental-tax.htm [08-01-2021].

Regarding another measure of the environmental policy stringency, i.e. the share of environmental taxes in GDP, calculated for the years 1994-2018, it should be noted that the EU-18 differentiation in this respect was usually small in that period. The largest share of environmental taxes in GDP was recorded in Denmark (the first place in 1994-2016, the second place in 2017-

2018, behind Greece). At the other extreme, there was Spain, where environmental taxes accounted for the lowest average share of GDP in the EU-18. Moreover, in Spain, there was a minimal size of this share in the analysed EU-18 in 2000-2003 and 2005-2014. Excluding the last year of the analysed period 1994-2018, Poland was always below the EU-18 average (table 3). In the years 1995-1998, Poland was even in the last place among the analysed countries regarding the importance of environmental taxes for GDP. It can be seen that the share of environmental taxes in Poland's GDP was gradually approaching the EU-18 average.

Table 4. National expenditure on environmental protection as a percentage of gross domestic product

States	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Belgium	n/a	n/a	n/a	n/a	n/a	n/a	3.3	3.1	3.1	3.2	n/a
Czech Republic	n/a	n/a	n/a	n/a	n/a	n/a	2.8	2.7	2.7	2.6	n/a
Denmark	2.1	2.2	2.2	2.2	2.2	2.2	2.0	2.2	2.1	2.1	n/a
Germany	n/a	n/a	2.0	2.0	2.1	2.1	2.2	2.1	2.1	2.2	n/a
Ireland	1.6	1.6	1.4	1.3	1.2	1.1	0.9	n/a	0.6	n/a	n/a
Greece	n/a	n/a	n/a	n/a	n/a	n/a	1.4	1.4	1.3	1.3	n/a
Spain	n/a	n/a	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.6
France	1.9	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	n/a
Italy	1.7	1.8	1.8	1.7	1.8	1.7	1.6	1.7	1.8	1.7	n/a
Hungary	n/a	n/a	n/a	n/a	n/a	n/a	2.3	2.5	1.8	1.9	n/a
Netherlands	n/a	n/a	n/a	n/a	n/a	2.6	2.7	2.7	2.5	2.5	n/a
Austria	n/a	n/a	n/a	n/a	n/a	n/a	3.1	3.0	3.2	3.2	n/a
Poland	n/a	n/a	1.8	1.8	1.9	1.7	1.8	1.9	2.0	1.9	n/a
Portugal	n/a	n/a	n/a	n/a	n/a	n/a	1.4	1.4	1.2	1.4	n/a
Slovak Republic	1.8	2.3	2.2	1.9	2.0	1.9	1.9	2.3	1.9	1.9	n/a
Finland	n/a	n/a	n/a	n/a	n/a	n/a	1.7	1.8	1.8	1.7	n/a
Sweden	1.7	1.9	1.8	1.9	1.9	1.8	1.8	1.8	1.9	1.8	n/a
United Kingdom	n/a	n/a	1.2	1.2	1.2	1.3	1.3	1.4	1.3	1.3	n/a

Source: https://ec.europa.eu/eurostat/databrowser/view/ten00135/default/map?lang=en [18-02-2021].

Table 4 presents the available Eurostat data on environmental protection expenditure in the EU-18. Much data are missing, which prevents a more in-depth analysis. However, it may be noticed that similarly as in the case of the two other measures discussed above, it is possible to identify countries with both a higher (e.g. Austria, Belgium, Czech Republic, Netherlands) and a lower (Ireland, Portugal, the UK) stringency level than Poland.

Pearson's linear correlation coefficient for two measures of environmental policy severity (the EPSI and ET), calculated for the available data, i.e. 1994-2012, is 0.6875 and statistically significant at the significance level of 0.001. The value of the coefficient indicates a high correlation between the EPSI and ET.

Tables 5-8 show the results of multiple regression for models 1-24. Model 5 and 17 concerning the dependence of VOCs emissions on the EPSI and market EPSI, respectively, and renewable energy production, turned out to be insignificant at the significance level of 0.05. The environmental policy stringency measured with the EPSI has a statistically significant impact (at the level of 0.05) only on the SO_2 emissions in Poland (model 1). Considering the strictness of market-based environmental instruments only (market EPSI), it can be concluded that this variable is a determinant of SO_2 emissions and mortality due to PM2.5 (models 7 and 12, a 0.01 and 0.05 significance level, respectively). The stringency of non-market environmental instruments expressed by the non-market EPSI does not influence air pollutants emissions and mortality due to PM2.5.

According to the results of regression models, including the share of environmental taxes in GDP as a measure of the strictness of the state's environmental policy (models 19-24), the more severe the environmental policy, the lower the emission of SO_2, NO_x, CO_2, GHG, VOCs, and mortality due to PM2.5 in Poland (at the significance level of 0.01).

Table 5. Regression results for models 1-6

Specification	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable	SO_2 emissions	NO_x emissions	CO_2 emissions	GHG emissions	VOCs emissions	Mortality due to PM2.5
Multiple R	0.8670	0.6137	0.5476	0.5622	0.4725	0.7341
R-squared	0.7517	0.3766	0.2999	0.3161	0.2233	0.5389
Adjusted R-squared	0.7269	0.3143	0.2299	0.2477	0.1457	0.4928
Standard error	315.38	81.01	18.98	22655.79	50.74	66.75
Observations	23	23	23	23	23	23
P-value for F-test	0.0000	0.0088	0.0283	0.0224	0.0798	0.0004
Coefficients						
Const	2684.3***	1071.6***	340,4***	458109.9***	892.3***	1032.6***
EPSI	-332.09**	-24.44	-5,32	-3456.81	-35.96	-36.77
REP	-0.15**	-0.02	-0,0044	-6.7745	0.0021	-0.0231

Source: author's work based on OECD data (https://data.oecd.org/air/air-and-ghg-emissions.htm, https://stats.oecd.org/viewhtml.aspx?datasetcode=EPS&lang=en, https://data.oecd.org/air/air-pollution-effects.htm, https://data.oecd.org/energy/renewable-energy.htm [08-01-2021]).

Table 6. Regression results for models 7-12

Specification	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Dependent variable	SO_2 emissions	NO_x emissions	CO_2 emissions	GHG emissions	VOCs emissions	Mortality due to PM2.5
Multiple R	0.9012	0.6704	0.6069	0.6004	0.5512	0.7929
R-squared	0.8123	0.4494	0.3683	0.3604	0.3039	0.6287
Adjusted R-squared	0.7935	0.3944	0.3051	0.2965	0.2342	0.5915
Standard error	274.27	76.14	18.03	21908,94	48.04	59.89
Observations	23	23	23	23	23	23
P-value for F-test	0.0000	0.0025	0.0101	0.0114	0.0267	0.0000
Coefficients						
const	2585.9***	1053.9***	336.6***	454280.6***	881.9***	1014.3***
MAR_EPSI	-0.1064***	-0.0088	-0.0013	-3.2969	0.0068**	-0.0100**
REP	-554.5154*	-76.7631*	-16.4895	-15404.8	-59.0832	-86.9772

Source: author's work based on OECD data (the same as indicated in table 5).

Table 7. Regression results for models 13-18

Specification	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Dependent variable	SO_2 emissions	NO_x emissions	CO_2 emissions	GHG emissions	VOCs emissions	Mortality due to PM2.5
Multiple R	0.8468	0.6053	0.5383	0.5629	0.4193	0.7154
R-squared	0.7171	0.3664	0.2897	0.3168	0.1758	0.5119
Adjusted R-squared	0.6888	0.3030	0.2187	0.2485	0.0934	0.4631
Standard error	336.68	81.68	19.12	22642.80	52.27	68.67
Observations	23	23	23	23	23	23
P-value for F-test	0.0000	0.0104	0.0326	0.0221	0.1446	0.0008
Coefficients						
const	2732.7***	1076.8***	341.5***	459050.4***	897.5***	1039.2***
NMAR_EPSI	-165.079	6.071	1.201	3164.113	-18.367	-5.313
REP	-0.205**	-0.036*	-0.007	-9.524*	-0.003	-0.035**

Source: author's work based on OECD data (the same as indicated in table 5).

Table 8. Regression results for models 19-24

Specification	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24
Dependent variable	SO_2 emissions	NO_x emissions	CO_2 emissions	GHG emissions	VOCs emissions	Mortality due to PM2.5
Multiple R	0.9581	0.8234	0.6707	0.6414	0.8469	0.9172
R-squared	0.9180	0.6780	0.4498	0.4114	0.7173	0.8412
Adjusted R-squared	0.9106	0.6488	0.3998	0.3579	0.6916	0.8268
Standard error	155.17	58.24	13.83	15925.18	39.17	35.95
Observations	25	25	25	25	25	25
P-value for F-test	0.0000	0.0000	0.0014	0.0029	0.0000	0.0000
Coefficients						
const	4346.7***	1420.8***	404.5***	519736.5***	1180.3***	1364.6***
ET	-1057.48***	-193.39***	-43.01***	-46116.90***	-113.61***	-195.15***
REP	-0.1334***	-0.0189***	-0.0004	-0.3997	-0.0176***	-0.0178***

Source: author's work based on OECD data (https://data.oecd.org/envpolicy/environmental-tax.htm, https://data.oecd.org/air/air-and-ghg-emissions.htm, https://data.oecd.org/air/air-pollution-effects.htm, https://data.oecd.org/energy/renewable-energy.htm [08-01-2021]).

Conclusions

The conducted analysis of the stringency of the Polish environmental policy on the basis of three selected measures (the EPS index developed by the OECD, the share of environmental taxes in GDP, and the share of national environmental protection expenditure in GDP) allows for the conclusion that, compared to other European Union countries, Poland is a country with a moderate level of environmental policy severity. Except for individual years, the ESP index and the share of environmental taxes in GDP for Poland was lower than the EU-18 average. In the case of the third measure, i.e. the share of national environmental protection expenditure in GDP, although many missing data made it pointless to calculate the mean for the research sample, it is possible to identify countries with both a higher and lower share of environmental expenditure in GDP than Poland. Considering the EPS index, the level of environmental policy stringency in Poland was systematically increasing in the analysed period 1990-2012. This upward trend also occurred in all other analysed EU-18 countries. In the case of the share of environmental taxes in GDP, this indicator's values in 1994-2018 were not subject to clear trends in the EU-18. As for Poland, lower values of this share can be observed at the beginning of the analysed period.

The regression analysis of the dependence of selected variables characterising air pollution in Poland on the level of environmental policy stringency does not allow for drawing unequivocal conclusions. Using the share of environmental taxes in GDP as a measure of this severity, the results of the regression analysis show that the stringency of the environmental policy in Poland has a significant impact on reducing SO_2, NO_x, CO_2, GHG, VOCs emissions and mortality due to PM 2.5. However, in the case of the second measure of environmental policy stringency (EPSI), this relationship was found only for SO_2 emissions (using the total EPSI – taking into account the entire environmental policy) and for SO_2 emissions and mortality due to PM2.5 (using the index taking into account only market-based environmental policy instruments). The results may have been influenced by different analysis periods (1990-2012 vs 1994-2018) due to data availability.

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STUDIES AND MATERIALS

STUDIA I MATERIAŁY

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SUSTAINABILITY AS A COMPETITIVENESS FACTOR: A QUANTITATIVE CROSS-COUNTRY ANALYSIS

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ABSTRACT: That sustainability is an essential competitive advantage is a common dictum in politics and some areas of academic research. The past few decades have made more and more dispersed 'hard' and soft data available, indicating not only more details on the economic performance of countries, but also on their sustainability performance. This study aims to examine whether there is a relationship between sustainability performance and national competitiveness by analysing economic, environmental, and social indicators from four data sources, including economic and sustainability data from G-20 countries for the period 2010 to 2019, representing 73% of the global GDP in 2020. The research design is based on several stepwise regression analyses to explore the pooled data set. The data analysis concludes that the effects of sustainability on competitiveness are hardly confirmed or rejected, contrary to classic economic predictors.

KEYWORDS: sustainability, competitiveness, GDP growth, HDI, air pollution

Introduction

Sustainability is a normative concept in the context of a company's strategic management or in politics serving as a strategic guideline. However, the term is associated with many different concepts and definitions, so there is no uniform definition in political discussions or in the various disciplines of economics and social sciences (Grunwald & Kopfmüller, 2012, p. 219; Aiginger & Vogel, 2015, p. 497). A minimal definition could be: Sustainability is a resource-oriented management approach respecting the preservation of essential strategic resources to secure the long-term stability of a system in terms of an economic or political entity (Petschow et al., 1998, p. 22).

In contrast to the concept of sustainability, theories and models in competitive advantage in the international economy are defined much more precisely. While the classical theories (Smith, Ricardo, Heckscher and Ohlin) explain country-specific specialisation and competitive advantages as a result of differences in factor costs and country-specific resource availability (Lathi, 2010, p. 39; Zhang, 2008, pp. 2-4), recent theories focus more on country-specific factor combinations (Lathi, 2010, p. 39; Gaspar et al., 2015, p. 44). However, the criticism of international trade theory models points out the difficulties in the operationalisation of these models for empirical research due to its multifactorial effects and complex interactions between a multitude of factors (e.g., Zhang, 2008; Dunning, 2001).

However, several researchers, politicians and economist state a positive association between environmental and social performance and national competitiveness. The sustainability strategy of the German Federal Government postulates an explicit link between national competitiveness and sustainability: "Sustainability stands for adaptation to the challenges of our time [...] In the meantime, it is becoming increasingly clear that, understood correctly, sustainability is an essential competitive advantage" (Deutsche Bundesregierung, 2011, p. 14). This assumption requires an examination, which is the primary aim of this research.

Consequently, this study aims to examine whether such a relationship can be found by analysing economic, environmental, and social indicators to explore the relationship between competitiveness and sustainability indicators of several countries. The statistical analysis as the core of this study examines a data set including economic and sustainability data of G-20 countries from 2010 to 2019, representing 73% of the global GDP in 2020.

According to the three-pillar model of sustainability (ecology, economy and society), different sustainability indicators from the fields of economy, environment and society are included as independent variables. A total of 15 variables are selected and calculated based on a research model derived from

theoretical literature. The data are sourced from the IMF (World Economic Data), UNO (UN Human Development Index), Yale University (Environmental Performance Index), and the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII Comparative Advantage Index. This research uses country-level data from secondary data sources. All data are public data for different periods. Thus, the observation period, which is covered by all data sets, is the period of 2010 to 2019.

The main contribution from the explorative data analysis is expected in the discussion of their results in the context of empirical research findings concerning the variables which are found as predictors of distinct competitiveness indicators. In contrast to the research mainstream, this research does not focus on one or the other factor dimension (sustainability or competitiveness). Instead, both factor dimensions are merged into one data set in a balanced form, while the mainstream of both research fields outweighs or neglects the one or the other factor group depending on the research perspective. In this context, this research's contribution can be seen as an extended explorative approach using current data and different data sources compared to mainstream research to select factors and variables.

Literature review

For decades, Porter's concepts of competitive advantage of nations and its model extensions were considered state of the art and examined in many studies in order to obtain empirical evidence for example, where recent criticism and research have pointed towards the missing factors in the field of social and environmental sustainability (Weihrich, 1999; Sledge, 2005; Snowdon & Stonehouse, 2006; Berger, 2008). The double-diamond's main innovation may be seen in that Porter has not included the 'human factor', respectively human capital, which can be realised, for example, by including data from human development indices (Cho & Moon, 2002, pp. 178, 184).

Concerning the three pillars of sustainability, however, the double-diamond nine-factor model has not included environmental factors and gender equality, health and other social capital factors. Similarly, Aiginger et al. (2013) and Huemer et al. (2014) criticised neoclassical concepts of competitiveness because they do not operationalise the social and environmental factors in measuring competitiveness and determine a one-dimensional fixation on cost-based competitiveness factors. Aiginger et al. (2013, p. 11) stated that cost-based indicators (labour costs, capital costs and taxes) as the only explanatory factors of competitiveness ignore the meaning of qualitative factors such as, for example, human capital in the context of value creation.

As Ulman (2013, p. 152) notes, economic research has identified an increasing list of relevant factors influencing the national competitiveness, such as the social infrastructure, including education, health, fiscal and monetary policies and other factors promoting economic productivity, thus, national competitiveness. Huemer et al. (2014, pp. 3, 6) criticised the missing of variables indicating market and policy conditions as institutional indicators reflecting institutional competitiveness (market conditions, the rule of law, trust in government, etc.). According to Rozmahel et al. (2016, p. 13), the traditional cost-based approach of measuring competitiveness by productivity and cost indicators is limited in its explanatory power. This approach follows mainly a firm-level perspective. They do not argue that cost-based competitiveness measures are irrelevant but must be supplemented by social and environmental factors.

Recent studies in the context of classical competitiveness research have included 'hard' economic data but increasingly 'hard' and 'soft' sustainability factors and data. Thus, the GCI (Global Competitiveness Index) of the World Economic Forum has included social and environmental indicators to complement the set of economic 'hard' data such as GDP, productivity and employment (WEF 2018, p 6). Aiginger and Vogel (2015) state that the evolution of competitiveness research has started with a "narrow definition of cost competitiveness, focusing on 'inputs' only" (p. 513). Most recent approaches show more balanced research models and competitiveness indices, including increasingly social investment activities, environmental performance indicators and other 'soft' data (Aiginger & Vogel, 2015, pp. 501-503, 513-514).

Concerning the data collection, Kovačić (2017) notes that the mixture of different international institutions' statistical data is an appropriate approach to examine national competitiveness. However, Zubović and Bradić-Martinović (2014, p. 762) conclude that the highly-aggregated data of the WEF's GCI are not precise enough to determine variables with more significant impact on the national competitiveness of the selected countries (SEE countries). One reason for this problem with the GCI may be the self-similarity of independent and dependent variables because the GCI includes several sustainability variables used in the reviewed studies as independent variables. This challenges the explanatory power of several studies because examining the effect of independent variables on a dependent variable, including one or several independent variables, raises the question of what is really measured in such research. It could be assumed that only the index itself is examined. Thus, the explanatory power of calculated models, respectively, the correlations between independent variables included in the index and the GCI indicate only their weighting in the index, respectively the weighting of certain indicators in selected countries' index rating.

Among the reviewed research, only Greenstone et al. (2012) make use of a 'first-level' dependent variable in the form of total factor productivity, which can be seen as the 'classical' competitiveness factor. They examine the economic costs of environmental regulations finding a negative effect of sustainability on the competitiveness proxy: the higher the sustainability level, the lower the productivity. Thus, environmental regulations' economic costs are not negligible (Greenstone et al., 2012, p. 32). Furthermore, Greenstone et al. (2012) stated that the increasing availability of data from different areas of society and economy allows calculating the economic costs of environmental sustainability regulation. Hence, they consider their research as the "first large-scale estimates of the economic costs of environmental regulations" (Greenstone et al., 2012, p. 32), moreover recommending for future research the inclusion of other sustainability factors into competitiveness research (pp. 1, 33). The results of Greenstone et al. (2012) are supported by Porter and Etsy (2005). In a prior study, Porter and Etsy (2002, p. 95) conducted a cross-sectional analysis of sustainability indicators and country performance indicators (GDP, GDP growth and GCI). They found that environmental performance is positively correlated with economic growth. However, they recommend that future research should be based on time-series data. They stated that the "data available suffer from many limitations, narrowing the statistical and modelling feasibilities. Precise causal linkages cannot be proven" (Porter & Etsy, 2002, p. 95). Anyhow, both found in a subsequent study with more data available that sustainability performance has a weak effect on competitiveness measured in GDP growth, which they interpret as a problem of available data (Porter & Etsy, 2005, pp. 423-424).

To sum up, the results and the discussion of the literature review can be summarised in five essential points which will affect this study's research design:

- Most of the reviewed research is based on regression analysis focused on only one-factor dimension (sustainability or competitiveness).
- However, the reviewed research in the preceding section is based on hard data, sometimes completed by other researchers' data sets.
- Index data should not be used as dependent variables when some of their components are included in the independent variables.
- The use of pooled panel data is recommended instead of cross-sectional data.
- A general model of competitiveness is non-existent. The reviewed research uses data models instead of research models, which means that they explore the data available.

Nonetheless, the basis for the selection of sustainability variables is limited by the availability of data. However, the sustainability data should include variables representing main sustainability indicators for each of the three-pillar sustainability model.

Data and methodology

Research Approach and Research Model

This study's approach is explorative, aiming at identifying from many potential predictor variables the variables contributing to the overall prediction of the dependent variable(s). A 'consolidated' or unified model of sustainability in the context of national and international competitiveness is non-existent, which is the typical starting point for explorative research (Menard, 2002, p. 64; Menard, 2010, p. 117; Mertler & Reinhart, 2017, p. 175).

Consequently, this research is not based on a research model but a 'big-data' approach based on a not-predefined data model resulting from the available data and theoretical considerations (Dorschel, 2015, pp. 7-8) derived, in this case, from the reviewed literature and the three-pillar model of sustainability. Thus, the selection of variables depends, on the one side, on the data availability and, on the other side, on the existing data to the model elements assignment.

The three-pillar model of sustainability requires data from social development, sustainability performance and economic performance. Furthermore, in the process of variables selection, this research follows the growth model as developed by the OECD (Dellink et al., 2017, pp. 203, 212) in extracting data on (1) the total factor productivity, (2) physical capital (such as the investment rate), (3) the labour market (such as education, employment and others), and (4) energy efficiency.

Four publicly available data sources are identified, providing data for all three areas. The data sources are World Economic Data 1980 to 2020 of the International Monetary Fund (IMF 2020), the UN Human Development Index of the United Nations Organization (UNO 2019), the Environmental Performance Index (EPI) (Yale University 2020), and the CEPII Comparative Advantage Index of the Center D'études Prospectives et D'Informations Internationales (CEPII, 2019).

To sum up, the available data represents a different data model used in a specific context of benchmarking countries' performance in the areas of social, environmental and economic development. Except for the HDI, only first-level data are selected from the data sources, resulting in a data set of 15 variables (see table 1).

Table 1. List of Independent Variables

Social and Environmental Variables, Government Variables	Economic Variables
Air pollution index	Share in global GDP in %
Child mortality	Total factor productivity (TFP)
UN Human Development Index Ranking	Total investment in % of GDP
Government structural balance in % of GDP	Unemployment in % of the total labour force
Wastewater Treatment	Total factor productivity (TFP)
CO_2 emission/KWH	Annual change of the export volume in %
Energy productivity	Annual change of the import volume in %
Household O2-quality	

Source: author's work.

Two dependent variables are tested, where the export volume is included as a predictor in testing GDP growth. Therefore, it is also included in the list of independent variables, although it is a dependent variable.

- The annual GDP growth ('GDP Growth %'): The selection of this variable as an indicator for competitiveness follows the recommendation of the OECD (2014b, p. 139) and the research approach of Porter and Etsy (2002, p. 95; 2005, p. 395). GDP continues to be the universal barometer for national wealth creation and a relevant indicator in competitiveness research (Vinhas da Silva, 2016, p. 4).
- The annual change in export volume ('Vol. Export % Change'): The export performance as competitiveness indicator follows the recommendation of the International Trade Center (ITC) – a common organisation of the UNO and the WTO – for measuring international (trade) competitiveness (ITC 2016, p. 17).

The total sample includes 18 countries, namely Germany, Australia, Canada, Brazil, China, India, France, Indonesia, Japan, Italy, Mexico, Russia, South Africa, Saudi Arabia, Turkey, South Korea, the United States of America and the United Kingdom. It should be mentioned that the 20th member is the EU Commission, explaining why only 18 countries remain in the sample after excluding Argentina (due to missing data). Therefore, the final data set contains the pooled time-series data for 18 countries covering 10 years. All variables are interval-scaled, indexed or ratio-scaled. The data set includes no missing values. For each country, the time series for each variable is complete.

Data Analysis Methods and Procedure

This research approach is explanatory, which means that no given model and its selected set of factors (variables) are tested with other different or larger samples to confirm or reject it. On the contrary, the aim of this research is hypothesis generation. Consequently, the forward or backward stepwise selection approach should be considered, while automatic selection is excluded due to its methodological problems.

Exploratory studies aim to identify those potential predictor variables which make a useful contribution to the overall prediction model in the case that theory in a specific research area is not well developed and/or the number of explanatory variables is larger than usual – as is typical for exploratory research questions (Menard, 2002, p. 64; Menard, 2010, p. 117; Mertler & Reinhart, 2017, p. 175).

Forward regression is a recommended approach for finding exploratory data models from a multitude of variables in the context of searching for causal-effect relationships to identify independent variables with a lack of explanatory power (Pearsons, 2015, p. 677; Mertler & Reinhart, 2017, pp. 175-176). Forward stepwise regression is used to identify a single or a group of independent variables which should be included in the regression model to develop research models which are supported by data (Mertler & Reinhart, 2017, pp. 175-176). However, selecting the best, respectively most robust regression model requires the controlling of (1) collinearity or multicollinearity (variance inflation factor, respectively tolerance tests), (2) autocorrelation (Durbin-Watson test), (3) normality (Shapiro-Wilk test) and (4) heteroscedasticity (Breusch-Pagan test) (Meyers et al., 2013, pp. 363-365; Baltes-Götz, 2018, pp. 44-46, 99, 134-136).

To sum up the data analysis for each dependent variable: First, the forward stepwise regression is performed. Based on its results, the final model is selected based on the tolerance values of the independent variables, excluding models including variables with TOL values below 0.8 (TOL < 0.8). This model is analysed concerning multicollinearity and autocorrelation effects. The tests concerning heteroscedasticity and normality follow this. The data analysis process is structured in three steps, resulting from the identification of three dependent variables that can be seen as appropriate measures for competitiveness. Step 1 is multiple regression on GDP growth as a dependent variable resulting in Model 1; step 2 is multiple regression on the annual change in export volume as a dependent variable resulting in Model 2.

Empirical Results

GDP Growth Model (Model 1; DV: 'GDP Growth %')

The first regression analysis explores the relationship between all 15 variables and GDP growth to find indications for the effect of sustainability variables on competitiveness measured in GDP growth. The regression analysis has generated a final model that explains 60 % of the GDP growth variances (Model 1) in which none of the included variables show a TOL of < 0.8 (VIF < 1.25). Three variables are thus identified as predictors for GDP growth with an explanatory power of r^2 (adj.) = 0.602 (p = 0.000) (see table 2).

Table 2. GDP Growth Model (Model 1)

Independent Variables	B-Coefficient	r^2 adj. (p-value)	r^2 change	Multicollin. (Tolerance)
(1) Vol. Import % Change	0.158	0.313 (0.000)	0.317	0.801
(2) Tot. Invest. % GDP	0.118	0.514 (0.000)	0.203	0.813
(3) UN Hum. Dev. Indx.	-7.605	0.602 (0.000)	0.089	0.820
Model Sig. (F-Test)	**Autocorrelation D-W Test**	**Heteroskedasticity (1) B-P Test (2) Koenker-Test**	**Normality DV (1) S-W Test (2) K-S Test**	**Symmetry (1) Median DV (2) Mean DV**
p = 0.000	D = 1.237	(1) p = 0.000 (2) p = 0.002	(1) p < 0.001 (2) p < 0.001	(1) 2.39 (2) 2.99

Note: B-Coefficient = Unstandardised Coefficients; D-W Test = Durbin-Watson Test; B-P Test = Breusch-Pagan Test; S-W Test: Shapiro-Wilk Test; K-S Test: *Kolmogorov-Smirnov Test;* DV = Dependent Variable; N = 180.

Source: author's work.

The B-coefficients for the change in import volume and the total investment indicate a positive effect on the GDP growth (table 2), explaining the variance of GDP growth by 51 %. Van den Berg and Lewer (2007, pp. 142-143) point out that increasing imports leads to an increase in productivity, leading to GDP growth. Technology and equipment import is one of the most important growth factors in GDP growth, which is particularly true for emerging countries such as India (e.g., Ghosh & Roy, 2017) and China (Bloom et al., 2016), which have shown high growth rates (see figure 1). This finding also seems intuitively logical because emerging economies are more dependent on the import of technology and machines than advanced economies. It is also apparent in the sample with two of the three countries with the highest growth rates are leading import countries where the top 5 only consists of emerging economies (see figure 2).

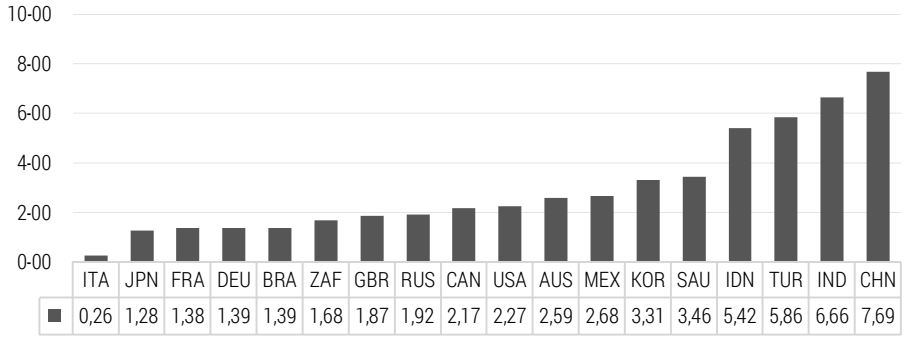

Figure 1. Average Annual GDP Growth Rates (2010-2019) [%]

Source: author's work.

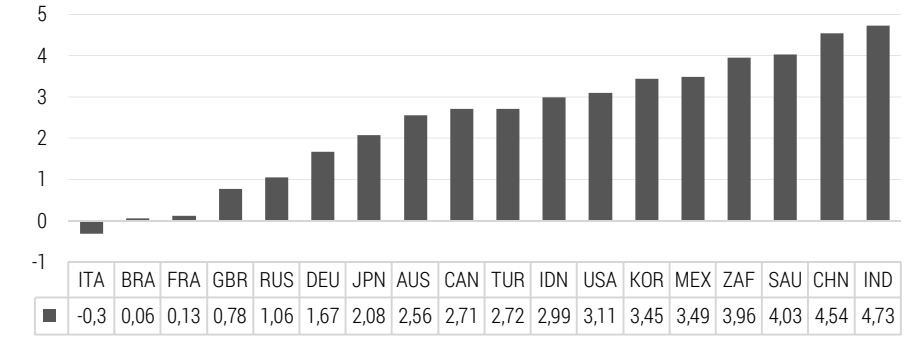

Figure 2. Average Annual Import Growth Rates (2010-2019) [%]

Source: author's work.

Both at the initial investment and the operation period, foreign direct investment (FDI) influences the import volume of a country (e.g., Marelli & Signorelli, 2011). At the initial investment period, the import of equipment, machinery, installation facilities, and experts increase the import volume. FDI companies have high propensities to import capital and intermediate services and goods that are not readily available in the host country. Japan economic recoveries in the late 1980s and at the beginning of the 1990s are one of the most prominent examples of the necessity of FDI, technology spill-over and import volume change as GDP growth driver (Stern, 2003, pp. 101-106).

Concerning the effect of the total investment in % of the GDP, Leimbach et al. (2017, p. 216) stated that the mainstream assumption is that growth results predominantly from endogenous factors, mainly in the form of investments in R&D, education and capital stock. They examined data from

different data sources on population, education, physical capital, investment activities and labour market data for the observation period from 1950 to 2011, aggerated for global economic regions each including several countries. They found convergence in the areas of human capital and technology level. However, this process has been slower than expected in the last decade by several international institutions due to diffusion barriers, mainly in the form of trade barriers (Leimbach et al., 2017, pp. 215, 224). The main driver of GDP growth and the growth of the global GDP share is the investment in capital stock rather than the investment in human capital and technology (Leimbach et al., 2017, pp. 215-216).

Concerning the HDI ranking, the three of four countries with the sample's highest GDP growth (China, India and Indonesia) are the companies with the lowest HDI rating (see figures 1 and 3).

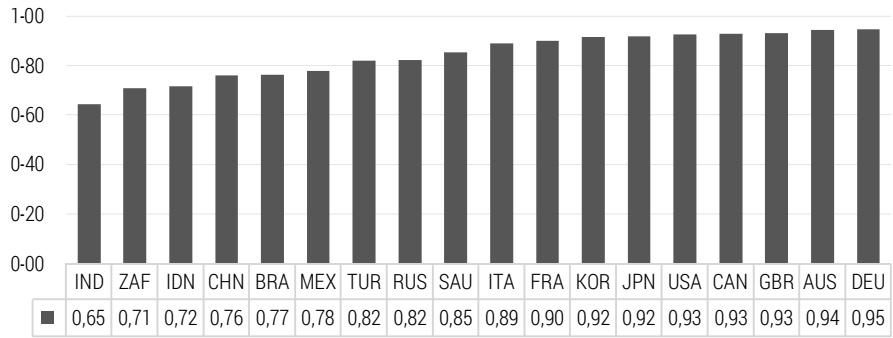

Figure 3. HDI Rating, 2019

Source: author's work.

This explains the negative relationship between both variables. The interpretation of this finding is that a low human development index as a comparative advantage would need first-level data on factor costs. Therefore, the conservative interpretation of this finding is that low human development levels are the general and constituting characteristic of emerging countries. The statement that low human development levels explain high growth would be tautological. Furthermore, the HDI is questioned as inadequate in the examination of the relationship between human development and economic growth due to its imprecision in the time series in the longer run, mainly to the fact that the HDI is a ratio-scaled, so that the ranking of countries is more appropriate to investigate the relationship between growth and human development levels (Grubaugh, 2015, pp. 5, 15). However, this

approach does not contribute to the findings in this research area (Grubaugh, 2015, p. 15).

The variances of all three independent variables are highly independent of all other independent variables with TOL values of > 0.8 (see table 2). Multicollinearity effects are very weak among the predictors. The Shapiro-Wilk test suggests a violation of the normality assumption caused by outliers. However, the median and mean of the dependent variable are almost equal (see table 2). Regardless of this, in the context of the explorative approach carried out here, any effect on the coefficients is therefore acceptable, since the explorative approach's aim is not the development of a precise model.

Therefore, the elimination of the 10 outliers or transformation is omitted. Furthermore, the normal Q-Q plot of GDP growth shows outliers exist in both areas (see figure 4). As the descriptive statistics have shown, these outliers are a result of boom-bust-cycles. Eliminating these outliers would mean negating the reality of economic development, which is erratic and cyclical. Therefore, the elimination or transformation of outliers was not considered merely because quasi-symmetry is given, as the mean-median comparison has shown, and the number of observations can be considered as sufficient to generate a robust regression model.

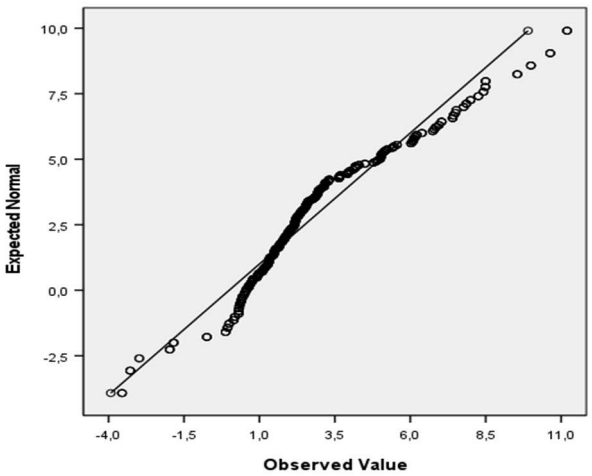

Figure 4. Normal Q-Q Plot of 'GDP Growth %'

Source: author's work.

The Breusch-Pagan test and the Koenker test show a p-value of less than 0.05 so that the null hypothesis must be rejected, which indicates heteroskedasticity. However, the chance of possible distortion of the coefficients and their significance are considered as low due to the sample size. Furthermore,

this research is explorative, which means that the development of precise models from the data analysis results is not intended. Nonetheless, the Durbin-Watson test is another indicator for the distortion of the coefficients and their significance. A low autocorrelation effect can be determined from the Durbin-Watson test result with D = 1.234, which is just outside the range of the critical values (1.5 < d < 2.5). Anyhow, although autocorrelation effects may be considered not very strong – because only a Durbin-Watson test result of d < 1 must be interpreted as a definite autocorrelation effect (Schwager, 1984, p. 215) – it must be assumed that the coefficients are rated as more significant than they actually are, resulting in a possible overestimation of their effect on the dependent variable.

Nevertheless, this problem can be neglected in interpreting the test results because the aim of this explorative study is not to formulate a precise cause-effect model based on the coefficients but to find effects of sustainability on competitiveness. In Model 1, a negative effect of a single sustainability variable was found, which was not interpreted as a statistical effect but as classification bias instead of negative externalities of growth or sources of competitiveness due to comparative advantage. Moreover, the change in the explanatory power of Model 1 is very modest, with r^2 change = 0.089.

Furthermore, the results allow the assumption that domestic growth is the main cause for GDP growth because the growth in the share of global GDP or export growth was not found as a predictor. From this finding, it may be concluded that national competitiveness in terms of improved locational conditions on the country-level may be much more important for GDP growth, resulting in attracting increased foreign direct investment.

Model for the Export Performance (Model 2; DV: 'Vol. Export % Change')

The second regression analysis focuses on investigating the change in export volume as a second alternative measure for competitiveness. The total variable set is included except export performance which is the dependent variable in Model 2. The regression analysis generates two predictors for the final model with an explanatory power of r^2 (adj.) = 0.489 so that 49 % of the dependent variable's variance is explained (see table 3):

The change in import volume ('Vol. Import % Change') shows a positive relationship (B = 0.499) with export performance and explains 39 % of the dependent variable's variance.

The air pollution rating ('Air Pollution') as a measure of air quality shows a negative relationship (B = -0.102) with the export performance but with low explanatory power, increasing the r^2 of the model only by 10 percentage points.

Table 3. Model for Export Volume Change (Model 2)

Independent Variables	B-Coefficient	r^2 adj. (p-value)	r^2 change	Multicollin. (Tolerance)
(1) Vol. Import % Change	0.499	0.391 (0.000)	0.394	0.966
(2) Air Pollution	-0.102	0.489 (0.000)	0.099	0.966

Model Sig. (F-Test)	Autocorrelation D-W Test	Heteroskedasticity (1) B-P Test (2) Koenker-Test	Normality DV (1) S-W Test (2) K-S Test	Symmetry (1) Median DV (2) Mean DV
p = 0.000	D = 1.797	(1) p = 0.009 (2) p = 0.077	(1) p = 0.001 (2) p = 0.001	(1) 5.63 (2) 5.46

Note: B-Coefficient = Unstandardised Coefficients; D-W Test = Durbin-Watson Test; B-P Test = Breusch-Pagan Test; S-W Test: Shapiro-Wilk Test; K-S Test: *Kolmogorov-Smirnov Test;* DV = Dependent Variable; N = 180.

Source: author's work.

With a Durbin-Watson value of d > 1.5, autocorrelation effects are considered very low (see table 3). Furthermore, the tolerance values indicate a very low multicollinearity effect of above 4 %. However, heteroscedasticity must be assumed as well as a violation of the normality assumption, whereas the latter finding must be put into perspective with the almost equal median and mean. The normal Q-Q plot implies that the linearity condition can be considered satisfied (see figure 5).

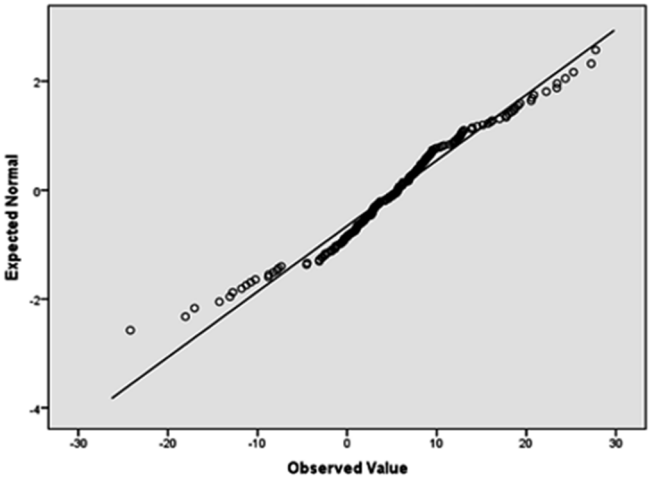

Figure 5. Normal Q-Q Plot of 'Vol. Export % Change'

Source: author's work.

In order to discuss the relevance and indication of air pollution in Model 2, it must be explained that a higher air pollution value indicates lower air pollution because the indicator is an air quality rating. Therefore, Model 2 implies that the higher the air pollution value (the lower the air pollution rating), the higher the export volume change. Respectively, countries with higher export performance produce relatively more air pollution resulting in a lower air pollution rating. This relationship is visible when comparing figures 6 and 7. Both charts show that the top 3 countries in air pollution are in the top 5 countries in terms of export performance.

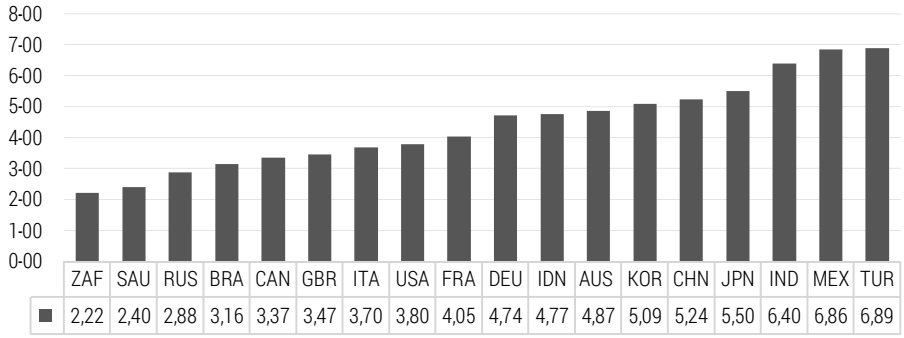

Figure 6. Average Annual Export Growth Rate (2009–2019) [%]

Source: author's work.

India, Indonesia and China, which are all countries with a very high export volume growth average over the total observation period, all displaying an excessively low air quality level, which should have a strong effect on the regression analysis. A recent climate research has identified China as the world's largest air pollutants emitter (Lin et al., 2014, p. 1736). However, Lin et al. (2014, pp. 1740-1741) have found that this phenomenon can be explained, at least partly, by the outsourcing of U.S. manufacturing to China resulting in partial improvement of the air pollution level in the U.S. local areas which have previously had very high emission levels resulting from manufacturing activities. Consequently, it can be stated that air pollution has been outsourced. This result is supported by Peters et al. (2011, p. 2) who found that the global CO_2-emission intensity depends strongly on the world trade intensity: If world trade slows down through the decrease of demand in advanced industrial countries, emerging economies reduce their emission-intensive production, leading to an excessive decrease of emission. In the context of these findings, Model 2 can be interpreted not as the reflection of a comparative advantage of low air pollution regulations but as an

indirect result of a comparative advantage in terms of factors of production, leading indirectly to outsourcing not only of labor-intensive manufacturing but also of air pollution.

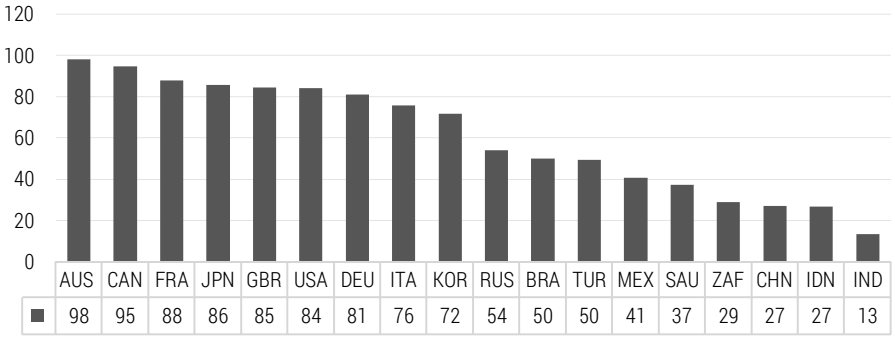

Figure 7. Air Pollution Rating by Country, 2020

Source: author's work.

Beside this data quality issue concerning environmental data, which was – as mentioned before – already criticised by Porter and Esty (2002; 2005), it can be summarised that air pollution only has modest explanatory power in Model 2, whereby the conclusion is that the measured effect does not generally explain a comparative advantage due to low environmental standards. The mechanism of the main predictor – import volume growth – was already discussed in more detail in the context of the Model 1. There, it was concluded that import is an essential precondition for growth in terms of GDP and the share in the global GDP. Hummels et al. (2001) examined the growth and nature of specialisation in world trade based on panel data on import and export of 10 OECD countries for the observation period 1970 and 1990, finding out that the import of commodities is a function of export. Imported goods are used as inputs for export goods (Hummels et al., 2001, p. 76). Furthermore, they presented a positive relationship of import volume and export volume, assuming a moderating role of country size in the form that the positive effect between import and export is higher in smaller countries (Hummels et al., 2001, pp. 93-94).

Conclusions

In respect of all two models examining the relationship between sustainability and economic variables with two distinct competitiveness indicators, it can be stated that sustainability performance and competitiveness

show, if at all, a very weak relationship. Instead, it was found that the classic predictors, such as total investment in % of the GDP and import volume, are far better predictors with a very high explanatory power, while a higher level of sustainability performance has no positive effect on competitiveness.

Despite some doubts concerning the robustness of the models generated by regression analyses, it has been found that sustainability performance variables are indicators rather than predictors in terms of causal-effect relationships. As such, the identified sustainability performance indicators effects are considered indicators of fast-growing economies rather than of the comparative advantage of emerging economies which refers particularly to the issue of distinguishing between correlation and causation. Therefore, the identified sustainability performance effects were evaluated as indicators for country-specific structural problems, such as population density, urban growth or labor-cost advantages resulting in pollution outsourcing.

A surprising and perhaps contra-intuitive finding is that the total factor productivity (TFP) did not show a direct measurable effect. However, it may be concluded from both models that the TFP is the latent variable behind the effect of import volume growth, which results in spillovers, modern equipment, etc. and leads to growing total factor productivity. In this context, it should be mentioned that energy productivity was also not measured as predictor which may be interpreted as an indication for that only energy as input factor was previously not relevant as factor cost.

The Human Development Index as the single social sustainability indicator in the data set has been found to be a predictor with a modest contribution to the explanatory power of Model 1, claiming a negative relationship between high GDP growth rates and low HDI ratings. Nevertheless, this finding should be seen in the same context as air pollution ratings or wastewater treatment levels. Such variables shall be viewed more as an identifier of emerging economies instead of a competitive advantage of these countries. Emerging economies are per se countries with a lag in social development which is more a limitation for faster development than a source of competitive advantage. In this sense, a deeper investigation of first-level data on social development would generate some findings concerning, for example, the role of tertiary education in the context of the speed of technology transfer and total factor productivity growth.

Furthermore, state spending and government budget policy indicators have not been found to be effective variables. Anyhow, explaining this variable was not within the scope of this study's research aim. Moreover, the increase of the import volume has been found to be effective in all two models as a dominant predictor. This emphasises the necessity for low import barriers for developing countries, particularly in the field of manufacturing technology.

To sum up, comparative advantages due to low environmental and social regulation standards could not been detected as well as indicators for the paper that higher competitiveness is the result of higher sustainability performance, respectively higher environmental regulations. On the contrary, the theory of the environmental Kuznets curve allows the prognosis that, in the near future, countries such as Indonesia, China and India will show a decoupling of sustainability underperformance and economic growth so that the perhaps existing but hardly measurable comparative advantages of low regulations are only temporary effects. However, this also means that the assumption of essential competitive advantages through high regulations and sustainability performance as assumed by the German government or environmental economists are also, if at all, a temporary effect.

Moreover, the effectiveness of such a complex sustainability strategy on competitiveness is beyond scientific seriousness. The strategy is based on a model consisting of a multitude of variables assuming without justification that these 56 factors (variables) (Destatis, 2016, pp. 6-9) have an effect on competitiveness without mentioning competitiveness indicators somewhere in the strategy paper. Consequently, it can be said that the German Government's sustainability strategy is based on a non-explicit cause-effect model in which the dependent variables are unknown. In terms of Popper's critical rationalism, such an approach must be classified as an unscientific approach, because the underlying model cannot be falsified (Popper, 2009 (1963), pp. 53-59). In addition, the effect of single activities can hardly be measured due to missing outcome variables so that neither the underlying model cannot be confirmed or rejected, nor the performance of policy actions can be controlled.

In the face of the findings of this research, it must be stated that the assertation that competitiveness and sustainability performance interact and can legitimise a specific policy approach must be rejected as arbitrary, while the assertion of the German government may seem as intuitively correct. But in view of the many variables of the German Federal Government in its implicit model of sustainability and the correspondingly complex economic relationships between this multitude of factors, this assertation will basically never be verifiable. Therefore, this assertion must be considered as only politically opportune value judgment alone as the result of difficulties of collecting reliable data. Thus, it remains a political decision which follows not pros and cons from the economic point of view but can only be explained by the economic theory of democracy, respectably the economic theory of voting and party competition. However, it will possibly never be substantiated by data-driven research.

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ENVIRONMENTAL ASPECTS OF CONSUMER SHOPPING BEHAVIOUR IN PACKAGING-FREE STORES

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ABSTRACT: One of the recent biggest environmental problems is pollution by excessive waste production. One of the ways to partially eliminate this problem is packaging-free stores. The paper focuses on analysing the environmental behaviour of individual generations of consumers concerning shopping in packaging-free stores. A questionnaire survey served as a source for data gathering. In the analysis, we applied the method of descriptive statistics and mathematical-statistical methods (Shapiro-Wilk W test, Kruskal Wallis test, Wilcoxon rank-sum test) to verify the difference between generational groups of consumers and their awareness of packaging-free stores. Another verified variables were the gender of respondents and their experience of shopping in a packaging-free store. The research results confirmed that packaging-free stores should focus their marketing activities on all generations of consumers and focus on finding appropriate ways to increase the level of interest of all age groups.

KEYWORDS: environmental management, packaging-free stores, consumer generations

Introduction

Increasing consumer awareness of food supply chains' environmental and social aspects in developed countries leads to the opening of packaging-free stores that do not use disposable plastic packaging for their goods (Beitzen-Heineke et al., 2016). Over the last 5-10 years, there has been a very strong increase in the number of shops, jobs, and sales in the packaging-free business sector in Europe. The average turnover of packaging-free stores is around €170,000, although this varies from country to country. Long-term forecasts for this type of store in the European market predict at least €1.2 billion in 2030. In 2023, the forecast estimates 10,000 jobs in packaging-free stores across Europe. The estimated EU-wide packaging savings in 2023 due to packaging-free stores should be around 5,500 tonnes (Eunomia Research & Consulting Ltd., 2020).

The market for disposable plastic packaging and the use of packaging made of non-natural materials is constantly growing. The use of the packaging as an important tool in marketing is also growing (Piontek, 2019). Despite this fact, shopping in packaging-free stores and support for packaging-free products is gaining in popularity in Slovakia. Their major positive impact on the environment is that they limit the use of non-recyclable disposable plastic packaging. Due to consumers' growing environmental awareness, more and more of them are interested in protecting the environment and prefer healthy organic products that are safe and produced traditionally. Many consumers also limit the production of waste and the use of non-renewable resources (Hanus, 2020). The "precycling" rule governs a large number of packaging-free stores, so they try to prevent the generation of packaging waste. Shopping without packaging offers people the opportunity to purchase with the feeling that they know what they are buying because food does not have a packaging "filter". One of the essential functions of packaging is providing information about products, but it is possible to use a different way to inform customers about them. The principle of packaging-free stores is to acquire local suppliers, which guarantees high-quality products (Andreoni, 2017).

Packaging-free business is nowadays applied by retailers in a very different way, from supermarkets to small neighbourhood shops, for selling a variety of goods (Ingrao, 2020).

According to Fujdal (2015), all packaging-free stores operate on the same principle. Customers come to these stores with their containers or packaging (e.g. cans, glasses, boxes, or pouches) to which they put the number of raw materials and food, and they pay for them according to their weight. If the customer does not bring his/her container, it is possible to rent a container

or buy it directly in the store. Figure 1 shows the current territorial distribution of packaging-free stores in Slovakia (as of 2019), i.e., places where it is possible to use your reusable containers for shopping.

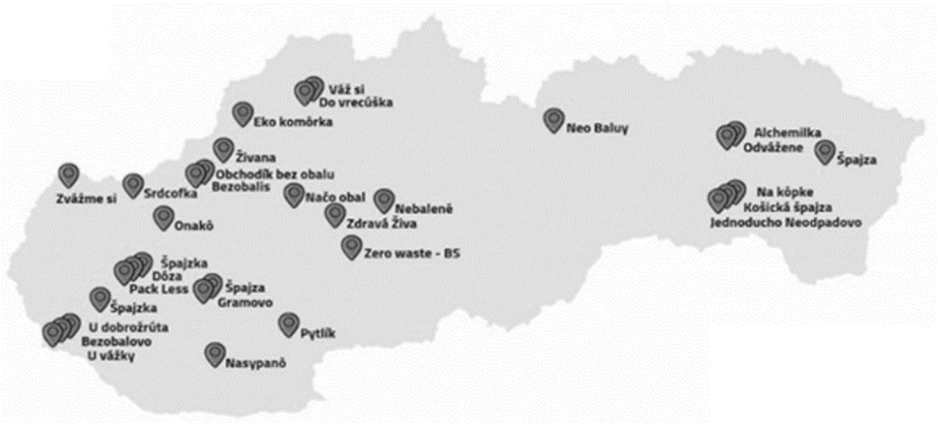

Figure 1. Map of packaging-free stores in Slovakia in 2019
Source: Ecohero.sk, 2019.

The key factor of commercial success or failure is mainly the knowledge of consumer behaviour of individual market segments. One of the main assumptions for the proper market segmentation is the knowledge of generations of consumers. This typology is used by marketers, especially concerning market segmentation. Each generation has its own characteristics and features of behaviour which is often associated with specific products. The issue of generations has become an integral part of modern marketing. If a company wants to acquire and address the right generation of customers with a new or existing product, it must know and correctly identify each generation of consumers. Kovaľová et al. (2019) state that each generation of consumers has unique characteristics, and their perception and behaviour are different. Their research found that there are significant differences between consumer perception and behaviour of different generations in several areas. "Consumer behaviour cannot be understood separately, regardless of behaviour in general and without links to the micro and macrostructure of society. In addition to psychology, information about consumer behaviour is also provided by many other disciplines such as sociology, cultural anthropology, economics, and others (Vysekalová, 2011)". McCrindle (2014) defines a generation as a community born in the same period that is affected by the same events, trends, or developments. Different features and characteristics are typical for each generation. Differences between genera-

tions often cause mutual conflicts. The most common disputes are in employment relationships and family life. Given this, it is essential to understand individual generations' needs, know how to communicate properly, and be adequately motivated and led. We encounter disagreements in the timeline of each generation very often. Many authors deal with this issue. They follow the different data obtained from their research (Reeves, Oh, 2013).

The paper aims to analyse the environmental aspects of the behaviour of individual generations of Slovak consumers concerning shopping in packaging-free stores.

Research methods

Although the professional literature is dominated by the generational division into 3 main and 5 transitional generations (some of them are overlapped in time), in the research, we used the age structure of respondents and divided them according to Wallace et al. (2014) into four-generation periods (table 1).

Table 1. Time period and characteristics of the generations

Name of the generation	Time period	Characteristics of the generation
Baby Boom Generation	1946 -1965	• the generation born after World War II, • its development took place during dramatic changes (Burnett, 2010), • giving preference to domestic producers, craftsmen, entrepreneurs, • giving preference to their own experience or advice from family and friends concerning buying a new product, • showing loyalty to the products, • its characteristic feature is saving and thrift, • giving preference to traditional values, • the problem with the use of modern technologies (but they do not reject them).
Generation X	1966-1976	• loyalty – in case of satisfaction, • willingness to pay – in the case of quality or popular brand, • lifelong customer – if the company offers high-quality products and services, • communication – giving preference to a personal or telephone conversation, • considering purchases – until they find the best for them at an affordable price, • giving preference to the purchase of branded and quality products, • looking for meaning even where it is not at first sight, • openness to new things and the possibility to be influenced by the advice.

Generation Y	1977-1995	• optimism – the family shaped them with an optimistic education, • education – the quality of education in the home country or abroad, • investment in experience – investment in a product if the product is an experience, • self-confidence – in some cases more than appropriate and tolerant, • trends – a hobby to discover new trends, • criticism – towards advertising.
Generation Z	1996-2012	• day-to-day use of modern technology, • virtual communication – many contacts and relationships from social networks, • ability to cooperate – team cooperation, • ability to work and have fun, • independence – a high desire to be independent, but they often do not know it, • loss of privacy – sharing thoughts and opinions on social networks, • lack of skills and experience.

Source: author's work based on Wallace et al., 2014 and Burnett, 2010.

The respondents to the questionnaire survey were residents of the Prešov region. The total number of respondents was 271. Of these, 189 were women, representing a relative share of 69.74%, and 82 were men with a percentage of 30.26%. The research included 39 questions focused on the environmental aspect of the behaviour of individual generations of consumers in relation to shopping in packaging-free stores. Due to the limitation of the paper's scope, we selected and analysed 5 questions from the total number.

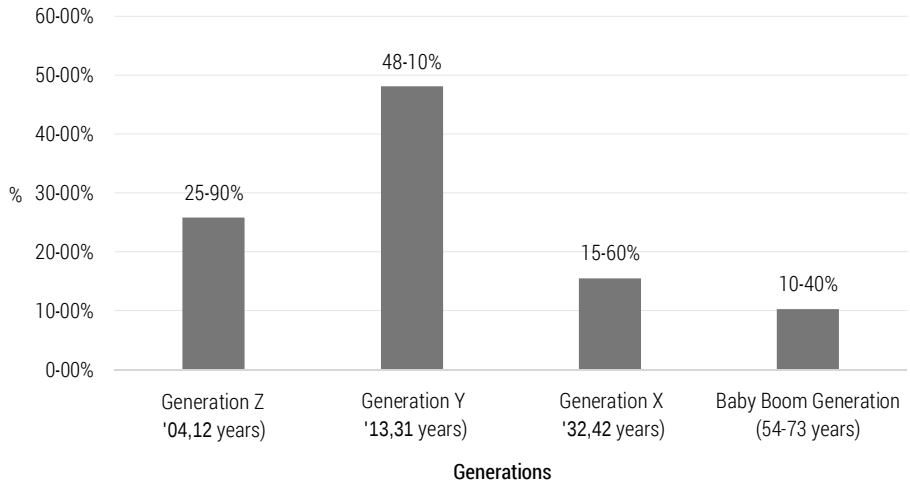

Figure 2. Percentage of respondents divided by generations

Source: author's work.

According to Wallace et al. (2014) (table 1), the respondents to the questionnaire survey were divided into four-generation periods (figure 2):

- Baby Boom Generation (1946-1965),
- Generation X (1966-1976),
- Generation Y (1977-1995),
- Generation Z (1996-2012).

The results of the questionnaire survey were processed by using descriptive statistics methods (percentage, figures). The hypotheses were tested by using difference analysis in the statistical software Gretl.

Results of the research

From the highest achieved education, the most numerous group consisted of respondents who achieved a complete secondary school education (completed by a school-leaving examination), followed by respondents possessing a university degree (I. and II. degree). Respondents with a university degree of the III. degree and basic education had the smallest percentage (figure 3). We believe that respondents' educational structure has a significant impact on the positive attitude or increased interest of respondents in environmental issues.

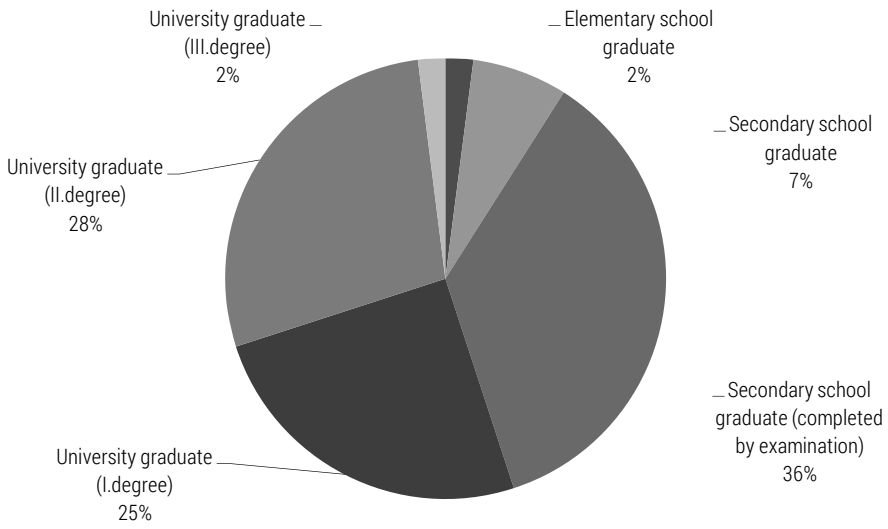

Figure 3. Percentage of respondents divided by the highest achieved education

Source: author's work.

A key aspect that significantly influences respondents' attitudes of all analysed generations could be their shopping experience in a packaging-free store. The answers show that most respondents have not had experience with shopping in a packaging-free store yet. The reason is the relatively small number of these shops and the lack of information or fear of something new and unknown. On the other hand, the percentage of respondents who have shopped in a packaging-free store at least once was less than 4%. A summary view of the respondents' opinion on the statement "I have already shopped at least once in a packaging-free store" is shown in figure 4.

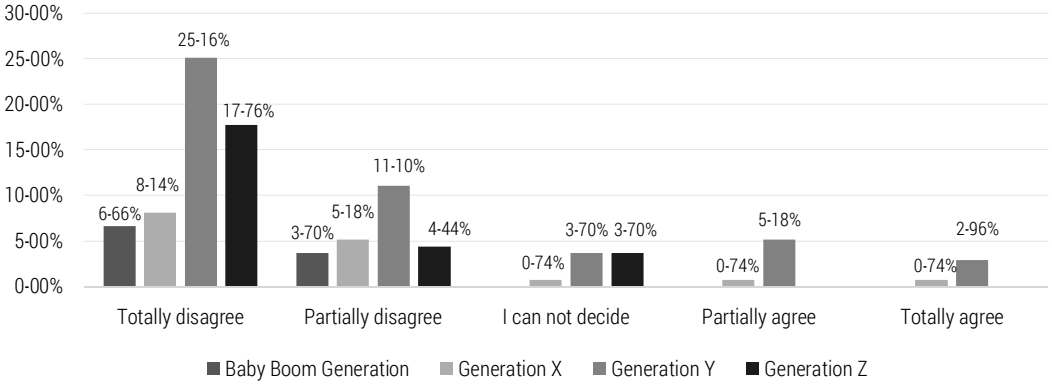

Figure 4. Graphic representation of the respondents' opinion on the statement: "I have already shopped at least once in a packaging-free store"

Source: author's work.

Respondents' attitudes towards the environment were examined through the statement "I care about the state of nature and the environment". The dominant group of respondents (in all analysed generations) expressed their agreement. The most numerous group that declared "Totally agree" consisted of Generation Y respondents (more than 34%). The structure of the responses is shown in figure 5.

Another analysed statement was: "I think that product packaging has a negative impact on the environment." An interesting finding was either a completely or a partially negative attitude of some respondents (except for Generation Z). From the respondents' attitudes, it can be stated that Generation Z (born in 1996-2012) is the most intensively confronted with the issue of environmental quality. They are also interested in the future condition of the environment. An overview of all responses is shown in figure 6.

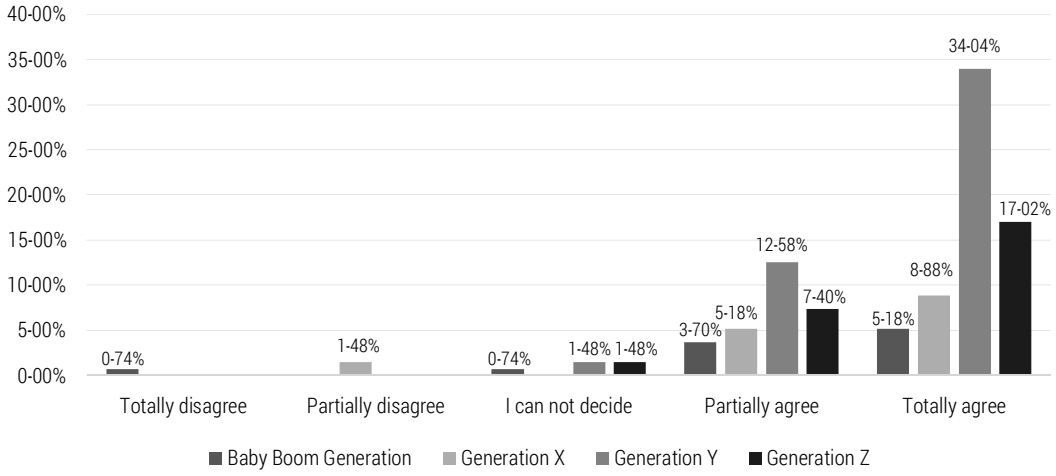

Figure 5. Graphic representation of the respondents' opinion on the statement: "I care about the state of nature and the environment"

Source: author's work.

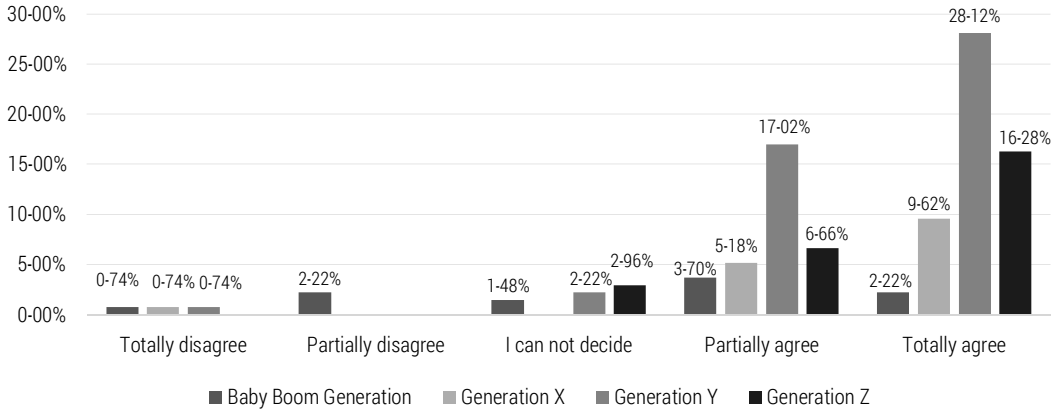

Figure 6. Graphic representation of the respondents' opinion on the statement: "I think that product packaging has a negative impact on the environment"

Source: author's work.

The respondents were also confronted with the statement: "By shopping in a packaging-free store, I try to contribute to improving the state of the environment." The response "Partially agree" dominated in all analysed generations. The option "Partially disagree" was also represented by all analysed generations, but in a relatively small proportion (5.92%). We assume that

respondents are not convinced that shopping in a packaging-free store makes a significant contribution to environmental protection. The attitudes of all respondents are shown in figure 7.

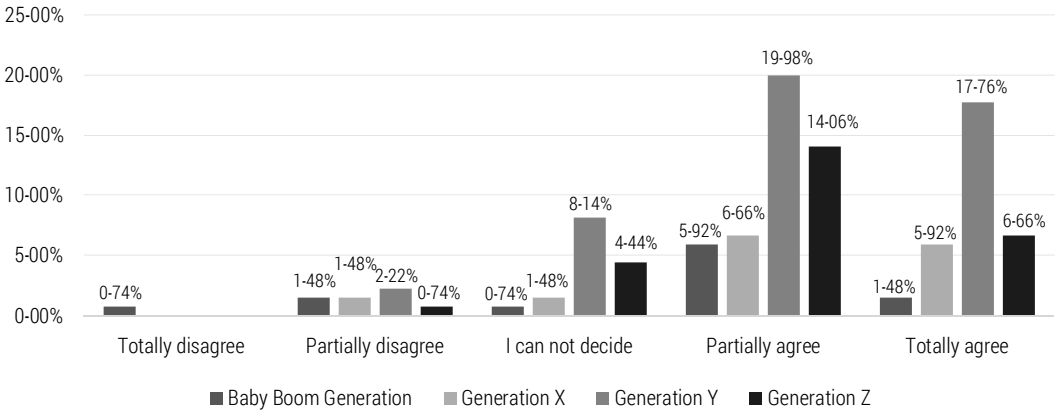

Figure 7. Graphic representation of the respondents' opinion on the statement: "By shopping in a packaging-free store, I try to contribute to the improvement of the state of the environment"

Source: author's work.

Knowledge of packaging-free stores in relation to the most important factors that motivate or influence consumers to visit "green" stores is a key factor influencing the identification of the "green consumers" segment. The description of generations is a key aspect for identifying the difference of consumers' "green activities" concerning their age, gender, or the highest level of education.

To verify the difference between:

- generational groups and their awareness of packaging-free stores,
- gender of respondents and their experience of shopping in a packaging-free store,
- we have defined the following hypotheses:
  - Hypothesis H1: There is a statistically significant difference between respondents' generational groups and their awareness of packaging-free stores.
  - Hypothesis H2: There is a statistically significant difference between the gender of respondents and their experience with shopping in a packaging-free store.

Each of the hypotheses was tested by the normality test (Shapiro-Wilk W test). In this test, the hypothesis H0 is rejected if the p-value is less than the

significance level of 0.05. In that case, the variable has no normal distribution (table 2).

Table 2. Shapiro-Wilk W test of normality

Shapiro-Wilk W test	
p-value	5.58803e-010
p-value < 0.05	H0 is rejected, so the variable has no normal distribution.

Source: author's work by using Gretl.

Hypothesis H1 testing:

- H0: There is no statistically significant difference between respondents' generational groups and their awareness of packaging-free stores.
- H1: There is a statistically significant difference between respondents' generational groups and their awareness of packaging-free stores.

Based on the Kruskal Wallis test (table 3), we can conclude that the p-value is higher than the significance level of 0.05, and therefore we cannot reject H0. There is no statistically significant difference between the generational groups of respondents and their awareness of packaging-free stores.

Table 3. Kruskal-Wallis test for Hypothesis H1

Kruskal-Wallis test	
chi-squared	6.0462
p-value	0.1957
p-value > 0.05	We cannot reject H0, so there is no significant difference between the variables.

Source: author's work by using Gretl.

Hypothesis H2 testing:

- H0: There is no statistically significant difference between the gender of the respondents and their experience with shopping in a packaging-free store.
- H1: There is a statistically significant difference between the respondents' gender and their shopping experience in a packaging-free store.

Table 4. Wilcoxon rank-sum test for Hypothesis H2

Wilcoxon rank-sum test	
p-value Women	2.9652e-008
p-value Men	6.45063e-015
p-value < 0.05	H0 is rejected, so there is a significant difference between the variables.

Source: author's work by using Gretl.

Based on the Wilcoxon rank-sum test (table 4), we can conclude that the p-value is lower than the significance level of 0.05, and therefore we reject H0. There is a statistically significant difference between the gender of the respondents and their experience with shopping in a packaging-free store.

Conclusions

The paper focuses on analysing environmental aspects of the behaviour of individual generations of Slovak consumers regarding shopping in packaging-free stores. As of today, no similar study of this type has been made publicly available in Slovakia. Due to this fact, a quantitative survey (for the collection of primary data) was conducted in a questionnaire survey, which 271 respondents attended. Of the total number of respondents, 189 were women and 82 men. Gender distribution is because women mostly make the purchase of food, and thus, they have shown greater interest in this issue.

Concerning the obtained population sample, the research results relate mainly to the relatively younger age category (up to 35 years), called consumer Generation Y. We could state that the form of shopping with the added value of positive impact on the environment suits them. We assume that other age groups will join the purchase in packaging-free stores later because they are used to shopping in a certain way, and the behaviour change occurs rather gradually.

From a territorial point of view, the respondents were residents of the Prešov region. The obtained data may, however, be considered applicable also to consumers in other regions of Slovakia.

It would be appropriate to research a larger representative sample of the population with an equal representation of all age groups and Slovakia regions to obtain more representative and generalised results for the whole Slovakia. Furthermore, it would be appropriate to do more detailed research into consumer reactions to the various promotion forms of these shops.

It would be found out which marketing communication tools should be used more for stores of this type.

Based on the results of research hypothesis testing, we can state that packaging-free stores should focus their attention on all generational groups and focus on finding appropriate ways to increase all age groups' level of interest. The focus of packaging-free stores' marketing activities should be based on the idea of "green purchasing" with a tangible positive impact on the environment. An appropriate form of addressing all generations can help retailers gain a wide range of customers and improve the environment. The results confirm that green behaviour is a very complex part of consumers' behaviour (of different generations) of consumers and is still a black box of green marketing. From a broader perspective, we can say that one of the aspects that affect consumers shopping behaviour is the impact on the environment. From the future perspective, it would be appropriate to focus further research on revealing the factors influencing a green consumer in Slovakia.

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The contribution of the authors

Martin Rovnak – 50% (conception, data analysis, interpretation, discussion).
Lenka Stofejova – 30% (literature review, data analysis, language correction).
Peter Adamisin – 10% (literature review, data collection, interpretation).
Matus Bakon – 10% (literature review, data collection).

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GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

PROBLEMATYKA OGÓLNOEKOLOGICZNA I SPOŁECZNA

Jolanta **PAKULSKA**

EMISSIONS OF MAJOR AIR POLLUTANTS AS AN INDICATOR OF QUALITY OF LIFE IN POLAND IN 1990-2017

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ABSTRACT: In recent deliberations on the quality of life, the air quality that man breathes plays a significant role. It is beyond dispute that since 1990, Poland has been a period of making up for many years of neglect of the natural environment. The study aimed to check whether the measures taken to reduce pollutants' emissions into the atmosphere were effective and to what extent it was possible to improve its condition and improve the environmental quality of life of Polish society in this area. The index of emission of the main air pollutants was used (this group includes: sulphur dioxide, nitrogen oxide, carbon oxide and dioxide, non-metallic volatile organic compounds, ammonia and particulates) to achieve the assumed objective. Using the statistical data available in the yearbooks Environment, an analysis of these compounds' emissions was carried out. The study used the descriptive, statistical and analytical method. The analysis showed that over the period analysed, emissions of the main air pollutants had decreased significantly in most cases, which has undoubtedly contributed to improving the environmental quality of life.

KEYWORDS: emissions of major air pollutants; quality of life, welfare economics

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Introduction

Quality of life most often refers to the objectives and effects of economic development. The paradigms of welfare economics, around which non-economic sciences are also developing, have become the basis for considering the measurement of quality of life, where other aspects complement the concept of prosperity in economic sense, e.g. the development of the economy, social security, political or civic conditions, family and the quality of the environment (Szyguła, 2017, p. 8-9).

Understanding the concept of welfare has been transformed throughout history, as until the mid-20th century, prosperity was treated as a purely sociological category. In the second half of the 20th century, it was also considered an economic category, but welfare was only limited to recent economic measures. Today, however, prosperity is a much broader category, as many indicators define its level. Therefore, welfare is measured not only in economic terms because it depends not only on the assets held or on the level of consumption per capita (these indicators define only well-being) (Krabbe, 1989, p. 46). Measuring prosperity is much more complicated, as it is economical and philosophical and psychological or political. Therefore, the measurement should take into account economic, social and ecological aspects. Due to its multi-aspect nature and a wide range of elements that should be taken into account in formulating a single, coherent measure of prosperity, it is not surprising that such an indicator has not yet been created.

Well-being can be understood as the extent to which a person feels satisfied with life, while in the theory of economics, the growth of prosperity is tantamount to an increase in consumption. There is no doubt that economic conditions and cultural, political and environmental conditions are important factors when the level of well-being is regarded. Although prosperity is very often associated with consumption, but in the light of current trends, instead of using consumption to assess prosperity, economists estimate human "prosperity" in all its complexity. Today, increasing emphasis and the analysis of prosperity are being placed on sustainable development and the state of the natural environment (Gowdy, 2005, p. 216-217).

Sustainability can be considered economically irrational, which is contrary to the objectives of welfare economics, as caring for prosperity for future generations leads to a reduction in the availability of natural resources, which will contribute to the reduced current production of goods and a reduction in the well-being of the current generation. Lower production will mean fewer goods available on the market, which will not lead to an increase in prosperity in the classical sense. Furthermore, reducing these goods over the long term will lead to uneven distribution over the long term,

which means a lack of market demand and supply balance. On the other hand, it is known that the market mechanism is unreliable and that overproduction of goods is a frequent market phenomenon. This means that supply exceeds market demand. The constraints introduced for a rational management of natural resources could likely lead to increased producer costs and, consequently, a supply reduction. If the changes were sufficient, they could lead to the equalisation of demand and supply, which would mean a market balance. By studying sustainable development from the point of view of the welfare economics assumptions, it is possible to check how the natural environment affects consumer satisfaction with the consumption of goods (both public and private) (Osiecka-Brzeska, 2011, p. 23-24).

The concept of quality of life is a broader concept than economic prosperity due to GDP growth and qualitative changes. On the one hand, quality of life is an objectively calculated standard of living based on statistical data. On the other hand, it is a complex measure influenced by many environmental factors (e.g. air pollution) and factors that are highly influenced by the environment (e.g. health).

A suitable quality of life can be ensured with an appropriate economic standard, but this is insufficient to recognise and assess life quality as high. Without a doubt, good health is a factor without which the quality of life is not satisfactory. The quality of the natural environment, especially atmospheric air, has a significant impact on human health. Its proper quality is a condition of human health (well-being and access to clean air and the absence of diseases).

An overview of the literature

The concept of quality of life can already be found in ancient thinkers who identified quality of life with happiness. Hippocrates saw happiness in the inner balance of man. On the other hand, Aristotle considered the pursuit of the highest possible achievable good as a guarantee of happiness, with economic prosperity as the only means to achieve happiness. They sought an answer to what happiness is and what can ensure a high quality of life for the man (Trzebiatowski, 2011, p. 26; Kot, 2004, p. 107). Throughout the centuries, many attempts have been made to determine what quality of life is. In the literature of the subject, life quality is defined as satisfaction with the level of satisfaction of the diverse needs of the individual or collective life, related to safety, health, work, living conditions or surrounding social and natural environment (Pielesiak, 2017, p. 52).

In recent years, the science of quality of life has been developing very rapidly (Diener, Lucas and Oishi, 2002); there are many definitions of quality

of life, well-being, which stem from various theoretical assumptions. The theory of comparison is worth mentioning here (Michalos, 1985), Kahneman's concept of objective welfare (Kahneman, 2012), theories embedded in philosophical currents (Seligman, 2004) or emphasising the almost one hundred percent share of genetic determinants in the formation of a sense of happiness (Lykken, 2000). Among Polish researchers, Janusz Czapiński proposing the so-called "onion concept of happiness", stands out (Czapiński, 2001).

According to Gillingham and Reece: "quality of life is the degree of satisfaction obtained by an individual as a result of consuming goods and services, spending free time, and enjoying the remaining material and social conditions of the environment in which that individual is located (Gillingham, Reece, 1980). Allardt differentiates between the concepts of the standard of living and quality of life, linking standard of living to material needs and quality of life to non-material needs (Allardt, 1993). Bentham stresses that the proper aim of action for the general public is to make as many people as possible happy as possible. The relative value of different actions should be measured using a 'pleasure calculus' (felicific calculus). It is supposed to be a reference system for rulers, and the main determinant is the "pleasure and suffering" experienced by society as a consequence of the actions taken.

Considering the development of research on the quality of life, one cannot fail to mention the American psychologist Angus Campbell, who emphasised that without reference to the sense of satisfaction, it is impossible to answer the question about the quality of life of an individual. He believes that life quality includes the degree of satisfaction from family life, work, neighbourly relations, social relations, health, ways of spending free time, education, profession or general standards influencing the quality of life within the local community. (Campbell, 1981).

The quality of life is also being considered by economists, who have been looking for years to distinguish between the quality of life and welfare. Sen, who received the Nobel Prize in 1998 for his reflections on well-being economics, made a significant contribution to this work. Sen noted that we differ in terms of age, gender, physical and mental condition, body resilience, intellectual capacity or social environment, so it is also natural to have differences in income, wealth or social status (Sen, 1970). However, the aim must be to ensure the relative well-being of as many individuals as possible. Sen has extended the understanding of prosperity beyond economic prosperity alone. According to Sen, prosperity can be understood as a person's quality of life, which consists of many elements, such as eating, good health, to more complex factors, such as being happy, feeling dignified or participating in society (Sen, 1982). He also stated that neither ancient philosophy nor medieval Christian thought combined the ideal of happiness with economic prosperity.

In the Polish literature, we can find analyses of changes in the emission of pollutants in Poland over the years. For example, Nowicki writes about environmental protection progress in recent years (Nowicki, 2014). There are also many studies on the environmental impact (including atmospheric air quality) on human health. However, no analyses are indicating a link between the amount of pollutant emissions (which largely translates into environmental quality) and the quality of human life. This study contributes to further research on this issue.

Research methods

The study uses a descriptive, statistical and analytical method. Thanks to the descriptive method, the concept of life quality was discussed based on the literature on the subject, especially in environmental quality. A dynamic analysis of the emission of main air pollutants in Poland over the last 30 years was made using statistical data concerning the emission of main air pollutants. The main air pollutants are sulphur dioxide, nitrogen oxide, carbon oxide and dioxide, non-metallic volatile organic compounds, ammonia and particulates. The choice of these data was determined by their availability in such a long time. These data come from statistics published by the Central Statistical Office in the yearbooks Environment (since the Central Statistical Office started publishing environmental data on a systematic basis, i.e. since the 1990s).

In most cases, these data are also comparable over the entire availability period, making it possible to analyse them over a relatively long time. Thanks to this, Poland's achievements in this area have been demonstrated. The results of the research are presented in a graphic layout.

Results of the research

Emissions of major air pollutants in Poland have significantly decreased over the last 30 years (see figures 1 and 2). The lowest percentage of decreased emissions was recorded for carbon dioxide (less than 12% – see table 1). Fluctuations in the emissions of this gas are being observed throughout the analysis period, as emissions are increasing over specific periods, resulting in a relatively small decrease in emissions as a whole. The most significant proportion of these gas emissions come from energy generation processes (in 2017, almost 94% – see table 2). A positive phenomenon is that more than 11% of the carbon dioxide emitted is absorbed by forest areas (see figure 3). Thus, in addition to changing the structure of energy sources towards sources emitting less carbon dioxide, the second direction of reduc-

ing the threat to quality of life on the part of this gas is to increase the surface of forest areas that will more absorb harmful emissions.

Similarly, there is a small decrease in emissions of non-methane volatile organic compounds (less than 16% – see table 1). Their emissions decreased by 2015 (in 1990-2015, the decrease was almost 20%), and in the last two years, it has been steadily increasing. Most of these emissions come from anthropogenic sources (more than 70%), but emissions from these sources have also decreased by a larger degree (almost 17%). In this case, there is no strong leader in the share of emissions (see table 2).

Emissions decreased by around 40% were recorded for nitrogen oxides (more than 37%) and ammonia (approximately 44%) – see table 1. The emissions of these gases are relatively small, so such a reduction is significant. For ammonia, emissions increased in some years but overall decreased significantly (see figure 2). Similarly, as nitrogen oxide emissions are concerned,

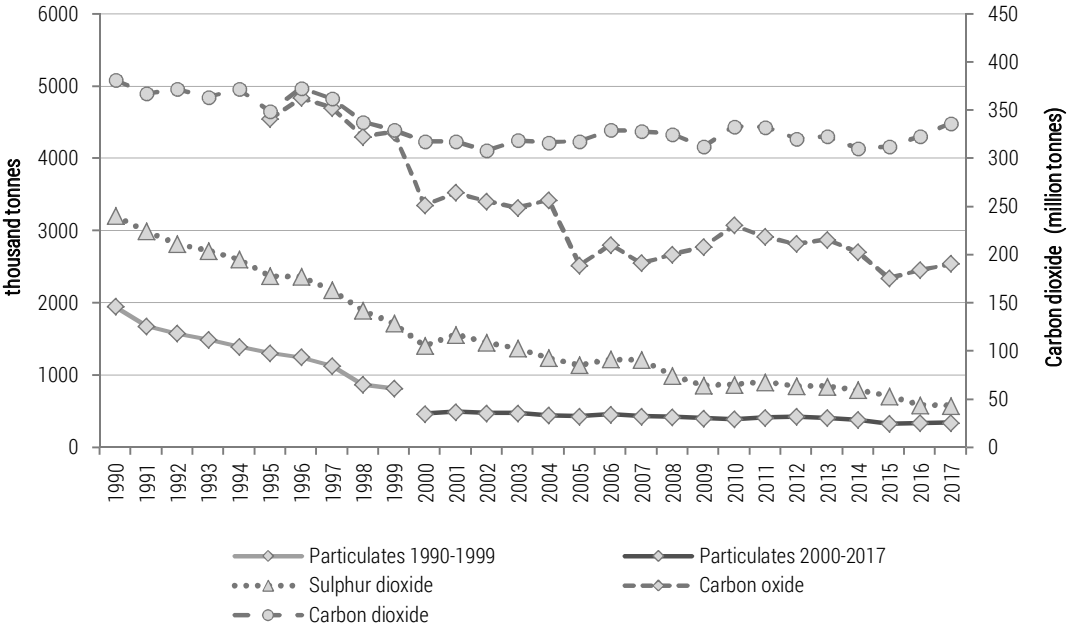

Figure 1. The total emission of particulates, sulphur dioxide, carbon oxide and carbon dioxide (1990-2017)

(As CSO inform, "data on the emission of dust for 2000-2006 are not comparable with previous data due to application of the verified methodology of their estimation: some categories of emission sources were added, and new emission indicators were applied. Calculated volumes of total dust emission for 2000-2006 are much lower than the level of dust emission estimated in former stock-takings because the volume of emission was exceeded – especially for the category "combustion processes in the industry" and "production processes" especially in the second half of the 90's – mainly owing to not taking into account the upgrade of equipment and technological progress.")

Source: author's work based on GUS, 2001-2019.

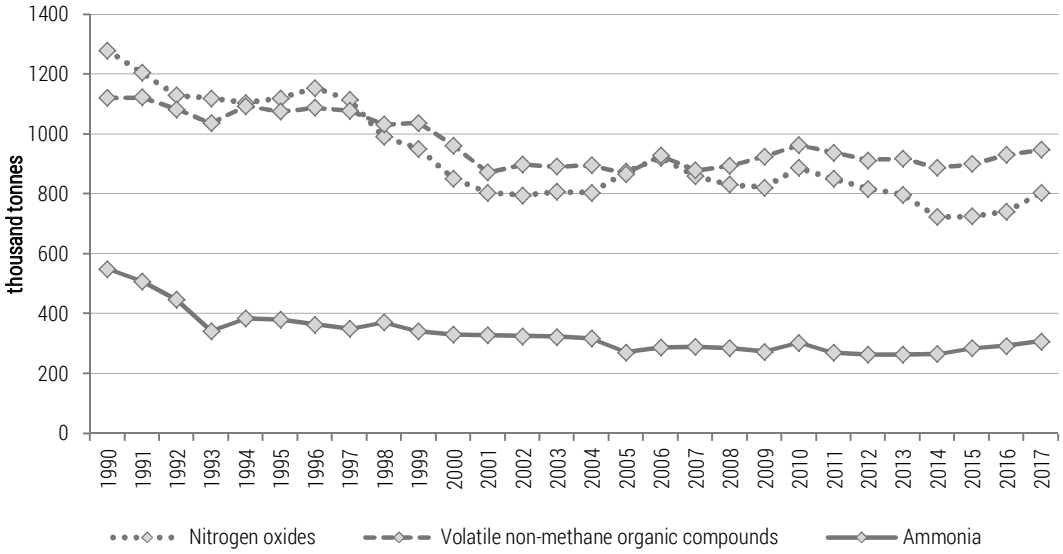

Figure 2. The total emission of nitrogen oxides, volatile non-methane organic compounds and ammonia (1990-2017)

Source: author's work based on GUS, 2001-2019.

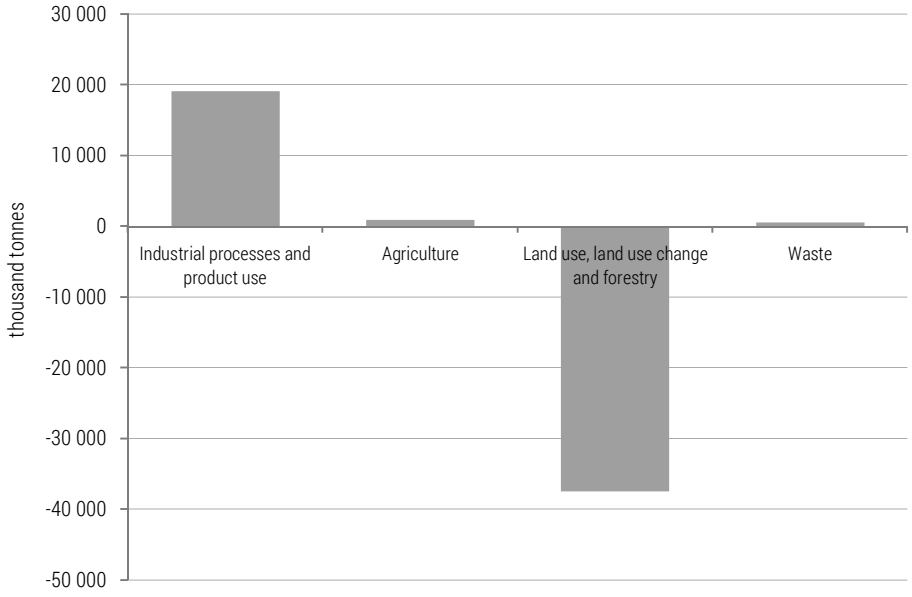

Figure 3. The total emission of carbon dioxide by emission sources in 2017

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

a small increase in emission was observed in 2005 and 2010, but ammonia emissions decreased significantly during the period considered (see figure 2). Car transport is the most responsible for emissions of nitrogen oxides. During the research period, the number of motor vehicles moving on our roads has significantly increased. However, these are increasingly modern vehicles, thanks to which the global emissions of this gas have been reduced. Agriculture is the most responsible for ammonia emissions (almost 85% of agricultural emissions in 2017 – see table 2). Thanks to the fact that this source is largely dispersed, this does not significantly impact the quality of life.

A similar reduction has been achieved in carbon oxide emissions since 1995 (around 44% – see table 1), especially since 1999 (see figure 1). This emission is largely the result of combustion processes outside the industry (in 2017, almost 60% – see table 2). Thanks to measures aimed at greening these processes, by changing the type of fuel burned or replacing furnaces, a large reduction in emissions and improved quality of life has been achieved.

Very significant emission reductions have been achieved in sulphur dioxide (almost 82% – see table 1). In the case of sulphur dioxide, an even reduction in emissions is recorded throughout the research period. There is a lack of a strong "culprit" of emissions (see table 2). Combustion processes in the energy production and transformation sector ranked first (in 2017 more than 40%), the next places are occupied by combustion processes outside the industry (almost 30%) and industrial combustion processes (almost 24%). The decrease in sulfur dioxide emissions from mobile sources since 2004 results from a significant decrease in the sulfur content in liquid fuels of this category. Combustion processes outside the industry caused almost half (more than 47%) emissions in 2017; the remaining sources were up to just over 10% of emissions (see table 2). The decrease in sulphur dioxide emissions is due, as in carbon monoxide emissions, to the measures taken to reduce emissions from these sources.

In the case of particulates emissions due to a change in methodology by GUS, comparisons should be made in two periods: 1990-1990 and after 2000. In the first period, the decrease in emissions reached over 41% (see table 1), while in the second period it remained at a similar level.

Table 1. Emission indices of the main air pollutants (1990-2017)

Specification	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sulphur dioxide	100.00	93.30	87.85	84.89	81.15	74.02	73.77	67.94	59.10	53.55	43.95	48.72	45.36
Nitrogen oxides	100.00	94.14	88.28	87.50	86.33	87.50	90.16	87.11	77.42	74.30	66.55	62.89	62.19
Carbon dioxide	100.00	96.38	97.60	95.41	97.59	91.47	97.83	94.97	88.63	86.44	83.41	83.32	80.81
Carbon oxide	no data	no data	no data	no data	no data	100.00	106.38	103.36	94.61	96.00	73.80	77.59	74.99
Volatile non-methane organic compounds	100.00	100.18	96.61	92.51	97.59	95.99	97.15	96.25	92.06	92.60	85.87	77.88	80.11
Ammonia	100.00	92.36	81.27	62.18	69.8	69.09	66.18	63.64	67.45	62.00	60.13	59.64	59.09
Particulates 1990-1999	100.00	86.15	81.03	76.67	71.5	67.08	64.10	57.95	44.67	41.7	no data	no data	no data
Particulates 2000-2017	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	100.00	105.82	101.94

Specification	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sulphur dioxide	42.83	38.66	36.50	38.07	37.88	31.12	26.85	27.25	28.35	26.57	26.39	24.92	22.18	18.40	18.15
Nitrogen oxides	63.13	62.81	67.93	71.95	67.19	64.92	64.22	69.37	66.48	63.83	62.34	56.48	56.66	57.98	62.79
Carbon dioxide	83.64	83.02	84.55	86.40	86.11	85.29	81.85	87.41	87.18	84.11	84.64	81.34	81.87	84.68	88.22
Carbon oxide	72.97	75.35	67.94	61.67	56.15	58.81	61.10	67.68	64.13	61.97	63.25	59.47	51.52	54.02	55.93
Volatile non-methane organic compounds	79.57	79.93	85.81	82.87	78.41	79.75	82.60	85.90	83.68	81.45	81.98	79.21	80.30	83.00	84.55
Ammonia	58.73	57.64	58.97	52.18	52.55	51.82	49.64	55.15	49.09	47.82	47.82	48.18	51.77	53.08	55.91
Particulates 1990-1990	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Particulates 2000-2017	102.59	95.47	87.52	98.71	92.67	90.73	87.07	84.00	89.22	92.24	87.72	82.54	70.45	72.24	73.41

Source: author's work based on GUS, 2001-2019.

Table 2. The total emission of main air pollutants by kinds of activity in 2017

	Sulphur dioxide		Nitrogen oxides		Carbon oxide		Volatile nonmethane organic compounds		Ammonia		Particulates	
	in thousand tonnes	in %	in thousand tonnes	in %	in thousand tonnes	in %	in thousand tonnes	in %	in thousand tonnes	in %	in thousand tonnes	in %
Combustion in energy production and transformation industries	251.30	43.13	168.90	22.78	51.19	2.01	2.55	0.27	-	-	14.91	4.60
Non-industrial combustion plants	170.87	29.33	85.72	11.56	1505.80	59.11	116.15	12.35	7.76	6.08	152.05	46.96
Combustion in industry	138.85	23.83	73.35	9.89	212.83	8.35	41.27	4.39	3.68	2.88	34.07	10.52
Production processes	18.82	3.23	25.59	3.45	68.23	2.68	66.17	7.03	1.35	1.06	34.69	10.71
Extraction and distribution of fossil fuels	1.94	0.33	1.36	0.18	0.30	0.01	50.52	5.37	-	-	12.88	3.98
Solvent and other product use	-	-	-	-	-	-	206.96	22.00	0.02	0.01	-	-
Road transport	0.55	0.09	297.36	40.11	588.44	23.10	85.43	9.08	4.74	3.71	24.06	7.43
Other vehicles and machinery	0.18	0.03	84.71	11.43	96.26	3.78	9.56	1.02	0.02	0.01	11.46	3.54
Waste management	0.14	0.02	2.21	0.30	19.66	0.77	10.48	1.11	2.04	1.60	5.22	1.61
Agriculture	0.00	0.00	2.19	0.30	0.54	0.02	94.67	10.06	108.10	84.65	34.25	10.58
Other sources of pollutant emission and absorption	-	-	0.02	0.00	4.33	0.17	257.03	27.32	-	-	0.18	0.06
Total	582.66	100.00	741.42	100.00	2547.58	100.00	940.80	100.00	127.70	100.00	323.77	100.00

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

Conclusions

The analysis indicated that during the last 30 years, there was a significant improvement in Poland's quality of life in terms of atmospheric air quality. On the one hand, it seems that air and climate protection investments have helped reduce emissions. On the other hand, this has been influenced by structural changes in the economy. A thorough analysis of the reasons for reducing emissions requires further analytical work.

It is clear that it is not emissions that are decisive, but air pollution immissions; however, it is the volume of emissions that has the most significant impact on the immissions. Considering the need to carry out a long-term analysis covering the beginnings of environmental statistics in Poland, it was not possible to make comparisons on the immission of air pollutants. Therefore, it was necessary to analyse the volumes that most affect the immission, that is, the air quality that Poland's inhabitants breathe.

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EFFECT OF CIRCULAR ECONOMY ON THE SUSTAINABILITY OF CULTURAL TOURISM (CROATIA)

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ABSTRACT: Circular economy is a developmental concept promoted by the European Union and applied in practice by its member countries. When looking at the circular economy process, it is most commonly observed from the industry's point of view and its related processes. Tourism is less frequently observed, but in recent years, the circular economy application has become significantly more present in tourism, both in the hotel industry and in all types of tourism overall. This paper focuses on the issue of sustainable cultural tourism, emphasising supporting the protection and/or reuse of heritage, where the entire cycle is based on the principles of the circular economy. Sustainable cultural tourism should be founded on circular economy principles wherever applicable (heritage tourism, gastronomy, urban tourism, etc.). In this paper, we take a look at cities in Croatia that apply circular economy to sustainable cultural tourism. This paper's scientific contribution lies in the proposed guidelines for taking further action to create a "new" cultural tourism by adopting the circular economy's principles.

KEY WORDS: CSR, cultural tourism, circular economy, sustainability, local economic development

Introduction

In contemporary business, the circular economy represents a process that means applying the tenets of sustainable development in economic activities at all levels. Emphasis on the circular economy principles is also present in current initiatives in tourism, aiming to create sustainable tourism in all its elements. Heritage tourism is an essential segment in this regard. Sustainable development satisfies the demands of the current generation while aiming to preserve natural resources and the environment for future generations (Rudawska, Renko, Bilan, 2013). Based on the explored literature by various authors who tackled the topic of circular economy in tourism, the authors of this paper have reached the following research question – can sustainable cultural tourism in Croatia be achieved and how? The basis for creating sustainable tourism lies in understanding the concept of the circular economy.

Nevertheless, how specific forms of tourism can be developed remains, i.e. how can circular economy be applied to develop sustainable cultural tourism in Croatia? To that end, this paper explores various secondary pieces of research and available literature in order to determine the current stage of development of cultural tourism in Croatia. Based on the analysis conducted, the authors have provided guidelines for improving and developing particular cultural tourism forms. In addition to this introduction, the paper consists of an overview of relevant literature where the authors provide an overview of previous research pieces about cultural tourism and the circular economy. The section after that tackles how these two topics are connected, followed by specific examples of cities that have implemented best practices concerning the circular economy's application in cultural tourism. Ultimately, the paper ends with a discussion and conclusion, where the authors provide guidelines for applying the concept of circular economy in sustainable cultural tourism.

Literature overview

Research interest has been on the rise over the last ten years when it comes to defining and identifying the possibility of applying the concept of the circular economy that ensures sustainability in a specific area. Research focuses on how to benefit by shifting from linear to the circular economy. The EU has recognised the importance of this field, so the European Commission's new EU Circular Economy Plan (2020) specifies that the process of shifting towards regenerative growth should be faster in order to return to the planet more than we take from it. The Action Plan emphasises the neces-

sity to reduce resource consumption to a level in line with the planet's sustainability, which means reducing the effects of consumption and doubling the rate of the circular use of materials over the next decade. Vukadinović (2018) states that linear economy is based on a linear process encompassing resources, production, consumption and finally, waste. Protecting the living environment is neglected in this case, while circular economy aims the other way around. The circular economy is often defined as a sustainable development strategy that has to secure solutions for urgent issues concerning the endangerment of the living environment and lack of natural resources, which can be achieved by adhering to three principles: reduce, reuse, recycle. Drljača (2015) states that circular economy constitutes a significantly different approach to economic processes, not just in the field of sustainable use of material resources but also in social responsibility and equal economic development. The concept of linear economy is abandoned in such a way, as it has become too expensive and unsustainable to increase competitiveness in the long term. Furthermore, authors Šverko Grdić, Krstinić Nižić, and Rudan (2019) emphasise that the model that supports the concept of sustainable development is based on the transition from linear to the circular economy. This concept took shape as an efficient mechanism for achieving sustainability, which should, in turn, reduce environmental degradation, correct and prevent negative effects, as well as enable both entrepreneurs and the community in general to save money. Authors Šverko Grdić, Krstinić Nižić and Rudan (2020) defined that transitioning to a circular economy requires not only changing one single activity but systemic changes in the industry, social components, energy, transportation, agriculture and more. Change is necessary in all segments of economy, politics and ultimately in the lives of local communities.

Authors Kirchherr, Reike and Hekkert (2017) define a circular economy as an economic system that replaces the "end-of-life" concept with reducing, reusing, recycling and recovering materials in the production/distribution and consumption processes. It operates at the micro-level (products, companies, consumers), meso-level (eco-industrial parks) and macro-level (city, region, nation and beyond), intending to achieve sustainable development, thus ensuring the quality of life and safe and continuous economic local development. The end goal is the benefit of all current and future generations. Author Sabol (2019) states that the initiative combines an approach of consuming less with an approach of consuming differently, i.e. ecologically friendly. According to Fusci and Girard (2016, p. 67), a circular economy does not only concern the waste cycle; it pertains to economic synergies and symbiosis between different industrial activities, cities and industrial systems and more. It is the regenerative economy of materials and energy, water,

natural, cultural and social resources. Looking at circular economy in general, a crucial aspect is how it can be applied to tourism to improve the local community's quality of life and tourists' stay at a destination and ensure the sustainability of a destination with appropriate regional development. Tourism causes change at a destination. Thus, it is necessary to develop new tourist attractions on top of the existing resource base that will be in line with the destination's values and identity.

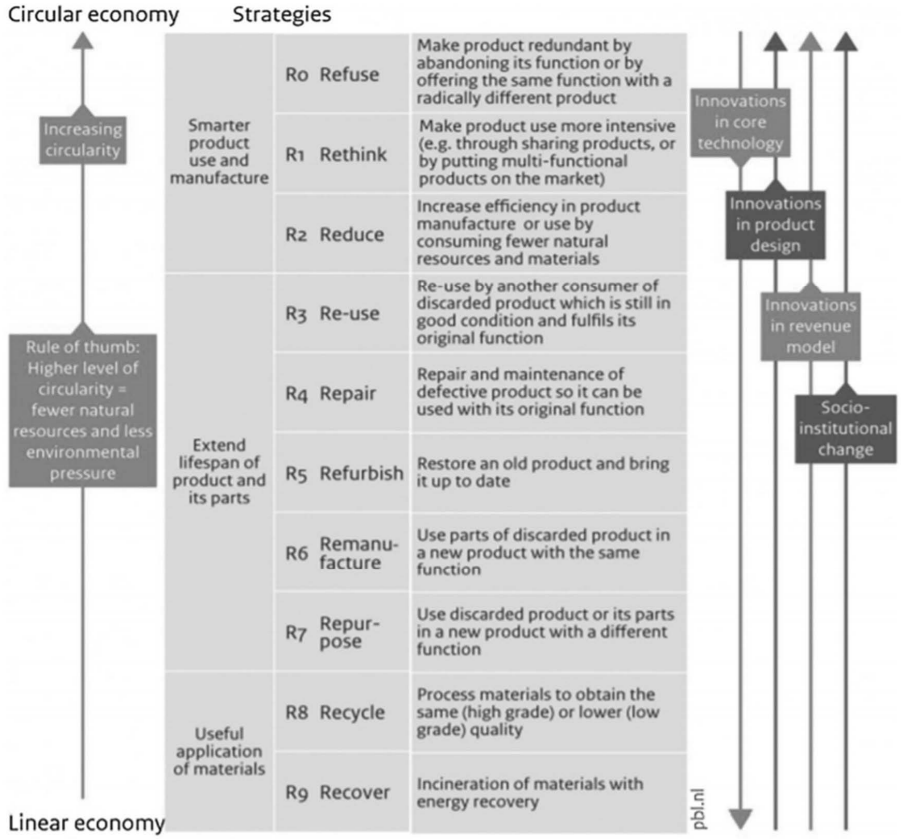

Figure 1. Circularity strategies Employed for Adaptive Reuse of Cultural Heritage Buildings
Source: Foster, 2020.

The circular economy concept was initially based on the 3R principle – reduce, reuse, recycle, but it has since been expanded to 6R – reuse, recycle, redesign, remanufacture, reduce, recover (Jawahir and Bradley, 2016, p. 105). When looking at the circular economy through the perspective of heritage, the principles of restoration and rehabilitation can be used (Fusco and Nocca,

2019, p. 70), which is particularly important for preserving and presenting cultural-historical heritage. Furthermore, according to Foster (2020), when it comes to renovating buildings with a cultural-historical value, other principles may be added: refurbish (modernisation for reuse), repurpose (use components of old products for new purposes) and refuse (no raw materials needed). The authors use the R0-R9 scheme regarding the circular economy and point out that the circular economy's goal is the macro-level transformation to sustainable economy. This goal cannot be achieved unless the micro-level transformation has also been undertaken.

The concept of circular economy is interesting for researchers in all aspects of human activity. However, governments have to adopt policies and laws to fully encompass its elements in as much detail as possible to ensure the sustainability of a location and life in it. The synergy between all stakeholders is paramount for this task, encompassing all levels from local self-government units through ministries and the public sector in general to entrepreneurship and scientific institutions. It is only through joint action based on the circular economy's principles that satisfactory results can be achieved to ensure sustainable development sufficient for current and future generations.

The link between circular economy and sustainable cultural tourism

Cultural tourism is a specific type of tourism that has become more prominent in the tourism market over the last decades. The contemporary tourist has access to various cultural attractions, events, resources at tourist destinations. In contrast, the cultural offer at destinations has become an integral part of all other tourism types. Contemporary tourist destinations aim to present their cultural values and their cultural-historical heritage, thus becoming more recognisable and competitive on the tourism market. Various authors have researched and contributed to defining cultural tourism's complexities, which essentially represents a form of tourism where tourists were spending time at a tourist destination based on culture and art (McKercher, Du Cros, 2002; Pančić Kombol, 2006; Csapo, 2012). Sustainable tourism is exceptionally important for contemporary business on the tourism market. It emphasises a destination's values that must not be lost to the pressures of tourism and how tourists affect the natural and cultural resources. The principles of sustainability refer to the natural, economic and socio-cultural aspects of tourism development. An appropriate balance must be struck between these three dimensions to ensure long-term sustainability

(Jegdić, Škribić, Milošević, 2013). Sustainable tourism planning in a destination is identified as a process in which leading members or groups of the local community see their future and develop the necessary procedures and processes to achieve that future, taking into account internal capabilities on the one hand and external facts other. Tourist destinations develop very different forms of tourism, and each type of tourism aims to achieve sustainability (Butler, 1999; Pforr, 2001), which is particularly true for cultural tourism. The goal is to achieve sustainable cultural tourism, which means ensuring the safety of and improving the value of a destination's resource base serving tourists as contemporary explorers. The European Union defines sustainable cultural tourism as the integrated management of cultural heritage and tourism activities in conjunction with the local community creating social, environmental and economic benefits for all stakeholders, to achieve tangible and intangible cultural heritage conservation and sustainable tourism development. The EU, in its guidelines for sustainable cultural tourism, provides recommendations concerning sustainable cultural tourism to particular stakeholders in tourist destinations (EU members, local governments, tourists, etc.). The importance of heritage was further elevated when the EU named 2018 as the European Year of Cultural Heritage. Sustainable cultural tourism was highlighted as one of ten initiatives for that year (EU, 2019).

Sustainability is paramount when it comes to cultural tourism if it is oriented on cultural-historical heritage and all activities undertaken to preserve and present it appropriately. According to Kožić and Mikulić (2011), the three essential dimensions of sustainability, both economic and tourism, are ecological, social, and economic sustainability. Additionally, sustainable tourism is achieved when all three dimensions are accomplished simultaneously. It means that sustainable tourism cannot degrade the natural and cultural resource base. It cannot be at odds with either the local population or tourists' needs and desires, and it must guarantee a reasonable return on investment. According to the presented definitions, sustainable cultural tourism can be present in all its subtypes whose development includes preserving the local population's cultural-historical values, taking into consideration a tourist destination's cultural and natural values as preserving them for future generations.

Cultural-historical heritage is closely tied to a destination's identity, and managers in tourism aim to use cultural values to further emphasise this integration to create a difference between similar tourist destinations worldwide. Whether cultural tourism, especially cultural tourism focused on heritage, is sustainable and to what degree. Is heritage-based tourism achievable on the principles of linear or circular economy?

To that end, Girard (2017) states that heritage reuse can revitalise the local economy with jobs, new businesses, tax revenues, and local spending; it can provide valuable wildlife habitat and recreational amenities and regenerate values. From the cultural/landscape perspective, adaptive reuse is a way to put the circular economy's principles into practice. Reuse, restoration, rehabilitation, etc., are improved through circular processes. When the principles of circular economy are applied to the restoration and revitalisation of old resources (small historical cities, old buildings, old furniture, etc.), cultural-historical heritage can gain new value and be repurposed for tourism. This facilitates regional development and population satisfaction. The population then has access to both preserved cultural-historical heritage and contemporary values such as employment options, pride concerning traditional values and more. Tu (2020) states that historic buildings' adaptive reuse has become a popular method to reinvigorate culture, manage heritage, and develop tourism. Gravagnuolo, Fusco Girard, Ost and Saleh (2017) state that the adaptive reuse and regeneration of abandoned cultural heritage contributes to a circular urban-territorial economy which extends the life cycle of heritage by giving it new uses as well as contributing to economic development, employment and more. Nedyalkova (2018) points out that local governments can protect their environments through adaptive reuse, as such projects generate much less waste than new construction. Reusing existing buildings saves energy and reduces greenhouse gas emissions by avoiding new construction and diverts demolition waste from landfills.

Taking into consideration the facts presented above and by further contemplating possibilities, sustainable development of cultural tourism becomes achievable by creating different subtypes of cultural tourism (figure 1) such as:

- archaeological tourism (Kececiogli, Dagli, Cengiz, 2018; Afrić Rakitovac, Urošević, Vojnović, 2019),
- heritage tourism (Du Cros, 2001; Foster, 2019; Alazaizeh, 2014),
- creative tourism which is based on creativity included in cultural and creative industries (Rudan, 2012; Korez-Vide, 2013),
- gastronomy tourism which includes using local ingredients to reduce the supply chain (Yurtseven, 2011; Yurtseven, Karakas, 2013),
- rural tourism (Muresan et al., 2016),
- urban tourism (Lerario, Di Turi, 2018) and more.

Elements of sustainable cultural tourism are present in all segments of the offer provided by different tourism types and have taken the forefront in strategic planning of tourist destination development over the recent decades.

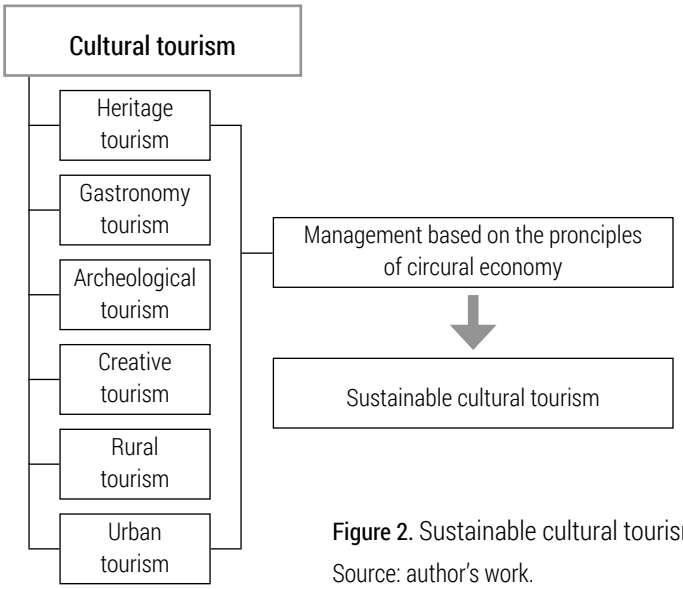

Figure 2. Sustainable cultural tourism
Source: author's work.

The diversity of potential types of cultural tourism based on the principles of circular economy can bring sustainability to tourist destinations in the form of cultural-historical heritage and preserve the area's identity where tourism is in development.

Examples of circular economy in sustainable cultural tourism in Croatia

The circular economy is a model that is being considered in the Croatian economy. However, it has not yet been sufficiently applied in all segments. The model itself is insufficiently represented in papers researching tourism. This lack of research and consideration stems from a host of limitations, particularly due to sustainable tourism development policies not being sufficiently implemented. According to Andabaka (2018), Croatia needs to overcome the limitations rooted in a poorly defined legal framework, lack of policies for promoting circular economy, lack of infrastructure dedicated to increasing the value of secondary materials and reducing landfilling, and a lack of public awareness on the advantages of circular economy and sustainable waste management. The author explores the economy in general and points out the lack of application. This paper may be considered a continuation of that research as it analyses cultural tourism and why the circular economy principles are not more present in Croatia's cultural tourism.

Cultural tourism in Croatia has seen intensive growth and development, especially in the last twenty years since the Strategy of Development of Cultural Tourism (Ministry of Tourism, 2003) and the Action Plan for Cultural Tourism (Tomljenović, 2015) were adopted. With varying success, Croatian tourist destinations have opened and created their cultural-historical values based on their tourism offers, which indicates that cultural attractions and events have become a more prominent reason for tourist arrivals to the country. Based on the TOMAS Institute for Tourism, back in 2001, this motivation was the primary reason for 7.5% of tourists, and it increased to 12.3% in 2017. According to the latest TOMAS research results (2020), in the year 2019, this went up to 13%. When looking at regions, the percentage for Adriatic Croatia is 12.7%, and in Continental Croatia, it is 15.7%. Sea (81%) and nature (56%) are the most important motivations for visiting Adriatic Croatia, and the most important motivations for visiting Continental Croatia are nature (32%), touring (26%), and city break (26%). In 2019 culture polled sixth in both regions, so plans for further development should include sustainability in cultural tourism.

Using the circular economy principles results in many benefits for cultural tourism, primarily through the preservation of a destination's cultural identity. The local population identifies with its environment's traditional values, and sustainable cultural tourism ensured the preservation of identity and pride of one's heritage. Economic benefits pertain to the possibilities opened up to the local population by a "new" cultural attraction in the form of potential employment and improving the regional development of a tourist destination. The circular economy principles also create an environmentally sustainable destination that involves not creating new tourist attractions, but repurposing, refurbishing and restoring a destination's existing resource base instead. According to Korhonen, Honkasalo and Seppala (2018), social goals include sharing economy, increased employment, participatory democratic decision-making, and more efficient use of existing tangible material capacities through cooperative and joint action. Cultural heritage adaptive reuse, which applies the circular economy model operationally (Angrisano et al., 2016), can ensure that cultural heritage continues to "live" for present and future generations by ensuring use-values indefinitely, thus preserving the heritage's intrinsic value. The opposite is also true – abandonment and obsolescence threaten their existence (Nocca, Fusco, 2018, p. 40). Restoring cultural-historical heritage (old buildings, historical towns, industrial complexes) is not just the foundation of how we think about tourism development; it is also something that adds value to the local community and its pride. It is how heritage is protected, how the local community's living space gains quality, how the quality of life increases, and how regional devel-

opment is enabled. According to Hardy et al. (2002), more effort is dedicated to environmental preservation and the economic effects of tourism than to the local community's impact, even though the realisation of sustainable tourism development depends on the same local community. Restoration of old objects for tourism or for personal or community requirements is not just limited to the restoration itself, it is a model that enables reusing cultural-historical heritage on the principles of circular economy striving for sustainable development. Müller's work (1994), back from the very beginnings of sustainable tourism development, is essential in this regard as he observed the balance between key factors of development without domination, as seen in the magic pentagon (figure 3). The magic pentagon can be used to maximise benefits and minimise costs for the local community. It can be applied to a destination's cultural resources when the destination does not adequately manage those resources or simply lacks the interest for reusing them to benefit the local community and the tourist offer.

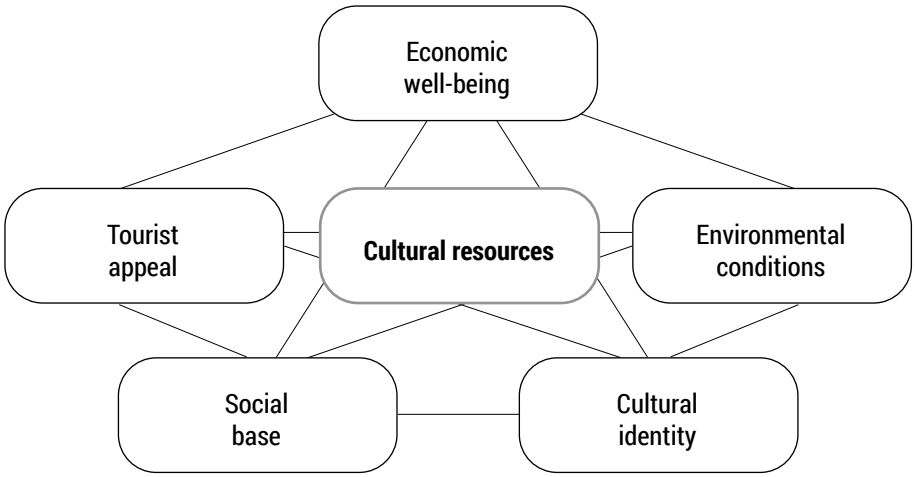

Figure 3. Pentagon of sustainable cultural tourism

Source: author's work based on Müller, 1994.

According to the Croatian Ministry of Culture, old medieval towns (burgs, forts) are particularly at risk, mostly because of their geographical positions, difficult access and lack of documentation in the sense of problematic ownership structures. Built cultural heritage, in general, is exposed to the permanent effects and pressures of modernisation. Valuable built heritage in Croatia is in a bad state due to many factors such as war devastation, neglect and lack of maintenance, lack of funding, unsolved property-legal matters, disregard for legal regulations and lack of penalisation, and insufficient awareness

of the value of heritage. Cultural-historical heritage is often restored by means of construction work done without proper expert verification by conservators. There is no statistical data on how much of the cultural-historical heritage has been restored. Therefore, it is impossible to determine what was achieved to create a cultural tourism offer based on a circular economy. Regardless of this situation, there have been positive examples in Croatia over the recent years, often co-funded through EU projects.

Examples of good practices of applying the concept of circular economy in cultural tourism in Croatia:

a) **Revitalization of St. Michael's Fortress – Šibenik**

A well-known example proving that cultural-historical heritage can be turned towards sustainable development on the principles of circular economy is St. Michael's Fortress in Šibenik. Restoring the fortress provided the City of Šibenik with a new tourist attraction to create innovative cultural-artistic, educational and other contents. During the revitalisation, attention was paid to all details, and the circular economy and sustainability guided them. As a result, all existing spaces have been given a new, more modern purpose, in line with recommendations to ensure sustainable development. The revitalisation of St. Michael's Fortress involved infrastructural work on an area of 2600 m^2 which encompassed the construction and design of a summer stage with room for 1077 visitors and refurbishing the subterranean level of the fortress. The project was funded from European sources and national funding (https://tvrdjava-kulture.hr/).

b) **The Routes of the Frankopans – Primorje-Gorski Kotar County**

Interpretation centres are being opened in castles and buildings around the Primorje-Gorski Kotar County as part of the Routes of the Frankopans project, which is also funded through European projects and national funding. The castles located along this route were in a dilapidated state, neglected and non-functional. With the renovation of the castles, a new tourist product was designed, resting on sustainable foundations. During the renovation, the castles were renovated in accordance with the requirements of monument protection based on a circular economy, i.e. they were restored with the existing materialThe Nova Kraljevica Castle is the first station on a historical and cultural journey that invites visitors to explore the rich material and spiritual heritage of the Frankopans and Zrinskis. The old castle became an interpretation centre for visitors, thus having a new cultural-touristic function (https://frankopani.eu/).

c) **Petrapilosa Castle – Buzet**

Another positive example is the Petrapilosa Castle located near the city of Buzet. The first written sources mention this castle in the X. century. The castle served to guard the entire valley of the Mirna River and central Istria. The medieval castle is situated on a high rock dominating the wider surroundings. For centuries it was an excellent military-defensive position from which any movement in the field or road across the valley was controlled. In recent years it has been much neglected and was in a dilapidated state. In 2019 the castle was completely reconstructed, taking care to restore and preserve its original form. Original materials were used, ensuring the application of the concept of a circular economy. Today, the castle has a new function and is used for cultural tourism events (http://www.buzet.hr/).

d) **The City of Rijeka – European Capital of Culture 2020**

Rijeka – European Capital of Culture 2020 is the most recent and most significant example of Croatia's circular economy. Not all of the programme, especially events, has been run because of the pandemic. However, there are active programmes concerning the adaptive reuse and regeneration of buildings to give them a new purpose. Three industrial heritage buildings in the area of the formed Rikard Benčić industrial complex are being repurposed for culture. They will include the Rijeka City Museum, Rijeka City Library, and the Children's House intended for developing child creativity, the first of its kind in Croatia, and the Museum of Modern and Contemporary Art.

Additionally, the ship Galeb is also being restored and turned into a ship-museum and cultural-tourist attraction in Rijeka. Furthermore, a space called RiHub was furbished in the city centre, serving as the central hub for information about the European Capital of Culture project and as a place for citizens to gather, educate, coworking and creative development. The City of Rijeka and the Port of Rijeka Authority furbished the former space of the Exportdrvo company at Delta, a large building where various programmes can be held. Industrial spaces constructed and active during socials have not been used since they were closed, and they were consequently left unrecognised in terms of culture and tourism. Reusing these former manufacturing facilities like museums, libraries, and more will benefit the local community and the city's tourist offer. Abandoned industrial spaces hold incredible potential for contemporary urban planners as well as creators of cultural development and a destination's tourism products (https://rijeka2020.eu/).

e) **Diffuse Hotels**

When broadly looking at cultural tourism, the new ground can be broken in the sustainability of accommodation capacities by developing diffuse

hotels in historical areas located mainly in Adriatic Croatia. According to the Croatian Ministry of tourism, there were two diffuse hotels in Croatia in 2020, Vela Vrata in Buzet (Istria) and Ražnjevića Dvori in Polača (Dalmatia). Fusco Girard, Nocca and Gravagnuoto (2019) state that a widely spread diffuse hotel is a well-known innovative hospitality concept that can simultaneously generate cultural and ecological benefits. This type of hotel was first mentioned in Croatia in the Regulation about the Classification, Categorization and Special Standards for Hospitality Facilities (2016) as a functional unit comprising three or more buildings and/or parts of buildings integrated into the local community and way of life of a settlement. Each building or part of the building has to have a separate entrance, horizontal and vertical communications. It is a tourist and accommodation facility located in a city's historical centre comprising several nearby buildings that provide hotel services. A diffuse hotel opens up new possibilities within the existing boundaries of small historical cities. Heritage hotels are also counted as hotels in historical buildings, and there is a total of 46 of them. According to the same Regulation, a heritage hotel is a functional unit comprising a part of a building, one or two buildings. These are territory development models that do not further impact the environment as they restore and reuse existing historical buildings without any new construction (Regulation, 2016).

f) **Gastro- and enotourism**

Gastronomy tourism as part of cultural tourism involving traditional values of tourist destinations in Croatia constitutes a significant element of creating recognizability and competitiveness on the tourism market. By using traditional ingredients and recipes and reusing the remains and leftovers in further manufacturing, we create sustainable tourism foundations based on a circular economy. The same can be applied to enotourism, wine production, and wine directly at a tourist destination, for example, by designing wine trails. In addition to wine trails, other agricultural products can impact trails, especially in Istria, Croatia's most famous gastro destination, which includes olive oil trails, Istrian prosciutto trails and trails for other autochthonous foodstuffs. When approaching the creation and promotion of a tourist offer from this angle, it may reduce the length of the supply chain, i.e. food is used at the location where it was produced and frequently so in a traditional manner. Branding and monitoring the production and sales of traditional food ensures recognizability. However, it should be emphasised that the initiative for such an approach to designing and applying the gastro offer needs to stem from the local community. The local community has to head such initiatives. With a rise in global trends towards local food and traditional recipes, such strategies are a welcome addition to every tourist destination attempting to build its specific offer (Moira, Mylonopoulos, Kontoudaki, 2015).

Discussion

Sustainable cultural tourism is based on the principles of the circular economy. Thus, Croatia needs to become faster at adjusting the administrative and regulatory frameworks that shape the base of the initiatives and innovations that entrepreneurs in tourism and hospitality are willing to undertake. Local partnerships are very important for local communities as they enable faster and better access to circular economy concepts focused on sustainable development. The most prominent role here – angry, is played by local (self) governments. They should be the ones who determine whether the area possesses the resource base to reuse resources in accordance with sustainable development and the principles of circular economy (e.g. old medieval towns, forts). A common problem is the complex ownership of particular objects that prevents reconstruction. Regardless, models should be developed through which local governments and self-governments could encourage and facilitate new types of cultural-tourist offers based on reusing cultural-historical heritage.

Furthermore, an important matter to improve is communication with the Ministry departments that have jurisdiction over protecting target objects of cultural-historical heritage. Restored historical heritage opens up new possibilities for the local population as stakeholders of the tourist offer. In addition to cultural tourism being connected to local values and pride of one's traditions in all its subtypes (heritage, gastronomy, creative, rural), it increases employment and the local population's life satisfaction at the destination. It is paramount that all stakeholders involved in developing sustainable cultural tourism act in synergy to achieve sustainable cultural-tourism products. Authors Rodriguez, Florido and Jacob (2020) state that governments, businesses in tourism and individuals need to participate actively and that information campaigns could increase the degree of social awareness among stakeholders in the sector for the transition to a circular economy model.

Tourists are also significant stakeholders in maintaining a tourist destination's sustainability. They have to be aware of the impact they can have on the location, their environmental footprint. They also need to respect the local values of the destination they are staying. They should use local products and services and local creative industries, which enables successful local economic growth.

Conclusions

The circular economy concept aims to achieve sustainability and is becoming more prominent in contemporary destinations worldwide. The goal of all destinations planning future growth is to achieve sustainability in all tourism types they are developing. Cultural tourism, which has become more significant over the last few decades, is no exception. Achieving sustainable cultural tourism based on circular economy principles requires that all stakeholders involved in fulfilling this task act in synergy. The goal is to both empower a destination's values and to preserve them for future generations. Cultural-historical heritage with elements of circular economy has the potential to become a new tourist attraction (adaptive reuse and regeneration), with all stakeholders (local population and tourists) being satisfied with the changes made. Contemporary tourists are explorers searching for a destination's identity, and it is thus necessary to shift destination development towards a circular economy. The authors propose that circular economy becomes as connected as possible to cultural tourism and sustainable development because tourism is an all-encompassing activity with numerous possible approaches and relationships between stakeholders. Optimal use of a destination's resource base, preservation, and revitalisation also ensure the destination's economic sustainability – economic success, employment, local economic development, and more. This paper has some flaws as there was no primary research piece. However, the contribution is based on the analysed examples in Croatia, emphasising Rijeka – European Capital of Culture 2020.

Based on the research and reflection carried out on the development of sustainable cultural tourism on the principles of the circular economy, i.e. the realisation of new cultural tourism that respects the principles of the circular economy, it is necessary to follow the following guidelines:

- research of the cultural and historical heritage that the tourist destination possesses, because only based on a sufficiently researched heritage can an enhancement of the tourist product be created – this process must involve the local administration (municipalities, cities), nature conservation departments, the Ministry of Culture; in this part of Croatia there is a problem of ownership structure, which is often an obstacle in initiating such project ideas,
- if the value of cultural and historical heritage is known, it is necessary to educate, i.e. make known, the destination management, local population and entrepreneurs about the values that exist in the destination,
- cultural and historical heritage must be adequately protected and adequately restored in accordance with the principles of the profession concerned with the protection of cultural and historical heritage,

- a substantially new way of using the restored heritage should be considered by all tourism destination stakeholders (local people, businesses, local governments, tourist boards, associations, etc.); this step will establish the principles of the circular economy, which must involve all destination stakeholders, improve the quality of life in a tourism destination.

Moreover, the authors propose that further research be conducted on stakeholder attitudes, stakeholders including destination managers, local governments and self-government, and the local population, on the importance of implementing circular economy principles in contemporary cultural tourism. Research should be conducted through guided focus groups that include people who have their interests and their views about the future functionality of a particular cultural and historical heritage in a tourist destination. The conclusion is that it is only through joint action by all stakeholders that sustainable tourism can be achieved and, consequently, increase the quality of life in cities and tourist destinations.

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The contribution of the authors

All authors participated equally in conception, development, literature review, data acquisition, analysis and interpretation of data.

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DISCUSSION AND REVIEWS

RECENZJE OMÓWIENIA, PRZEGLĄDY

Eugeniusz KOŚMICKI

The review of the book CONTEMPORARY GARDENING LEXICON OF DECORATIVE PLANTS – KNOWLEDGE FOR SPECIALISTS AND PLANT AND GARDEN AFICIONADOS

Didier Willery, **Was wächst wo? 1900 Gartenpflanzen für jeden Standort**, (What grows where? 1,900 species of horticultural plants for each position in the garden), Aus dem Französischen von Sabine Hesemann, ISBN 978-3-8186-0551-3, Stuttgart (Hohenheim) 2018, Eugen Ulmer KG, www.ulmer.de

Didier Willery is a well-known horticultural expert, recognized not only in France but also across Europe. Many of his critically acclaimed books have been translated into German. The book that is subject to this analysis was originally published in French by the French branch of a German publishing house, Eugen Ulmer KG, seated in the capital of France. D. Willery's book serves as a modern gardening lexicon intended both for a wide group of decorative plants' and gardens' aficionados but is also very useful for gardening specialists. It contains a detailed description of more than 3,000 species and varieties of trees, shrubs, perennials, vines, bulbous plants, annual and biennial plants. The aim of D. Willery's book is to indicate plants that have adapted to the conditions present in specific gardens, following the popular saying: "the right plant in the right place." The book's main feature is the division of plants according to the flowering calendar, the color of their flowers, as well as fragrances, properties of leaves, fruit and bark, plant growth and size, and finally, the specific use of those plants in decorative horticulture.

Didier Willery's work is truly extensive, as it covers 384 pages. It consists of an introduction ("The right plant in the right place", pp. 7-13), five basic chapters and an ending consisting of an "Index" and "Acknowledgements". It is worthwhile to mention the titles of the chapters included in the basic part: "Flower Calendar" (pp. 14-78); "Colors of flowers and their scent" (pp. 80-163); "Leaves, fruits, bark" (pp. 164-269);

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"Plant growth and size" (pp. 270-297); "Sites of plants and their special use" (pp. 298-373), as well as "Index" (pp. 374-381) and "Acknowledgments" (pp. 382). In the introduction, D. Willery points out that the gardening lexicon that is subject to this review was an attempt to summarize the past thirty years of his work. Additionally, frost-resistant species (ones that tolerate temperatures below -10˚C) were indicated. However, plants that are less frost-resistant and therefore less appropriate for German climate (and even less so in the Polish climate) are marked with an appropriate symbol (a caron with an asterisk). The author points out that the lexicon has a very limited selection of roses, daylilies, peonies and iris varieties.

Annual flower calendar

Various trees, shrubs, vines, perennials, bulbous plants, and annual and biennial plants blossom throughout the year. The following seasons can be easily distinguished: January to mid-February; mid-February to the end of March; late March to early May; May and early June; mid-June to the end of July; August to mid-September; September and October; November and December. This analysis is concluded with a table devoted to long- (lasting) flowering plants. From January to mid-February, relatively few woody plants (heather, witch-hazel), perennials or bulbous plants (crocuses, common snowdrop) blossom. Many more plants bloom from mid-February to the end of March. Camellias (unfortunately not particularly frost-resistant in Central European conditions), cornelian cherry, mezereum, early flowering ornamental cherries, many spring perennials (pennywort, pulmonaria, common violet), as well as many small bulbous plants and narcissuses also blossom at that time.

From late March to early April, many trees and shrubs are already in bloom. This applies to Norway maple (*Acer platanoides*), shadbush, magnolia, Japanese flowering cherries, flowering quince, tree peonies, fragrant viburnum. Climbing plants also bloom during this period: clematis, wisteria, as well as perennials: bergenias, forget-me-nots, many primroses, spurgeons, as well as plants. In the period from May to early June, a significant number of plants are in full bloom. This applies to trees (chestnut trees, redbuds, dogwoods, hawthorns, ornamental apple trees, robins), shrubs: sweetshrubs (*Calycanthus*), deutzias (*Deutzia*), common lilacs, rhododendrons and azaleas, viburnum (*Viburnum*), weigelas (*Weigela*), perennials (great masterworts, bellflowers, knapweeds, bleeding hearts, crane's-bills, iris, catnip, peonies), numerous bulbous plants and annual and biennial plants.

The period from mid-June to the end of July is considered to be the summer period. Relatively few trees blossom at that time, although many species of shrubs (shrub chestnuts, summer lilacs, smoke trees, hydrangeas) and climbing plants. This is when perennials typically blossom: bear's breeches, yarrow, lilies of the Nile, false spireas, larkspurs, daylilies, pincushions, speedwells (*Veronica and Veronicastrum*), as well as galtonia and many species of lilies. Relatively few trees and shrubs blossom from August to mid-September. That being said, this is the period of mass flowering of Japanese thimbleweed, coneflower (*Echinacea*), echinops, sneezeweeds (*Helenium*),

sunflowers (*Helianthus*) and sunshinee (*Heliopsis*), beebalms (*Monarda*), garden phloxes, knotweeds, coneflowers, goldenrods. Flowering annual and biennial plants are also characteristic.

September and October periods include relatively few flowering trees and shrubs, but still contains numerous perennials. Many species of asters, stonecrops, many interesting prairie perennials and bulbous plants should be mentioned here. In November and December, only a few trees, shrubs and vines bloom.

The colour of flowers and their scent

The next chapter is devoted to the flowers' colours and their scent. The chapter ends with the tables of "Underestimated Sources of Pollen" (p. 160), as well as "Edible Flowers" (p. 162). D. Willery discusses the colours of flowers on trees, shrubs, vines, perennials, bulbous plants and annual and biennial plants. The following flower colors are mentioned: "white flowers"; "green flowers"; "pale yellow flowers"; "yellow flowers"; "orange-colored flowers"; "red flowers"; "purple flowers and »black«"; 'pink-tinged and bright red flowers '; ' mallow-tinged flowers'; "pink flowers"; "fragrant flowers".

White colours are known among numerous flowers of trees, shrubs, vines, perennials, bulbous plants, as well as annual and biennial plants. These include, among others, such trees as dove tree (*Davidia involucrata*), the little known Wilson's chestnut, many species and varieties of magnolia, numerous fruit trees, as well as shrubs: shadbush (*Amelanchier*), common lilacs, hydrangeas and white-flowering variants of many varieties of perennial and bulbous plants. Green flowers are much less known, including Norway maple, lady's mantles, spurge and Corsican hellebore (*Helleborus argutifolius*). Light yellow and yellow flowers are well known. We should mention here the selected varieties of magnolia, the *Paeonia lutea* peony, the one variety of the common lilac (*Syringa vulgaris* 'Primrose'), golden chain tree *Laburnum x watereri* 'Vosii', Japanese kerria (*Kerria japonica*); numerous perennials: leopard's-banes, trollius, tickseed (*Coreopsis*), perennial sunflowers and sunflowers, many species of goldenrod. Yellow bulbous plants are also characteristic, as are numerous annual and biennial plants.

Orange-colored flowers are relatively rare among trees and shrubs (i.e. barberries, shrubby cinquefoils). However, they are more common among perennials, which blossom, especially in the summer. This applies, inter alia, to butterfly weed (*Asclepias tuberosa*), many varieties of daylilies, torch lilies (*Kniphofia*), chrysanths, as well as bulbous plants and annual plants.

Red, purple and "black", as well as purple and blue colors are also highly valued in decorative gardens. Beautiful red flowers are relatively rare among trees and shrubs, but numerous among perennials and bulbous plants. Purple and "black" flowers, seen primarily among varieties of roses, perennials and bulbous plants, can make a lasting impression. This also applies to purple and blue flowers. These plants are often sought after by garden and plant aficionados. Fragrant plants are especially appreciated in gardens. A number of trees (including magnolias, lindens), shrubs and perennials should be mentioned here.

Characteristics of leaves, fruits and bark

The chapter devoted to leaves, fruit, and bark is relatively extensive, as there are a plethora of various forms present in this area. When it comes to leaves, we can distinguish the unusual always-green colour; large leaves, cut and feathered leaves; blue leaves; silvery leaves; white-edged leaves; white and marbled leaves; gold-tinged leaves; yellow marbled leaves; brown and copper coloured leaves; purple leaves; black leaves; pink-tinged and pink-framed leaves. Particularly interesting for gardeners are coloured autumn leaves (colours: yellow, orange, red, pink), as well as leaves are sprouting in spring and fragrant leaves. Many trees and shrubs, as well as perennials, also have edible leaves, among others beech and birch.

Decorative fruit also deserves gardeners' attention: white and pink; yellow and orange-tinged; red; blue and black; dried fruit on plants. The table presents decorative and edible fruit (p. 254). Bark also has decorative value in gardens and parks; we distinguish white and yellow bark; orange and red bark; purple and black bark; green and brindle bark (with black stripes); cinnamon-colored and marbled bark, but also adorned with beautiful thorns, spikes or cork and, finally, trees and shrubs with twisted branches.

The beautiful, evergreen colour of the leaves is seen, among others, on southern magnolia, loquat (*Eriobatrya japonica*), numerous conifers, perennials and bulbous plants. On the other hand, many trees have large leaves (including azaleas, catalpas, some magnolias), similar to many shade-loving perennials growing by the water (including rodgersia, plantain lilies, rhubarb). Much appreciated in decorative gardens are also blue and silvery leaves (including conifers, plantain lilies, grasses, silverberries), seen among numerous species and varieties of mugwort, as well as caucasian forget-me-not, and variants of lungwort. Gardens also frequently contain gold-coloured plants (with the adjective 'Aurea'), as well as gold-edged ones. Plants with purple and black leaves can also look beautiful. Many such species and varieties of plants, including Catalpas *Catalpa x erubescens* 'Purpurea', common beech *Fagus sylvatica*, Purpurea group, wild elderberry *Sambucus nigra* 'Thundercloud', as well as numerous perennials. Fragrant leaves are common among shrubs and prostrate shrubs, especially spicy ones, of Mediterranean origin. Fragrant grasses are also known.

Plant height and size

The height and size of cultivated plants can also vary greatly. These are--according to the author--erect, bar (columnar), superficial; inherently round; creeping; wide and bunk; dangling (crying); umbrella-shaped, rosettes; stolon plants. This chapter lists plants by their size: 0-5 cm; 5-25 cm; 25-30 cm; 50-100 cm; 1-1.5 m; 1.5-2 m, 2-4 m, 4-7 m, 7-25 m and more than 25 m. *Catalpa bignonioides* 'Nana', viburnum *Viburnum opulus* 'Compactum' and several conifers marked with the 'Globosa' adjective, including plants with hanging (weeping) branches known as 'Pendula', are also admired. Many perennials have beautiful rosettes as well as stolons that can be truly expansive.

Plant sites and their specific application

Multiple sites with a variety of plants and particular uses are present in gardens. The following sites can be listed here: coasts; undercoat and shade; windy position; good garden soil; acidic soils; limestone-containing soils; permeable soils; clay soils; permanently moist soils; aquatic plants and mud plants; soil-fertilizing plants; potted plants, containers and patios; hedges; ground cover plants. Many trees, shrubs and perennials typically grow at seasides. Those plants are characterized by a high tolerance of soil salinity (they are also often called "maritima"). There are also many plants known as undergrowth and occupying shaded positions. A number of trees and shrubs can be mentioned here, but, most of all, perennials (including lily-of-the-valley, crane's-bill, plantain lilies, foamflowers, periwinkles) and some bulbous plants should be included in this category. The so-called moving shadow present near houses and walls (p. 310) is a separate phenomenon. Additionally, in areas with high-quality garden soil, several bedding plants can grow well.

The following sites can also be distinguished in gardens: acidic soils; soils containing much calcium; permeable soils; clay soils; permanently moist soils. On acidic soils, Japanese maple, various types of andromedas, rhododendrons, numerous perennials and bulbous plants can grow. Other plants grow in soils containing limestone, e.g. field maple, sycamore maple, numerous species of conifers and deciduous shrubs, and perennials bulbous plants. Numerous plants of Mediterranean origin, conifers, perennials, and annual and biennial plants grow well on permeable soils. Clay soils are a good site for numerous deciduous trees and shrubs, conifers, numerous species of perennials and bulbous plants. Permanently moist soils exhibit a completely different flora. These include maple (*Acer negundo*), alder (*Alnus glutinosa*), black birch (*Betula nigra*), conifers (*Metasequioia glyptostroboides, Taxodium distichum*), numerous species of perennials and bulbous plants. Plants appropriate for hedges are also in high demand (field maple, European hornbeam, common beech, English yew, thujas) and cover plants (numerous shrubs and perennials).

* * *

Didier Willery developed an excellent gardening lexicon, clearly up to European standards. It can also be very useful in Poland. The author marked plants that are not frost-resistant in typical conditions of Central and Eastern Europe. It allows the reader to get to know the rich world of decorative plants quickly. The plant species are conveniently divided according to: the flowering calendar; flower colours and their scents; properties of leaves, fruit and bark; plant growth and size; sites occupied and their use in gardening. This publication is useful for gardeners, including specialists and dendrologists, and for a wide group of plant and garden aficionados.

Prof. **Eugeniusz Kośmicki**
University of Life Sciences in Poznań

SUMMARIES IN POLISH

STRESZCZENIA POLSKOJĘZYCZNE

Rambabu LAVURI, Eddy JUSUF, Ardi GUNARDI

ZRÓWNOWAŻONY ROZWÓJ EKOLOGICZNY: CZYNNIKI SPRZYJAJĄCE I RÓŻNICE W ZACHOWANIU POMIĘDZY POKOLENIEM MILLENIJNYM I GENERACJĄ Z: POŚREDNICZĄCA ROLA ZAMIARU ZAKUPU PRODUKTÓW EKOLOGICZNYCH

STRESZCZENIE: Praca przedstawia czynniki, które promują zakupy ekologiczne i pozwalają zrozumieć różnice między dwoma pokoleniami: „millenialsów" i pokolenia Z w badanym aspekcie. W pracy wykorzystano dane zebrane od 372 respondentów reprezentujących dwa pokolenia pochodzące z trzech południowych stanów Indii. Dane analizowano za pomocą pakietu IBM SPSS 23.0, przy użyciu analizy czynnikowej, korelacji Pearsona, regresji wielorakiej i testu t. Subiektywne normy (SN) nie miały istotnego związku z intencjami zakupów zielonych (GPI). Zmienne, takie jak ekspozycja na media (ME), troska o środowisko (EC), wiedza o środowisku (EK) i nastawienie (EA), postrzegana kontrola behawioralna (PBC) miały znaczący wpływ na GPI. Zamiary kupujących znacząco wpłynęły na ich zachowania zakupowe dotyczące produktów ekologicznych, a wyniki te zostały potwierdzone przez model TPB. Zmienne ME, SN i PBC nie wykazały żadnych różnic behawioralnych pomiędzy dwoma pokoleniami. Mimo to zmienne, takie jak EK, EC, EA i GPI wykazały różnicę w zachowaniu przy zakupie produktów ekologicznych.

SŁOWA KLUCZOWE: wiedza o środowisku, postrzegane zachowanie, troska o środowisko, pokolenie Z, pokolenie milenijne, normy subiektywne

Agnieszka BARAN

ZRÓWNOWAŻONE INNOWACJE – WYBRANE ASPEKTY

STRESZCZENIE: Celem artykułu jest analiza stanu wiedzy w zakresie zrównoważonych innowacji w Polsce oraz identyfikacja barier dla ich rozwoju. W artykule opisano główne bariery w zakresie wdrażania zrównoważonych innowacji oraz związane z tym zagadnienia problematyczne. Ekoinnowacje mogą ułatwić europejskim przedsiębiorcom opracowywanie zrównoważonych rozwiązań, umożliwiających lepsze wykorzystanie cennych zasobów i zmniejszenie negatywnego wpływu gospodarki na środowisko. Świadomość korzyści, jakie przynoszą technologie środowiskowe, jest nadal niska. Wdrażanie innowacji środowiskowych wymaga strategicznego podejścia, a wprowadzenie ich do istniejących struktur przedsiębiorstwa jest trudne i czasochłonne. Współczesne wyzwania, takie jak zmiany klimatyczne i wyczerpywanie się zasobów naturalnych, wymagają nowych rozwiązań. Nowoczesne gospodarki opierają się na wartościach niematerialnych chronionych prawami własności intelektualnej, a zarządzanie własnością intelektualną jest obecnie integralną częścią każdej skutecznej strategii biznesowej.

SŁOWA KLUCZOWE: zrównoważone innowacje, innowacje, ekorozwój, ochrona własności intelektualnej

Justyna GODAWSKA

RESTRYKCYJNOŚĆ POLITYKI ŚRODOWISKOWEJ I JEJ WPŁYW NA ZANIECZYSZCZENIE POWIETRZA W POLSCE

STRESZCZENIE: Celem artykułu jest ocena stopnia restrykcyjności polityki środowiskowej w Polsce na tle wybranych krajów UE oraz jego wpływu na emisje SO_2, NOx, lotnych związków organicznych, CO_2 i gazów cieplarnianych oraz przedwczesną śmiertelność z powodu narażenia na PM2.5. W badaniach opartych na danych OECD i Eurostatu wykorzystano analizę regresji wielorakiej. Wyniki analizy regresji nie pozwalają na wyciągnięcie jednoznacznych wniosków. Użycie jednej z wybranych miar restrykcyjności polityki środowiskowej potwierdza wpływ tej restrykcyjności na wszystkie badane zmienne charakteryzujące zanieczyszczenie powietrza, natomiast w przypadku drugiej miary zależność tę stwierdzono tylko dla dwóch zmiennych. Przyczyną odmiennych wyników może być przyjęcie różnych okresów badawczych (1990-2012 i 1994-2018) wynikające z dostępności danych.

SŁOWA KLUCZOWE: polityka środowiskowa, zanieczyszczenie powietrza, podatki środowiskowe, wydatki na ochronę środowiska

Milad ZARGARTALEBI

ZRÓWNOWAŻONY ROZWÓJ JAKO CZYNNIK KONKURENCYJNOŚCI: ILOŚCIOWA ANALIZA MIĘDZYKRAJOWA

STRESZCZENIE: Stwierdzenie, że zrównoważony rozwój stanowi istotną przewagę konkurencyjną, jest powszechną tezą obecną w polityce i niektórych obszarach badań naukowych. W ciągu ostatnich kilku dekad udostępniono coraz więcej rozproszonych danych „twardych" i „miękkich", wskazujących więcej szczegółów nie tylko na temat wyników gospodarczych krajów, ale także na temat ich wyników w zakresie zrównoważonego rozwoju. Celem badania jest sprawdzenie, czy istnieje związek między wynikami w zakresie zrównoważonego rozwoju a konkurencyjnością kraju poprzez analizę wskaźników ekonomicznych, środowiskowych i społecznych z czterech źródeł danych, w tym danych ekonomicznych i danych dotyczących zrównoważonego rozwoju z krajów G-20 w okresie od 2010 do 2019 roku, reprezentujących 73% globalnego PKB w 2020 roku. Badanie opiera się na kilku analizach regresji wykonanych w celu analizy zbioru danych, która prowadzi do wniosku, że wpływ wyników zrównoważonego rozwoju na konkurencyjność jest trudny do potwierdzenia lub odrzucenia, w przeciwieństwie do klasycznych predyktorów ekonomicznych.

SŁOWA KLUCZOWE: zrównoważony rozwój, konkurencyjność, wzrost PKB, HDI, zanieczyszczenie powietrza

Martin ROVNAK, Lenka STOFEJOVA, Peter ADAMISIN, Matus BAKON

ŚRODOWISKOWE ASPEKTY ZACHOWAŃ ZAKUPOWYCH KONSUMENTÓW W SKLEPACH BEZ OPAKOWAŃ

STRESZCZENIE: Jednym z problemów środowiskowych jest obciążenie spowodowane nadmierną produkcją odpadów. Sposobem na częściowe wyeliminowanie tego problemu są sklepy bez opakowań. W artykule skupiono się na analizie zachowań proekologicznych poszczególnych generacji konsumentów dokonujących zakupów w sklepach bez opakowań. Źródłem pozyskania danych były badania ankietowe. W analizie zastosowano metodę statystyki opisowej oraz metody matematyczno-statystyczne (test Shapiro-Wilka, test Kruskala Wallisa, test Wilcoxona) w celu weryfikacji różnic między grupami pokoleniowymi konsumentów oraz ich świadomości na temat sklepów bez opakowań. Kolejnymi weryfikowanymi zmiennymi były płeć respondentów oraz ich doświadczenie z zakupami w sklepie bez opakowań. Wyniki badań potwierdziły, że sklepy bez opakowań powinny skoncentrować swoje działania marketingowe na konsumentach wszystkich pokoleń i skupić się na znalezieniu odpowiednich sposobów na zwiększenie poziomu zainteresowania wszystkich grup wiekowych.

SŁOWA KLUCZOWE: zarządzanie środowiskiem, sklepy bez opakowań, pokolenia konsumentów

Jolanta PAKULSKA

EMISJA GŁÓWNYCH ZANIECZYSZCZEŃ POWIETRZA JAKO WSKAŹNIK JAKOŚCI ŻYCIA W POLSCE W LATACH 1990-2017

STRESZCZENIE: We współczesnych rozważaniach na temat jakości życia, jakość powietrza, którym oddycha człowiek odgrywa bardzo ważną rolę. Nie podlega dyskusji, że w Polsce okres od roku 1990 to czas nadrabiania wieloletnich zaniedbań dotyczących środowiska przyrodniczego. Celem podjętego badania było sprawdzenie czy podjęte działania służące zmniejszeniu emisji zanieczyszczeń do powietrza atmosferycznego były skuteczne i na ile udało się poprawić jego stan i podnieść środowiskową jakość życia społeczeństwa polskiego w tym zakresie. Dla realizacji założonego celu użyto wskaźnika emisji głównych zanieczyszczeń powietrza (do tej grupy zaliczany jest: dwutlenek siarki, tlenek azotu, tlenek i dwutlenek węgla, niemetalowe lotne związki organiczna, amoniak oraz pyły). Wykorzystując dane statystyczne dostępne w rocznikach Ochrona Środowiska przeprowadzono analizę zmian emisji tych związków. W opracowaniu wykorzystano metodę opisową, statystyczną i analityczną. Wykazano, że w analizowanym okresie w większości przypadków znacznie zmniejszyła się emisja głównych zanieczyszczeń powietrza, co bez wątpienia przyczyniło się do poprawy środowiskowej jakości życia.

SŁOWA KLUCZOWE: emisja głównych zanieczyszczeń powietrza; jakość życia, ekonomia dobrobytu

Elena RUDAN, Marinela Krstinić NIŽIĆ, Zvonimira Šverko GRDIĆ

WPŁYW GOSPODARKI O OBIEGU ZAMIKNIĘTYM NA ZRÓWNOWAŻONY ROZWÓJ TURYSTYKI KULTUROWEJ (CHORWACJA)

STRESZCZENIE: Gospodarka o obiegu zamkniętym to koncepcja rozwojowa promowana przez Unię Europejską i stosowana w praktyce przez jej kraje członkowskie. Najczęściej pojęcie gospodarki o obiegu zamkniętym dotyczy przemysłu i procesów z nim związanych. W ostatnich latach zaobserwowano zastosowanie zasad gospodarki o obiegu zamkniętym również w turystyce, zarówno w branży hotelarskiej, jak i we wszystkich rodzajach turystyki. W artykule skupiono się na zagadnieniu zrównoważonej turystyki kulturowej z naciskiem na wspieranie ochrony i/lub ponownego wykorzystania dziedzictwa, gdzie cały cykl opiera się na zasadach gospodarki o obiegu zamkniętym. Zrównoważona turystyka kulturowa powinna opierać się na zasadach gospodarki cyrkulacyjnej wszędzie tam, gdzie ma to zastosowanie (turystyka dziedzictwa kulturowego, gastronomia, turystyka miejska itp.) W niniejszym artykule przedmiot badań stanowiły miasta w Chorwacji, które stosują gospodarkę o obiegu zamkniętym w zrównoważonej turystyce kulturowej. Naukowy wkład tego artykułu polega na zaproponowaniu wytycznych do podjęcia dalszych działań mających na celu stworzenie „nowej" turystyki kulturowej poprzez przyjęcie zasad gospodarki o obiegu zamkniętym.

SŁOWA KLUCZOWE: turystyka kulturowa, gospodarka o obiegu zamkniętym, zrównoważony rozwój, lokalny rozwój gospodarczy

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