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FINANCIAL INVOLVEMENT OF LOCAL GOVERNMENT UNITS IN ACHIEVING ENVIRONMENTAL OBJECTIVES OF SUSTAINABLE DEVELOPMENT IN POLAND

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ABSTRACT: Poland's achievement of sustainable development goals, including environmental goals, requires substantial financial outlays and the necessity of incurring high expenditures by, among others, local government units (LGU). The article focuses on green investment expenditures incurred by LGU budgets. The aim is to identify and diagnose the spatial variation of these expenditures in the context of sustainable development goals and the new taxonomy for classifying economic activities as environmentally sustainable. The added value of the article is: first, to identify the structure of green investment expenditures of LGU according to the new EU taxonomy, which enables it to show their changes in the context of sustainable development goals, and second, to conduct a comprehensive comparative analysis of these expenditures, including all cities with county rights and municipalities, divided into urban, rural and urban-rural types in Poland into three periods: 2004-2006, 2007-2013 and 2014-2020. The study, carried out using the TOPSIS method, showed a wide variation in the level of green investment expenditures made from the budgets of local government units.

KEYWORDS: environmental goals of sustainable development, sustainable and green finance, green investment expenditures, local finance, TOPSIS method

Introduction

Poland, as a member of the EU, is obliged, among other things, to achieve the EU's sustainable development goals, including environmental goals, among which the climate and energy goals are a priority. These goals are contained in the most important EU strategic documents in force during Poland's membership in the Community, including the Lisbon Strategy (2000-2010) and Europe 2020 Strategy (2011-2020). Over time, the climate/energy goals have evolved and grown in importance in the fight against climate change and environmental degradation. On 12 December 2019, the European Council endorsed the goal of achieving climate neutrality for the Union by 2050 (Resolution, 2021a; Resolution, 2021b) in line with the goals of the Paris Agreement adopted under the United Nations Framework Convention on Climate Change (United Nations, 2015; Resolution, 2021a; Resolution, 2021b; Regulation, 2021a; Regulation, 2021b). All economic actors, including LGUs, are involved in meeting environmental obligations and financing their implementation.

The need to finance sustainable and green development by encouraging rapid financial innovation has been emphasised by the World Bank and International Monetary Fund (United Nations, 2019) and the European Commission (e.g., Resolution, 2021a; European Commission, 2019; European Commission, 2020; Regulation, 2020; Regulation, 2021a). In doing so, they have increased the unquestionable role of sustainable and green finance in achieving the Sustainable Development Goals. Shifting the entire economy to climate-neutral and implementing the Green Deal requires significant changes in the way all economic actors, including government entities at all levels of government, operate, make decisions and finance (Klub Odpowiedzialnych Finansów, 2020; PRI, 2017). According to Sachs et al. (2019a), with the worsening negative impacts of climate change and the low rate of investment to mitigate them, local government units (LGUs), like the financial sector, will be obliged to adopt an environmentally sustainable long-term investment concept. It will become important to structure and allocate the capital held to support investments to achieve EU environmental targets.

In the context of the above, sustainable and green finance can provide a kind of 'link' between the environmental industry and the public and financial sectors (Al-Sheryani & Nobanee, 2020; Niyazbekova et al., 2021). They can initiate decisions on investments and directions for the reallocation of financial resources from environmentally harmful to green/environmentally friendly (Wang et al., 2021). This is supported by, among others, studies of financial systems in Brazil, Canada and the US (Batrancea et al., 2020), which have demonstrated the need to 'green' the financial system. This is impor-

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tant, both for the commercial sector and for governments and local authorities of countries/regions pursuing climate-energy goals. Adopted climate-energy policies can be implemented in the form of financial flows to key areas related to environmental sustainability. Similar conclusions have been reached by, among others, Wang et al. (2019) and Mohammad & Kaushal (2018).

Given the critical role of sustainable and green finances in achieving environmental goals, this paper focuses on green investment expenditures made from local government budgets. To date, only Budzeń and Marchewka-Bartkowiak (2022a) have investigated green expenditures made as part of the budgets of local government units in Poland. Therefore, the research in this paper will be based on their concept, which was first presented in a report titled "Green Finance in Poland 2022" (2022a). By transposing the current budget classification (Regulation, 2010) to the regulations governing the European Taxonomy (Regulation, 2020), they estimated green investment expenditures of LGUs in 2010-2021. The relevance of the choice of their concept as the basis for the study may be indicated by its application by Bank Gospodarstwa Krajowego in its report titled "Sustainable Development against the background of investment challenges and the financial situation of Polish local governments" (2022). Therefore, the use of the proposed method for this research is justified, as it allows for an in-depth analysis of environmental expenditure.

To date, we do not know of other studies; moreover, Budzeń and Marchewka-Bartkowiak (2022a) did not analyse the structure of such spending in detail. Thus, a research gap arose, which the authors of this study decided to fill. Hence, the article aims to identify and diagnose the spatial variation of green investment expenditures in the context of sustainable development goals. The added value of the article is, firstly – to identify the structure of green investment expenditures of LGUs according to the new EU taxonomy, which enables us to show the directions of their changes in the context of sustainable development goals. Secondly – to conduct a comprehensive comparative analysis of these expenditures in three periods: 2004-2006, 2007-2013 and 2014-2020, corresponding to three EU funding perspectives. In the latter case, special attention was paid to the last research interval, characterised by significant changes from previous intervals. Although in the adopted research period, the taxonomy was not yet in force, TSUs had to participate in the achievement of environmental goals set by the EU – they incurred expenses for them. For this reason, it was assumed that a multifaceted and multi-criteria analysis of these expenditures would provide an opportunity to assess commitment to environmental goals by LGUs. In addition, the article attempts to answer 5 research questions:

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- Are there significant differences among LGUs in the level of green investment expenditures per capita?
- What are the differences in the total and per capita size and structure of LGU's green investment expenditures?
- Does the formation of green investment expenditures of LGU reflect the commitment to the EU environmental goals of sustainable development?
- Which LGUs have been most committed to achieving the environmental goals of sustainable development?
- Which LGUs should make changes in green spending to intensify the achievement of sustainable development environmental goals?

The article consists of the following sections: the review of literature, which synthesises the relationship between sustainable finance, green, and green investment expenditures and the new taxonomy; research methods, the results of the research, the discussion and conclusions.

An overview of the literature

The observed adverse climate change and many other negative effects of pollution/destruction of the environment have contributed to broader dissemination and efforts to implement the concept of sustainable development. The representatives of public authorities and institutions at all levels of government increasingly recognise the benefits and sources of long-term development based on the principles and goals characteristic of sustainable development, including environmental development. Achieving these goals requires increasing financial resources and the need for huge expenditures, both in the private and public sectors (Alińska et al., 2018; Dasgupta et al., 2019; Park & Kim, 2020). It has generated the need for significant changes in the way we operate, make decisions and propose solutions based on sustainable finance (Muktadir-Al-Mukit & Hossain, 2020; Zorlu, 2018).

Sustainable finance can be considered from three perspectives –a narrow, an intermediate and a broad one. In narrow terms, it is the process of considering environmental, social and corporate governance (ESG) aspects when making investment and financing decisions (Schoenmaker, 2017; Schoenmaker, 2018; Breuer et al., 2018; Schoormann et al., 2016; Geissdoerfer et al., 2018; Ludeke-Freund et al., 2018; Kryk, 2021). According to the intermediate view, it encompasses various types of financial instruments, programs and activities which, in their assumptions considerer not only the economic benefits but also the social and environmental aspects of the phenomenon, including ESG risks (Lokuwaduge & Heenetigala, 2017; Muñoz-Torres et al., 2018; Folque et al., 2021; Mezzanotte, 2020; Sciarelli et al., 2021; Ding et al., 2022; He et al., 2019; Liobikienė et al., 2019; Rinscheid et al., 2021;

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European Commission, 2023a; Al-Alawi et al., 2020; Kryk, 2003; Rybak et al., 2022; Filipiak & Wyszkowska, 2022).

In broad terms, sustainable finance is a stable financial system that addresses educational, economic, social, and environmental issues in the long term (European Commission, 2018). Forms of environmental degradation correspond with subcategories of sustainable finance, thus becoming part of the definition of the sub discipline of sustainable finance (Zioło et al., 2019), which serves the environmental goals of sustainable development.

The relationship between sustainable finance, sustainable development and Sustainable Development Goals has been analysed by Schoenmaker (2017), Zioło et al. (2021), Zioło et al. (2022), United Nations (2019a, 2019b, 2019c), Pisano et al. (2012), Ferreira et al. (2016), Aspinall et al. (2018), Gambetta et al. (2019).

The global financial crisis of 2008-2012, which shook the foundations of the international financial system, has triggered an evolution in conventional and sustainable finance (regardless of the framing) towards an exclusive focus of profits on a specific goal (Morano et al., 2020). As a result, global attention has focused mainly on sustainability and climate change (Zhang et al., 2019). The result has been the separation of green finance, which is considered part of sustainable finance (Spinaci, 2021; Filipiak, 2022). This concept, also associated with monetary aid for green development, includes financing of public and private pro-environmental investments that prevent and minimise environmental damage, as well as elements of the financial system (Sachs et al., 2019b; Mohammad & Kaushal, 2018). More on green finance, its definitions and scope can be read in PWC (2013), Tierney et al. (2011), Höhne et al. (2012), Volz (2018), Ding et al. (2022), Oktasari et al. (2021), among others. To put it simply – green finance contributes to the achievement of the climate/energy goals of sustainable development, as defined in Agenda 2030 and EU documents. Their achievement, as already mentioned, requires a lot of money. The public sector does not have such resources, so it is necessary to redirect financial flows within the private sector from non-green to green investments. Such redirection can be one way to protect the environment, including the climate. Only determining which investments are green and which are not was problematic. Therefore, the European Union has established requirements for an investment to be considered environmentally sustainable (Regulation, 2020), commonly referred to as a taxonomy or taxonomy regulation. It defines the criteria for considering an economic activity as environmentally sustainable and regulates other related issues, such as transparency requirements for financial products. Thus, in view of the above, the taxonomy can be taken as a reference point for identifying green investment expenditures incurred by LGUs in Poland. Their isolation in the public budget will make it possible to identify and diagnose

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the spatial variation of these expenditures in the context of the Sustainable Development Goals, that is, to assess whether TSUs were committed to achieving them. Although the taxonomy is a new instrument of the financial framework in relation to the adopted research period, the environmental goals established in it correspond not only to the current environmental goals of the European Green Deal (achieving zero net greenhouse gas emissions in 2050, so-called climate neutrality), but also to the goals of the previous financial periods 2004-2006, 2007-2013 and 2014-2020. It is worth noting that in the years covered by the study, European environmental goals were set in the Lisbon Strategy (2000-2010) and Europe 2020 (2011-2020). The revised Lisbon Strategy reduced these to three demands under one of 23 guidelines: internalising external costs, improving energy efficiency, and promoting environmentally friendly technologies (ETAP – Environmental Technology Action Plan). By contrast, in the Europe 2020 Strategy, one of the three main priorities was sustainable development: promoting a more resource-efficient, environmentally friendly, and competitive economy. The overarching goal, actually a package of climate/energy targets (the so-called 3x20) corresponding to this priority, was to reduce CO_2 emissions by at least 20% compared to 1990 levels or, if conditions permit, by as much as 30%; increase the share of renewable energy sources (RES) in total energy consumption to 20%; and increase energy efficiency by 20%. The increased prominence of environmental objectives was also evident in the much larger size of EU funding for them in the latest financial perspective 2014-2020 compared to previous periods. The subsidy, in line with EU priorities in this regard, influenced the directions of environmental investments undertaken by, among others, TSUs. It, therefore, supported their environmental spending directions. Therefore, it is worth assessing whether the green property expenditures incurred from the TSU budget in Section 900 reflect a commitment to achieving EU environmental goals in the adopted periods.

Research methods

The study was conducted in two stages. In the first stage, to assess the total amount of green investment expenditures, the measurement concept by Budzeń and Marchewka-Bartkowiak (2022a) was applied. First, the total amounts of LGU's green investment expenditures by budget classification sections were estimated, and the changes in total and per capita expenditures over time were analysed. Special attention was paid to section 900 – Utilities and Environmental Protection (Regulation, 2010). It answered the first three research questions formulated in the introduction. The second stage of the study applied the TOPSIS method, using 11 indicators character-

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ising green spending by LGUs at different levels, i.e., cities with county rights (MNP) and municipalities, divided into urban (GM), rural (GW) and urban-rural (GMW) ones. The survey was conducted in three periods: 2004-2006, 2007-2013 and 2014-2020. Only those LGUs where green spending was observed in section 900 took part in the study. The number of LGUs and their type in the three study periods are given in Table 1.

Table 1. Number of LGU by their type for the years 2004-2006, 2007-2013 and 2014-2020

	2004-2006	2007-2013	2014-2020
MNP	65	66	66
GM	241	240	236
GW	1235	1511	1514
GMW	575	602	643
Total	2116	2419	2459

The data source is the budget reports of LGUs published by the Ministry of Finance in the Public Information Bulletin. The following indicators (diagnostic features) were included in the survey: X_{1S} – wastewater management and water protection (PLN/person), X_{2S} – municipal waste management (PLN/person), X_{3S} – urban and rural clean-up (PLN/person), X_{4S} – atmospheric air and climate protection (PLN/person), X_{5S} – soil and water protection (PLN/person), X_{6S} – noise and vibration reduction (PLN/person), X_{7S}– the protection of biodiversity and landscape (PLN/person), X_{8S}–the protection of seashores (PLN/person), X_{9S} – other waste management activities (PLN/person), X_{10S}–the removal of the effects of natural disasters (PLN/person), $X1_{1S}$ – other activities (PLN/person). The influence of these characteristics on the phenomenon under analysis was also indicated by categorising it into a set of characteristics that stimulate development in the area (symbol S).

The TOPSIS method (Technique for Order of Preference by Similarity to Ideal Solution) is one of the methods of multivariate statistical analysis, which allowed the classification of LGUs in Poland according to the level of green investment spending. It belongs to multi-criteria decision-making methods (Yoon & Kim, 2017; Parida & Sahoo, 2013; Roszkowska, 2011; Zulqarnain et al., 2020; Ghose, 2021). The TOPSIS procedure applied to the linear ordering of multidimensional objects proceeds in the following steps:

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1. The determination of the observation matrix:

$$X = [x_{ij}], \tag{1}$$

where:
i – object number (i = 1, 2, ..., n),
j – diagnostic feature number (j = 1, 2, ..., m),
X_{ij} – the value of j-th feature for i-th object.

2. The normalisation of diagnostic features:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}, \tag{2}$$

where:
Z_{ij} – the value of j-th standardized diagnostic feature for the i-th object.

3. The determination of two reference points, which determine the coordinates of Positive Ideal Solution (the maximum values of features in the case of stimulants) and Negative Ideal Solution (the minimum values of features in the case of stimulants), respectively:

$$v_j^+ = \begin{cases} \max_i v_{ij} & \text{for stimulant} \\ \min_i v_{ij} & \text{for destimulant} \end{cases}, \tag{3}$$

$$v_j^- = \begin{cases} \min_i v_{ij} & \text{for stimulant} \\ \max_i v_{ij} & \text{for destimulant} \end{cases} \tag{4}$$

where:
v_j^+ – j-th coordinate of Positive Ideal Solution,
v_j^- – j-th coordinate of Negative Ideal Solution.

4. The calculation of Euclidean distances from the pattern (d_i^+) and anti-pattern (d_i^–) for all objects:

$$d_i^+ = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^+\right)^2}, \tag{5}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^-\right)^2}, \tag{6}$$

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where:
d_j^+ – Euclidean distance of the *i*-th object from Positive Ideal Solution,
d_j^- – Euclidean distance of the *i*-th object from Negative Ideal Solution.

5. The determination of the value of the aggregate variable denoting the relative proximity of the i-th object to the Positive Ideal Solution:

$$R_i = \frac{d_i^-}{d_i^- + d_i^+}, \tag{7}$$

where:
0≤R_i≤1.

The preferred object has the shortest distance to the pattern and, simultaneously, the longest distance to the anti-pattern; that is, it takes the largest value of the coefficient Ri.

6. Linear ordering of objects is performed due to the aggregate variable's non-increasing value (9).
7. Based on the resulting aggregate measure, the objects are divided into groups characterized by a similar situation due to green spending. The so-called "three median method" was used here, which involves determining the median from the values of the measure and then dividing the set of objects into those for which the values of the measure exceed the median and are not greater than it (Młodak, 2006). The division was made based on the following formulas:

$$Group\ IV:\ 0 \le R_i < \bar{R} - S(R), \tag{8}$$

$$Group\ III:\ \bar{R} - S(R) \le R_i < \bar{R}, \tag{9}$$

$$Group\ II:\ \bar{\bar{R}} \le R_i < \bar{R} + S(R), \tag{10}$$

$$Group\ I:\ \bar{R} + S(R) \le R_i \le 1. \tag{11}$$

where:
$\bar{R}$ – arithmetic mean of aggregate variable *R*,
S(R) – standard deviation of aggregate variable *R*.

This method made it possible to organise LGUs according to the determined synthetic measures in the adopted three research periods and to answer the last two research questions specified in the introduction.

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Results of the research

The results of the first stage of the research – the identification and analysis of green expenditures in the budget classification of LGUs. Green investment expenditures were identified in twenty budget classification sections. Table 2 shows the structure of "green" investment expenditures of all LGUs by budget classification section.

Table 2. Structure of green investment expenditures of LGU by budget classification sections

	2004-2006	2007-2013	2014-2020
section 010 – Agriculture and hunting	26.98%	25.65%	21.00%
section 600 – Transport and communications	9.24%	20.13%	26.49%
section 900 – Utilities and environmental protection	63.34%	53.44%	50.79%
Other sections	0.45%	0.77%	1.72%

The data shows that most of the total amount of green investment expenditures of LGU (on average about 99%) was concentrated in three budget classification sections – 900, 600 and 010. While the most significant proportion of these expenditures was in section 900 (on average about 56% of the total), in sections 010 and 600, they were relatively smaller, on average 24.5% and 19.5%, respectively. During the period under review, the share of green investment expenditures of sections 900 and 010 in total such expenditures decreased, while that of section 600 increased. Green investment expenditures in the other sections accounted for only about 1% of total such expenditures. Due to the highest concentration of green investment expenditures in the 900 section, it is this section that became the subject of research in the article. The structure of green investment expenditures in section 900 is formed into 12 chapters. Table 3 shows the structure of green investment expenditures by chapters of the 900 section.

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Table 3. The structure of green investment expenditures of LGU by chapters of the 900 section

	2004-2006	2007-2013	2014-2020
90001 Wastewater management and water protection	72.02%	69.81%	44.53%
90005 The protection of atmospheric air and climate	0.88%	1.68%	22.52%
90095 Other activities	21.66%	22.30%	27.55%
Other sections	5.44%	6.21%	5.39%
Total	100.00%	100.00%	100.00%

The volume and structure of green investment expenditures in the various chapters of section 900 varied during the period under review. Wastewater management and water protection expenses accounted for the largest share. Over time, their share decreased. However, the share of expenditures on protecting atmospheric air and climate increased in line with the EU's priority goals. In the 2004-2006 period, the share of these expenditures was less than 1% of total expenditures on municipal management and environmental protection, and in the 2014-2020 period, it increased to more than 22%, i.e. more than 25 times. During the period under review, a significant part of green spending was related to other activities. Their share increased from 21.66% in the first period to 27.55% in the latest study period. Expenditures in the so-called other chapters varied between 5 and 6%. The structure of expenditures was also analysed for all types of municipalities by funding period. The analysis findings are similar to those above, with the largest decrease on wastewater management and water protection in the MNP group, from 60.67% in the 2004-2006 period to 27.32% in the 2014-2020 period. In the remaining entities, these expenses accounted for more than 40% in the most recent period. The largest increase in spending on atmospheric air and climate protection tasks occurred in the GW group. In the 2014-2020 period, the share of expenditures in this chapter of the group was more than 28%, which was twice the share compared to the other groups. All types of municipalities also saw an increase in the share of spending on other activities. The highest increase was in the MNP group, and the share of these expenses in the 2014-2020 period was almost 51%. During the analysis, the data on total expenditures, investment expenditures and green investment expenditures incurred by LGU from the budget during the period under review were compiled for the three periods of EU financial programming. In the 2004-2006 period, they accounted for 23.7%; in the 2007-2013 period – 20.2%; and in the most recent period, 2014-2020, the share was 18.3%. The share of green investment expenditures in the dominant 900 section in total

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green investment expenditures also declined. This share in the 2004-2006 period was 63.3%, and in the following two periods, it was 53.4% and 50.8%, respectively.

In summary, the analysis of the changes in the structure of the green investment expenditures of section 900 by chapter, both in total and in individual groups of LGU, confirmed their differentiation and the alignment of the spending directions with EU environmental goals. Since the current priority is to achieve climate/energy goals, municipalities have been incurring expenditures to meet them. Both their size and their share in the structure of green property expenditures of total and individual LGUs increased.

The results of the second stage of the research. With the use of the eleven diagnostic characteristics presented earlier, synthetic measures were determined using the TOPSIS method (equal weights of), characterising green expenditures in individual LGUs during the three research periods. Table 4 shows selected descriptive parameters ($\bar{x}$ – the arithmetic mean, M –the median, Vs (%) –the coefficient of variation, As–the coefficient of asymmetry) characterising the average degree of variation and the asymmetry of the distributions of aggregate measures for LGU. Note that regardless of the level of aggregation, all synthetic measures are characterised by a high degree of differentiation and strong right-hand asymmetry. It means a predominance of objects (LGUs) with below-average indicators. The highest level of differentiation (232.70%) and the highest asymmetry index was characterised by GMs in 2004-2006. However, as of the second research period (2007-2013), this was the case for GWs. The distribution of the aggregate measure for cities with county rights was also characterised by a high level of differentiation and right-hand asymmetry but with a lower strength than the other LGUs.

Based on the values of aggregate measures, four typological groups of LGU were distinguished at different levels of aggregation, with group 1 having the highest green investment expenditures and group 4 having the lowest. In the article, the grouping table is presented only for the 2014-2020 period, both because of small changes in the first two research periods and the limitation of the study (Table 5). However, all periods are also included in the description of the results. The analysis of the results obtained allows us to note the following regularities:

- The situation of MNPs due to green investment expenditures was similar regardless of the research period; the highest values of green expenditures (1 group) were for MNPs in the mazowieckie, pomorskie and śląskie provinces.

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Table 4. Selected descriptive parameters for synthetic measures at each level of aggregation in the three periods studied

LGU		M	Vs [%]	As
2004-2006				
MNP	0.07	0.05	112.03	1.67
GM	0.01	0.004	232.70	6.17
GW	0.04	0.02	139.29	2.95
GMW	0.02	0.01	170.49	5.26
2007-2013				
MNP	0.11	0.08	79.30	1.15
GM	0.04	0.02	141.80	3.21
GW	0.01	0.01	198.02	6.38
GMW	0.03	0.02	143.97	3.48
2014-2020				
MNP	0.11	0.08	79.30	1.15
GM	0.06	0.04	106.24	2.17
GW	0.02	0.01	164.99	6.92
GMW	0.04	0.03	117.62	3.83

- More than 54% of GMs from the Małopolskie province and 50% from the podkarpackie province were in the first typological group with the highest green investment expenditures, while the majority of municipalities from the lubuskie province were included in group 4 with the lowest green expenditures.
- GWs were highly differentiated in terms of the level of green investment expenditures; the highest expenditures (group 1) concerned municipalities in the lubelskie and podkarpackie provinces, and the lowest (group 4) in the łódzkie, mazowieckie, pomorskie and wielkopolskie provinces.
- Among GMWs, there was also a wide variation in the level of green expenditures, with the highest level for GMWs in dolnośląskie, lubelskie, łódzkie, mazowieckie, podkarpackie, pomorskie and śląskie provinces, and the lowest in kujawsko-pomorskie, lubuskie, warmińsko-mazurskie, wielkopolskie and zachodniopomorskie provinces.

The level of green spending varied from period to period among LGUs, causing units to change their typological group membership. It is noticeable that in each group, there are units that did not change their position (group membership) in successive financing periods. Namely:

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- In the case of the MNP group in the 2007-2013 and 2014-2020 periods, the same units formed the group in both Group 1 and Group 4. Group 1 MNPs that did not change their position included Jelenia Góra, Bydgoszcz, Piotrków Trybunalski, Kraków, Ostrołęka, Płock, Gdynia, Słupsk, Sopot, Dąbrowa Górnicza, Rybnik, Świętochłowice, Zabrze, Żory, Poznań, Szczecin. Group 4, on the other hand, included: Legnica, Wałbrzych, Grudziądz, Toruń, Włocławek, Chełm, Lublin, Radom, Siedlce, Przemyśl, Białystok, Częstochowa, Jaworzno, Siemianowice Śląskie, Kielce, Elbląg, Świnoujście.
- In the GM group, 37.3% of units maintained their position in Group 1, while as many as 49.1% of units were in Group 4.
- In the GW group, 38.1% of units maintained their position in Group 1, while as many as 42.5% of units were in Group 4.
- In the GMW group, 33.8% of units maintained their position in Group 1, while in Group 4, it was 37.3% of units.

Table 5. Typological groups in LGU due to green spending from 2014 to 2020

Provinces	MNP				GM				GW				GMW			
	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4
dolnośląskie	1	0	1	2	8	9	7	7	22	14	24	18	22	12	10	12
kujawsko-pomorskie	1	0	0	3	4	3	4	2	23	23	27	19	6	8	10	11
lubelskie	0	1	1	2	6	8	2	0	80	50	19	15	12	11	3	2
lubuskie	0	2	0	0	2	0	0	5	7	8	8	14	6	5	9	14
łódzkie	1	1	1	0	0	3	5	7	34	28	25	39	8	5	7	8
małopolskie	1	0	2	0	6	1	2	2	35	34	35	16	11	13	13	11
mazowieckie	2	0	1	2	6	7	11	6	39	47	54	79	15	15	14	10
opolskie	0	1	0	0	0	0	1	1	14	6	6	8	5	10	11	7
podkarpackie	0	3	0	1	6	4	0	2	38	37	18	16	16	9	7	3
podlaskie	0	1	1	1	4	0	3	3	15	23	24	16	6	8	7	6
pomorskie	3	1	0	0	5	5	2	6	12	18	20	30	6	3	6	5
śląskie	5	5	6	3	6	9	11	4	20	28	26	22	7	7	7	1
świętokrzyskie	0	0	0	1	1	0	2	1	12	13	22	11	8	16	8	8
warmińsko-mazurskie	0	1	0	1	3	4	2	5	4	14	24	23	7	10	5	12
wielkopolskie	1	1	2	0	1	3	5	6	13	25	33	40	14	19	29	32
zachodniopomorskie	1	0	1	1	1	3	2	2	10	11	13	13	11	10	15	19

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Discussion/Limitation and Future Research

Achieving the environmental goals set out in EU documents and the 2030 Agenda requires large financial expenditures, among others, from LGU, which does not have adequate financial resources for these goals. Thus, as mentioned, it will become essential to organise and distribute the capital held to support investments to achieve the environmental goals set by the EU (Sachs et al., 2019a).

It will be linked to the shift of the entire economy to an environmentally friendly/climate neutral one, and the introduction of the Green Deal requires significant changes in the way all economic actors, including government entities at all levels of the economy, operate, make decisions and finance (Klub Odpowiedzialnych Finansów, 2020; PRI, 2017). The benchmark for identifying green spending is a new taxonomy. The authors, based on Marushkin's (2021) assessment that this taxonomy would have a broader application than just identifying the type of environmental investment, used it as a basis for identifying and diagnosing the spatial variation of green investment expenditure and assessing the commitment of LGU to achieving environmental goals of sustainable development. The concept proposed by Budzeń & Marchewka-Bartkowiak (2022b) was taken as a starting point for exploring the issue they addressed, and the 900 section of Utilities and Environmental Protection was identified, which accounts for the majority of expenditures for this purpose. These expenditures are referred to as green investment expenditures.

Since Budzeń and Marchewka-Bartkowiak's (2022b) research is pioneering in the field in question, it had a slightly different scope and a much shorter research period. Hence, this study yields results that are an extension of the previous results of their research. One can only see some convergence in the development of green spending in municipalities from 2010 to 2020. Other conclusions drawn by the authors based on the study are more detailed and in-depth for all types of municipalities. One is even quite specific that despite the passage of time, there is quite a lot of stability in the studied groups of LGU regarding green investment expenditures, which was not found in the compared study.

We have not come across other scientific studies with results that could provide a basis for direct comparisons with those obtained in this article. Therefore, it was decided to fill the existing research gap in this area. Due to the fact that the new EU taxonomy for classifying economic activities is just beginning to take effect, most scientific publications focus on presenting its essence, effects and benefits of its application, or problems with its implementation. For example, Kirschenmann (2022) tried to answer the question

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of how the new taxonomy affects bank lending to companies and whether an impact on the greening of companies' economic activities can be achieved. Similar issues were addressed by Houston and Shan (2022), Wackerbauer and Sitteneder (2021), Meo and Karim (2022), and Pedersen et al. (2021), among others.

The results obtained in the article can be helpful in greening budgets and making decisions about reallocating funds to environmentally sustainable tasks. Thus, they relate to the conclusions formulated by (Wang et al., 2021; Batrancea et al., 2020; Zioło et al., 2021, 2022; Wang et al., 2019; Mohammad & Kaushal, 2018). The EU's publication of a series of regulations called the Sustainable Finance Package (Directorate-General for Financial Stability et al., 2023) confirms the importance of this issue. It shows how the EU's sustainable financing program can support businesses and the financial sector by encouraging private financing of transitional projects and technologies and facilitating financial flows for sustainable investments.

The above coincides with a broad view of sustainable finance referring to the EU policy context, where it is understood as financing that supports economic growth while reducing environmental pressures and considering social and governance aspects (European Commission, 2023b). In this view, sustainable finance is assigned a key role in achieving the policy goals of the European Green Deal and, the EU's international climate commitments and other sustainable development goals of the 2030 Agenda.

Thus, the research confirms the need for green tagging and the possibility of gaining knowledge about the direction of spending. Indeed, the adopted climate and energy policy can be implemented through financial flows to key areas related to environmental sustainability. Similar conclusions have been reached by, among others, Zioło et al. (2021, 2022), Wang et al. (2019), and Mohammad and Kaushal (2018).

The analysis carried out does cover the full scope of the issue. Future research could try to apply the concept of green tagging in the context of Poland using international experience. It would also be interesting to study the reasons for incurring (or not) green expenditures and directional consideration of the legal framework for the so-called green budgets of JTS, as mentioned by Spinaci (2021), including the creation of a reporting system linked to the effects of achieving climate goals.

Conclusions

The conducted research confirms that it is possible to estimate green investment expenditures incurred by LGU using the new taxonomy. It is vital in the context of achieving climate/energy goals, both of the EU and the 2030 Agenda. Based on the results obtained, it should be concluded that the pur-

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pose of the article, which was to identify and diagnose the spatial variation of green investment expenditures in the context of sustainable development goals and the new taxonomy for classifying economic activities as environmentally sustainable, has been achieved. In addition, the research provided the opportunity to find the answers to the questions posed in the introduction.

The answer to question 1. There are significant differences among the LGU in the level of green investment expenditures per capita, with the majority of expenditures being incurred within the Utilities and Environmental Protection section. The highest level of differentiation (232.70%) occurred among GM in 2004-2006 and in the second research period (2007-2013) among GW. In the case of MNP, the differentiation was slightly weaker than the other LGUs. Among GMWs, there was also a high level of differentiation and the highest in the dolnośląskie, lubelskie, łódzkie, mazowieckie, podkarpackie, pomorskie and śląskie provinces, and the lowest in the kujawsko-pomorskie, lubuskie, warmińśko-mazurskie, wielkopolskie and zachodniopomorskie provinces.

The answer to question 2. During the period under review, the volume of JTS's green investment expenditures increased, both overall (five times), in section 900 (three times) and per capita (almost four times), confirming an increase in commitment to environmental goals of sustainable development.

The answer to question 3. The formation of the size and structure of green investment expenditures of JTS reflects the commitment to EU environmental goals. It is confirmed by a decrease in the share of expenditures on wastewater management and water protection and a significant increase in the share of funds incurred with regard to atmospheric air and climate protection, which was in line with the priorities of the EU's environmental and energy policy.

The answer to question 4. MNPs in the mazowieckie, pomorskie and ślaskie provinces were the most committed to achieving environmental goals, having the highest values of green spending (1st typological group). This group also included more than 54% of urban municipalities in Małopolskie province and 50% in podkarpackie province.

The answer to question 5. The LGU belonging to the 4th typological group with the lowest green spending was the least committed to achieving priority environmental goals. These were the majority of municipalities from lubuskie province and rural municipalities from łódzkie, mazowieckie, pomorskie and wielkopolskie provinces. In the case of municipalities from lubuskie province, this may be due to their location in an area at low risk of air pollution. In the case of municipalities from the other provinces, this suggests increasing green investment expenditures to intensify the environmental goals involved.

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The survey results not only reflect the LGUs' commitment to the priority environmental goals of sustainable development in Poland but also indicate which municipalities need support in achieving them. In addition, the presented conclusions can contribute to the dissemination of the taxonomy in practice, changes in the ways in which JTS assesses the achievement of environmental goals, and facilitate the raising of funds for investments for this purpose or the targeting of public assistance to those in need.

Among the directions for further research, in addition to those mentioned in the discussion section, one can point to an analysis of the effectiveness/effects of green asset expenditures incurred by LGUs. Further research is contingent on the availability of relevant data, which is a significant limitation of current and future research activities.

The contribution of the authors

The idea, I.B., D.B., B.K. and A.S.; literature review, B.K.; acquisition of data, D.B. and A.S.; analysis and interpretation of data, I.B., D.B., B.K. and A.S.

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