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TRENDS OF CHANGE IN THE DEVELOPMENT OF SUSTAINABLE CITIES AND COMMUNITIES IN POLAND IN COMPARISON WITH EUROPEAN UNION COUNTRIES

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Purpose: The main purpose of this paper is to present the diversity and trends of changes taking place in cities and communities in Poland and in other European Union countries with respect of implementation of the 2030 Agenda for Sustainable Development.
Design/methodology/approach: The indicators included in Eurostat, which are collected to analyse the implementation of Objective 11: Sustainable cities and communities, have been used to assess the problem. 10 indicators and 27 European Union countries were analysed. The research period was 2010-2019 and the data was statistically analysed. Variations and distances between countries, trends in the changes taking place, ranking of countries, and relationships between the analysed indicators and the scale of their changes were calculated.
Findings: EU Member States (27) are significantly differentiated in terms of household living conditions, environmental conditions, and safety at home. In Poland, dwellings are overcrowded but in relatively good condition. The Polish population is more often exposed to noise and air pollution, and they are at a higher risk of dying in a traffic accident, but they are less likely to report the occurrence of crime and vandalism. The results of the study confirmed important trends towards the development of sustainable cities and communities in Poland and in other EU countries.
Research limitations/implications: The study resulted in a confirmation of the hypothesis that sustainable cities and communities have developed in EU countries in the last decade. There has been an improvement in the living conditions, safety, and environment of the population, especially in those countries where 10 years ago the variables describing sustainable cities and communities were the lowest. One of the countries where sustainable development was a priority was Poland, where the dynamics of improvement of almost every indicator was higher than the EU average.
Practical implications: The conclusions may be useful for managers of economic entities for making more effective decisions regarding allocation of financial resources and making investments in social and technical infrastructure or safety regarding sustainable development of cities and communities.
Social implications: The paper provides useful information for city and community managers and citizens of EU countries and cities about living conditions, quality of life, and safety of inhabitants.

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Originality/value: The article presents the latest information regarding the conditions of cities and communities in EU countries and compares that data with indicators from previous years. The value of the article lies in identifying and recognising the significance of differences between EU countries and in verifying whether any positive changes towards sustainable development of cities and communities are occurring.

Keywords: cities, communities, sustainable development, trends, indicators, EU countries (27).

Category of the paper: research paper.

1. Introduction

Rapid urbanisation is one of the most prominent challenges of the 21st century (Zhang, 2016; McGranahan, Satterthwaite, 2014). Over the last two decades Poland has also experienced a process of urbanisation and urban expansion, albeit it has slowed down somewhat in recent years. Currently, the urbanisation rate is 60% and 65% of the Polish population lives in urban and intermediate areas (BDL GUS, 2021). The development of cities and the communities located in them contributes to economic growth. Cities concentrate most economic activity, including production of goods and energy, transport services, and intensive land use, which creates a number of benefits on the one hand. On the other hand, the development of urbanization influences the devastation of the environment and the deterioration of living conditions and the health of the inhabitants, through the negative impact of the city on the air, climate, soil, and fauna and flora, or the overexploitation of natural resources (McKinney, 2008; Lewandowska, 2015; Rzeńca, 2016).

If the cities want to maintain the balance between the level, quality, comfort, and safety of life of the inhabitants and, on the other hand, the protection of the natural environment in the place of residence and health of the urban population, they must try to eliminate those problems or at least reduce their impact. It is important that the dynamic development of cities should disturb valuable natural resources to the least degree, but above all that it should not cause visible differences in the conditions, level and quality of life and health of city dwellers (Kuddus et al., 2020).

To be effective in action, it is useful to be guided by the principles of prevention and forethought (Mega, 1996), which is why managing the urban environment in a sustainable way is probably one of the most important and difficult tasks for years to come (Hens, 2010). This difficulty stems from the fact that a city is a unit composed of many elements between which there are different relationships (McMichael, 2000). The basic components of the territorial social system of a city include the social layer, i.e. the community of people with their needs, goals, and life aspirations, and the material substrate layer with all natural and artificial elements in the form of infrastructural elements. As Mierzejewska (2015) points out, it is important to maintain a relative balance between the layers, which is not an easy task.

Matters of environmental protection are only one of the components of sustainable development, with social and economic issues being of equal importance.

Paszkowski (2011) adds that an ideal sustainable city is a city that uses environmental resources to the extent that it can renew them and the development of which is gradual, thoughtful, and purposeful. According to Mierzejewska (2008, p. 57), a city, in order to be defined as sustainable, must "recognise the needs of all people, not only those living within the city boundaries, but also outside them, and not only the present, but also future generations, and reduce the demand for certain resources and increase the environmental capacity on a local, regional, and global scale, and thus the capacity of the natural environment to absorb and neutralise the external effects of human activity".

The concept of a sustainable city is inherent to the idea of new urbanism, which promotes a slower pace of life for residents, the creation of spaces conducive to pedestrianisation, and jobs for local people (Wróblewski, 2016; Overstreet, 2021; Ghorbi, Mohammadi, 2017). The literary sources also sometimes equate sustainable cities with *smart cities* (Stratigea et al., 2017; Morelli et al., 2013; Caragliu et al., 2009), as smart behaviour can add value and influence the sustainability of cities and communities. Smart cities, thanks to information and communication technologies, make more efficient use of available resources in order to improve the quality of life in the city and ensure its sustainability. A city that successfully implements the assumptions of the smart city concept is Vienna which is currently the leader of many rankings regarding the key areas of development of this idea (Jankowska, 2015).

The literature on the development of sustainable cities and communities is vast due to the importance of this issue in the modern world. These issues have been addressed, in addition to those previously mentioned, by authors such as Blassingame (2019), He, Lin et al. (2020), Linan et al. (2004), Satterthwaite (1997), Hanna and Comin (2021), Jenks and Jones (2010). In the publications, the authors point out the importance, complexity, and ambiguity of this problem, and sometimes even the contradictions between some issues, which is why attempts to systematize knowledge on the development of sustainable cities and communities can pose quite a challenge.

It is well known that sustainable development can stimulate positive changes in the functioning of cities and the living conditions of their inhabitants and the quality of the environment in which they live. Objective 11 "Sustainable cities and communities" of the 2030 Agenda for Sustainable Development (UN 2015, OECD 2017) recommends making cities and human settlements safe, stable, sustainable, and inclusive. In various countries and also in Poland, the National Urban Policy 2023 (2015) was developed in 2015. It is a location-specific development policy for Polish cities indicating assumptions and ways to implement strategic and specific objectives towards sustainable development of Polish cities and communities. In line with the Agenda's objectives, cities in all EU countries, including Poland, must, inter alia, provide better and affordable housing, make safe transport systems available to all, raise the level of road safety, and reduce the adverse rate of the city's negative impact on the

environment, paying particular attention to air quality, management of municipal waste, and other pollutants (OECD, 2017; MIiR,2019).

These are ambitious and difficult goals to achieve, especially since more than 50% of the world's population already lives in cities – a number that will go up to 66% by the middle of the 21st century (UN, 2016). The problems associated with intense urbanisation will progress fastest in developing countries. By contrast, in developed countries, population ageing or urban shrinkage will increasingly pose an issue. Nevertheless, for all cities and communities, the greatest challenges will be the increasing polarisation of households in terms of living conditions and quality of life, excessive energy consumption, air pollution, the problem of post-consumer waste, feeling of insecurity, and population health issues. In the face of these challenges, it is advisable to monitor indicators describing these problems in all countries in order to make more effective decisions on actions towards the development of sustainable cities and communities.

2. Research methodology and process

Monitoring perspectives related to the development of sustainable cities and communities is important from the point of view of the quality of life of future generations and requires detailed and regular analyses of the implementation of the 2030 Agenda for Sustainable Development in the context of the changing environmental conditions. Therefore, the main aim of this article is to identify trends in changes taking place in cities and communities in the countries of the European Union, with particular emphasis on Poland. The specific objectives include, **firstly**, an analysis of the values of indicators describing the sustainable development of cities and communities in Poland and other EU countries, such as overcrowding and living conditions in urban households, road safety and feeling of safety at home, access to public transport, noise exposure, and air pollution, **secondly**, an assessment of the diversity of the EU Member States in terms of the examined indicators**; thirdly**, an analysis the trends of changes occurring in 2010-2019 in the EU countries and in Poland in particular, on the basis of the absolute increase/decrease P_A index; and, **fourthly**, an investigation on whether there is a relationship between the level of the analysed indicators in 2010 and their increase or decrease in 2010-2019. The realisation of the aim of the paper was to verify the hypothesis assuming that the last decade saw the development of sustainable cities and communities in the EU countries (27), which was evidenced by the improvement of living conditions, safety, and environment of the population, especially in those countries where ten years ago the indicators were the lowest, and one of the countries in which the development of sustainable cities and communities was a priority and where it actually occurred was Poland.

Indicators provided by the European Statistical Office EUROSTAT extracted and collected to analyse the implementation of Objective 11: Sustainable cities and communities were used to assess the problem. 10 indicators (variables) and 27 EU countries (cases) were examined. Due to missing data for individual years and countries and for technical reasons, the research period was ultimately set to span the 2010-2019 period. Consequently, a database was prepared consisting of indicators characterising: living conditions of households (X_{01}, X_{04}), environmental/infrastructure conditions (X_{02}, X_{03}, X_{05}, X_{07}, X_{08}, X_{09}), and population's life security (X_{06}, X_{10}). The variables are denoted as stimulants S or destimulants D of the investigated phenomenon. An increase in the stimulant S leads to the development of sustainable cities and communities, while an increase in the destimulant D leads to a decrease (Table 1).

Table 1.
Indicators considered for assessing diversity and trends in the development of sustainable cities and communities in EU countries (27)

Variable symbol	Variable name	Data from years	Data source	Last data update	Influence of variable*
X_{01}	Overcrowding rate in %	2003-2020	Eurostat (ILC_LVHO05)	27.10.2021	D
X_{02}	Settlement area per capita in m2 per capita	2009,2012, 2015,2018	Eurostat (LAN_SETTL)	08.02.2021	S
X_{03}	Population living in households perceived to suffer from noise, by poverty status in %	2003-2020	Eurostat (ILC_MDDW01)	27.10.2021	D
X_{04}	Population living in a dwelling with a leaking roof, damp walls, floors, or foundations or rotting window frames, floor in %	2003-2020	Eurostat (ILC_MDHO01)	27.10.2021	D
X_{05}	Population connected to at least secondary waste water treatment in %	2000-2018	Eurostat (ENV_WW_CON)	08.02.2021	S
X_{06}	Road traffic fatalities on urban roads per 100 000 persons	2000-2019	DG MOVE (SDG_11_40)	05.07.2021	D
X_{07}	Share of buses and trains in total passenger transport in %	2000-2019	Eurostat (TRAN_HV_PSMOD)	07.07.2021	S
X_{08}	Exposure to air pollution by particles < 10 µm - annual average concentration	2000-2019	EEA (SDG_11_50	08.02.2021	D
X_{09}	Municipal waste recycling rate in %	2000-2019	Eurostat (ENV_WASMUN)	17.05.2021	S
X_{10}	Population reporting incidence of crime, violence, or vandalism in their area w%	2003-2020	Eurostat (ILC_MDDW03)	27.10.2021	D

Key: S-stimulant, D-destimulant.

Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

In the descriptive and graphical analysis of the survey results, the abbreviations of the names of the European Union member states were used according to the ISO 3166 Alpha-2 code developed by the International Organization for Standardization (ISO 2019). The data were subjected to statistical analysis (c.f. Wysocki, Lira, 2005; Luszniewicz, Słaby, 2003). Among others, the absolute indexes of the increase or decrease of the P_A values of the indicators between 2010 and 2019 (base year = 2010), the coefficients of variation V_s, the measures of distance D and variation R between countries, the correlation coefficients r_{xy} and the determination coefficients R^2 were calculated. Using the correlation coefficient r_{xy}, an attempt was made to test whether there are significant correlations between the study variables X and the indices of their absolute changes P_A over the last decade.

3. Assessment of the diversity of development of sustainable cities and communities in EU countries and Poland and the trends and scale of change from 2010 to 2019 – results and discussion

Based on the analysis of the indicators taken into account in the study of the development of sustainable cities and communities in EU countries, and in particular in Poland, some interesting trends have been observed and insights made (Table 2).

Table 2.
Values, variation, and absolute increases/decreases of variables considered for the study on the development of sustainable cities and communities in Poland and other EU countries (27) from 2010 to 2019

Variable	EU (27)	*min*	*max*	PL	V_s	D	R	P_A EU (27)	P_A PL
	2019							P_A absolute growth for 2019 (base year = 2010)	
X_{01}	29.1	5.4 CY	56.9 SK	45.2	52.7	10.5	51.5	-3.1	-20.4
X_{02}	703.4	201.4 MT	2447.6 FI	633.7	58.7	12.2	2246.2	-	39.8
X_{03}	17.3	8.2 HR	28.3 MT	12.6	36.0	3.5	20.1	-3.3	-3.6
X_{04}	12.7	4.1 FI	31.1 CY	10.8	44.1	7.6	27.0	-3.6	-4.8
X_{05}	79.6	36.9 HR	99.8 AT	74.0	21.4	2.7	62.9	9.0	9.5
X_{06}	5.1	2.2 SE	9.6 RO	7.7	35.8	4.4	7.4	-1.6	-2.6
X_{07}	17.2	9.4 LT	28.4 HU	19.3	23.6	3.0	19.0	0.2	-4.6
X_{08}	20.5	10.2 FI	30.9 HR	27.0	27.5	3.0	20.7	-6.7	-12.7
X_{09}	47.7	8.9 MT	66.7 DE	34.1	37.5	7.5	57.8	9.7	17.8
X_{10}	11	2.7 HR	20.2 BG	4.4	45.0	7.5	17.5	-2.1	-2.1

Key: *min* – minimum value for the country, *max* – maximum value for the country, Vs – coefficient variation in %, D – distance (max/min), R – range (max-min), P_A – absolute increase/decrease for 2019 (X_{2019} minus X_{2010}) (base year = 2010).

Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

The differentiation of EU countries in terms of various aspects of economic and social life and sustainable development has been analysed by many authors (e.g. Zielenkiewicz, 2020; Leruth et al., 2019; Winzen, Schimmelfennig, 2016), and the scale of this differentiation influences the opportunities or threats to the level and quality of life in the society. Also in this study, significant heterogeneity among EU countries was demonstrated (27). This was confirmed by the coefficients of variation V_s, D and R calculated for the analysed variables. The relatively largest differences between countries are found in terms of living conditions in households (X_{01}, X_{04}), while slightly smaller differences are found in terms of safety conditions (X_{06}, X_{10}) and environment/infrastructure conditions (X_{02}, X_{05}, X_{07}, X_{08}, X_{09}) (Table 2).

Adequate household living conditions are among the most important determinants for the development of sustainable cities and communities. This has also been pointed out by other authors in their studies (Oyebanjia et al., 2017, Dixon and Woodcraft, 2016). One of the measures indicative of living conditions is the overcrowding index (X_{01}). It is found that in EU countries (27) in 2019, as many as 29.1% of people lived in overcrowded households, where there is not at least one room for the whole household and a room for a couple, for every single person over 18 years old, for a pair of teenagers (12-17 years old) of the same sex, for every teenager of a different sex, and for a pair of children (under 12 years old). The highest overcrowding rates are in Slovakia (56.9%) and Romania (54.4%), and the lowest in Cyprus (5.4%), Ireland (5.9%), and Malta (6.6%). In the ranking of countries, Poland still ranks unfavourably above the EU average, where X_{01} is at 45.2%, despite the fact that the absolute decrease compared to 2010 was one of the highest in the EU (27) (P_A=-20.4%) (Table 2 and Figure 1).

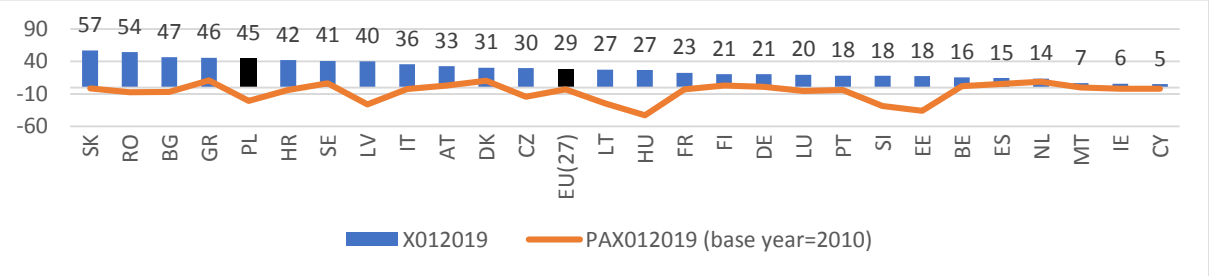

Figure 1. *Overcrowding index X_{01} in 2019 and its absolute increase/decrease P_{AX01} in 2019 (base year = 2010) – example of an indicator characterising sustainable living conditions of cities and communities in EU countries (27).* Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

Significant differences can also be observed in the percentage of the population living in dwellings with a leaking roof, damp walls, floors, or foundations or rotting window frames on the floor (X_{04}). In fact, 12.7% of the EU population lives in such unfavourable conditions. The situation is worst in Cyprus (31.1%) and Portugal (24.4%), while it is best in Finland (4.1%) and Slovakia (5.7%). In Poland, the percentage of the population living in unfavourable housing conditions was 10.8% in 2019 and was below the EU average, and it decreased further by P_A = -4.8% in the analysed decade. This shows that the dwellings in Poland, despite being

relatively small and cramped when compared to those of other European countries, are in relatively good condition.

Among indicators describing environmental/infrastructure conditions (X_{02}, X_{03}, X_{05}, X_{07}, X_{08}, X_{09}) indicating the sustainability of cities and communities, those with the highest variation values deserve most attention. EU countries are the most diverse in terms of settlement area per capita (X_{02}) and this diversity remains at a similar level, exceeding $V_s = 50\%$. On average in the EU there is 703.4 m^2 per capita of built-up area used for buildings, industrial and commercial areas, infrastructure, and sports grounds, with the highest in Finland (2447.6 m^2) and the lowest in Malta (201.4 m^2). In Poland, the settlement area is slightly smaller than the EU average at 633.7 m^2 and has increased in the last decade.

An important indicator of the quality of the environment in which EU citizens live that allows to assess the development of sustainable cities and communities is the proportion of the population living in households that claim they suffer from noise (X_{03}). It turns out that as much as 17.3% of the resident population in the EU suffers from noise pollution, with a variation between countries in this regard being high at of $V_s = 36.0\%$. The highest proportion of people exposed to noise is found in Malta (28.3%), the Netherlands (27%), and Germany (26%), while the lowest is found in Croatia, Ireland, and Estonia (8% each). In Poland, the percentage of people suffering from noise in 2019 stood at 12.6% and was almost 5 percentage points lower than the EU average. In the analysed decade, the absolute decrease of this indicator for Poland was close to the EU average and amounted to $P_A = -3.6$. As highlighted in the literature, environmental noise is an important risk factor for a number of short- and long-term adverse health effects (Nitschke et al., 2014). This risk mainly affects communities living in cities, and an increase in noise exposure will destimulate their sustainable development.

The sustainability of cities and communities is also evidenced by the provision of households with the necessary technical and social infrastructure (Wear, 2016). One of the analysed indicators is the percentage of population connected to sewage treatment systems (X_{05}). The importance of the development of wastewater infrastructure in Poland in economic and environmental terms was pointed out by Marszelewski and Piasecki (2014). According to data from 2018, on average 79.6% of the EU resident population is connected to such systems, the least in Croatia (36.9%) and Romania (48.1%) and the most in Austria (99.8%), the Netherlands (99.5%), Latvia (98.7%), and Luxembourg (97.0%). In Poland this percentage amounted to 74.0% and was slightly lower than the EU average, highlighting the importance of further improvement in the provision of households with basic technical infrastructure. This increase occurred for Poland in the last decade and, at the rate of $P_A = 9.5\%$, was close to the EU average.

Another indicator of sustainable cities and communities is the willingness of people to use public transport such as buses, trolleybuses, trams, or trains. Urban transport sustainability plays a key role in environmental and transport policies, as highlighted by many authors in their research (Da Silva et al., 2008; Cisowski, Szymanek, 2006; Strulak-Wójcikiewicz, Lemke,

2019; Colvile et al., 2004; Qureshi, Huapu, 2007). The shift of consumers from private to public transport will definitely reduce emissions of pollutants and greenhouse gases produced by vehicles. The share of buses and trains in total passenger transport (X_{07}) on average in the EU was negligible at 17.2%, the highest in Hungary (28.4%), the Czech Republic (26.2%), and Slovakia (26.2%), and the lowest in Lithuania (9.4%), Portugal (11.7%), and Slovenia (13.4%). In Poland, this share is only slightly higher than the EU average and is 19.3% as of 2019, with the decrease of this indicator between 2010 and 2019 (P_A = -4.6%) which is an unfavourable trend for Poland, hindering the implementation of sustainable development related to environmental protection.

Another major concern for the inhabitants of EU cities is pollution of the environment, and in particular of the air they breathe. Therefore, an important indicator used to assess the development of sustainable cities and communities is the exposure to particulate air pollution (X_{08}) (compare also studies Zgłobicki et al., 2019; Jasiński et al., 2021). The index measures population-weighted annual average concentrations of particulate matter at stations measuring background urban pollution levels in agglomerations. Fine and coarse particles (PM10), i.e. particles with a diameter of less than 10 micrometres, can enter deeply into the lungs, where they can cause inflammation and worsen conditions for people with heart and lung disease. The average annual concentration of particulate matter < 10 µm in EU countries was 20.5 in 2019, the highest being in Croatia (30.9), Bulgaria (30.4), Greece (27.5), and Poland (27.0) and the lowest in Finland (10.2), Estonia (10.8), Sweden (12.3), and Ireland (12.7). Poland, despite the reduction of the value of that index in the last decade by P_A = -12.7%, is still in the lead of the "biggest polluters", therefore, together with other countries with the biggest air pollution, it should implement measures reducing the concentration of harmful dusts as soon as possible (Figure 2).

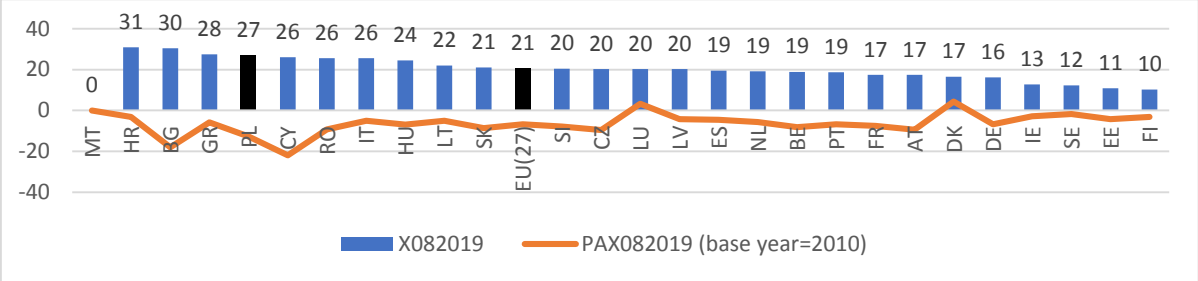

Figure 2. *Air pollution exposure of particulate matter < 10 µm (X_{08}) in 2019 and its absolute increment/decrement P_{AX08} in 2019. (base year=2010) – example of an indicator characterising the sustainable environment/environment/infrastructure of cities and communities in EU countries (27).* Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

An important action of cities and communities towards their sustainable and responsible operation is the recycling of municipal waste. According to the 2019 data, on average, member states recycled 47.7% of municipal waste in total, with the least recycling in Malta (8.9%), Romania (11.5%), and Cyprus (15.0%) and the highest in Germany (66.7%), Slovenia (59.2%), and Austria (58.2%). In Poland, in spite of significant increase in the absolute recycling rate of

municipal waste at $P_A = 17.8\%$, still much less waste undergoes this process than on average in the EU at only 34.1%.

In terms of assessing the development of sustainable cities and communities, in addition to analysing the living conditions of households and the conditions of their surrounding environment, an assessment of the level and sense of security among the population should also be included. An important aspect is the feeling of safety during among the population when travelling. Therefore, one of the indicators assessed is the number of traffic accident fatalities per 100 000 people (X_{06}). On average in the EU, there are 5.1 fatalities per 100 000 inhabitants, the highest in Romania (9.6), Bulgaria (9.0), Poland (7.7) and Croatia (7.3) and the lowest in Sweden (2.2), and Ireland (2.8). Poland unfortunately continues to be in the forefront of countries with the highest annual number of fatalities due to traffic accidents, despite a decrease in the value of this indicator in the last decade ($P_A = -2.6$).

No less important is the indicator representing the share of the population reporting the occurrence of crime, violence, or vandalism in their area (X_{10}). On average, one in 10 people in the EU reported such issues in 2019, with the highest number of such people living in Bulgaria (20.2%), Greece (16.9%), the Netherlands (16.3%), and France (14.7%), and the lowest reporting in countries such as Croatia (2.7%), Lithuania (3.2%), Poland (4.4), Hungary (5.3%), and Slovakia (5.6%). In terms of this indicator, Poland ranks favourably in the ranking of countries also due to the fact that over the last decade there has been a decrease in the percentage of the population reporting safety issues ($P_A = -2.1\%$) (Figure 3).

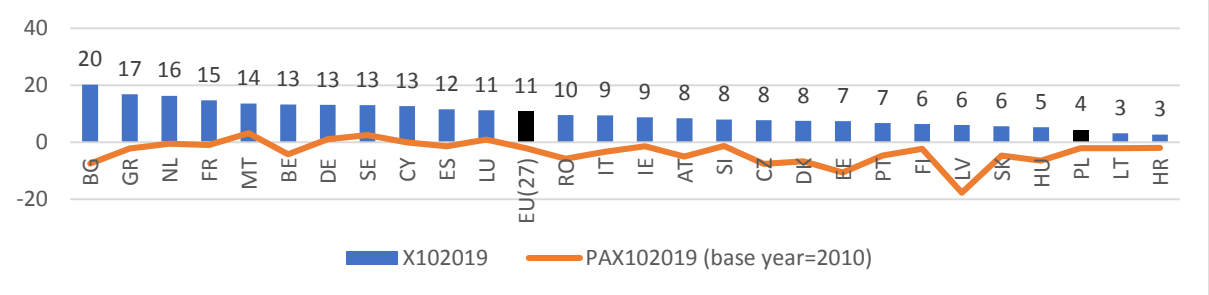

Figure 3. *Share of population reporting the occurrence of crime, violence, or vandalism in their area in % (X_{10}) in 2019 and its increase/decrease in absolute P_{AX10} in 2019 (base year=2010) – example of an indicator characterising sustainable urban and community safety in EU countries (27).* Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

The indicators that were analysed were the stimulants S or the destimulants D of the increase of sustainable development of cities and communities in EU countries. An increase in the value of stimulants indicates an increase in the level of the phenomenon under study, while an increase in the value of destimulants indicates a decrease in it. The stimulants of sustainable development of cities and communities were the variables X_{02}, X_{05}, X_{07} and X_{09}. It was assumed that if there is a larger settlement area per capita in a country, relatively more households are connected to sewage treatment plants, there is a larger share of buses and trains in total

passenger transport, and there is a higher rate of municipal waste recycling, then it can be concluded that cities and communities in these countries are relatively more sustainable.

In terms of achieving the aim of the study, it is important to know whether in the last decade (2010-2019) there was an increase in the values of the analysed stimulants which would indicate the development of sustainable cities and communities in EU countries. As can be observed in Figure 4, in most countries there has been an absolute increase in P_A values of stimulants X_{05} and X_{09} in 2019 as compared to 2010. The highest sustainable development of wastewater treatment systems and waste recycling can be observed in countries such as Lithuania, Latvia, Slovenia, Slovakia, Czech Republic, Hungary, Poland, and Bulgaria. Unfortunately, these countries cannot tout of an increase in the indicator/stimulant of sustainability X_{07}, where it is the countries mentioned earlier, such as Bulgaria, Latvia, Poland, and Hungary that have experienced the relatively largest decrease in the share of buses and trains in total passenger transport in the last decade at almost 10% decrease. A deepening of this trend in the next years will not be conducive to the development of sustainable cities and communities in these countries.

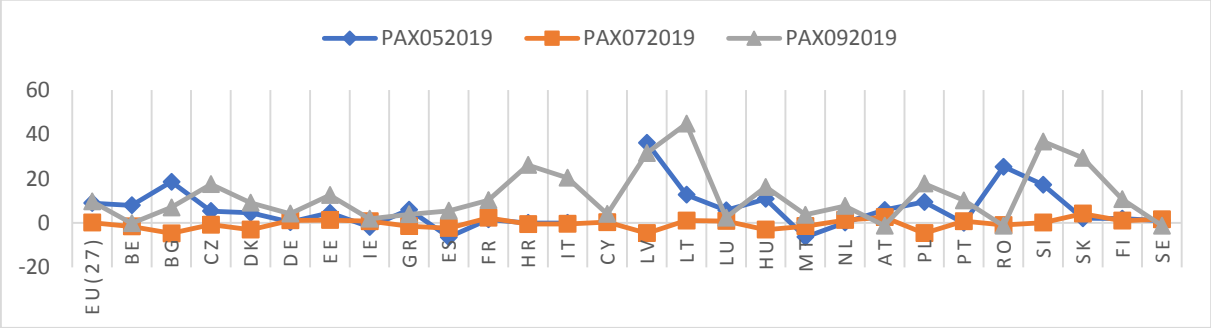

Figure 4. *Absolute P_A increases/decreases in 2019 compared to 2010 in the value of indicators that are stimulants of sustainable urban and community development in EU countries (27).* Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

The indicators X_{01}, X_{03}, X_{04}, X_{06}, X_{08}, X_{10} are the destimulants of sustainability of the studied phenomenon (Figure 5). If countries have a relatively higher rate of overcrowding and a higher proportion of people living in poor conditions, suffering from noise, and exposed to air pollution, as well as a lower sense of safety on the roads and in the area where they live, then it should be concluded that cities and communities in these countries are relatively less sustainable.

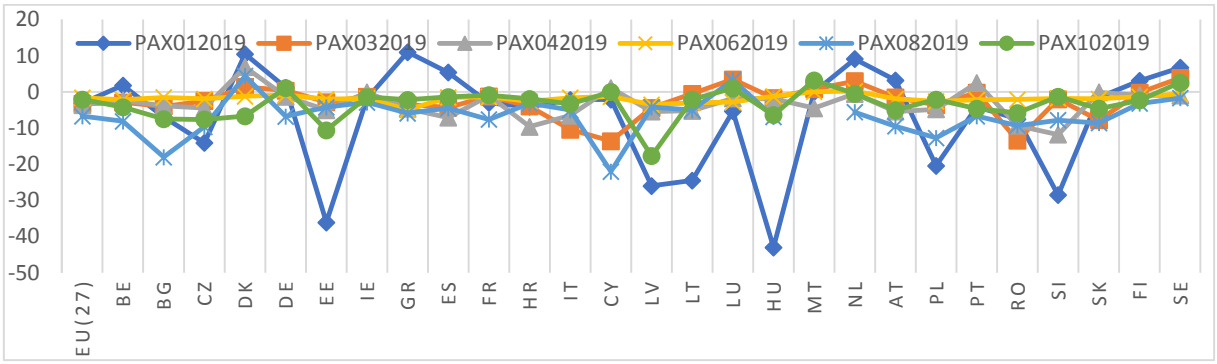

Figure 4. *Absolute P_A increases/decreases in 2019 compared to 2010 in the values of indicators that are destimulants of sustainable urban and community development in EU countries (27).* Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

An increase in the value of destimulants indicates a decrease and a decrease indicates an increase in the level or development of the investigated phenomenon. Due to the fact that the analysed indicators are destimulants it can be observed that in most countries there has been an absolute decrease in P_A of their values in 2019 compared to 2010. This trend indicates the development of sustainable cities and communities in EU countries. The largest decrease in the values of the destimulants in the analysed decade 2010-2019 can be observed in countries such as the Czech Republic, Estonia, Lithuania, Latvia, Hungary, Poland, and Slovenia, which is a positive trend for these countries and if it continues it will show that these countries are effectively implementing the goal 11 of the 2030 Agenda for Sustainable Development. On the other hand, an unfavourable trend towards unsustainable cities and communities is formed in the analysed decade in countries such as Denmark, Finland, the Netherlands, Luxembourg, Sweden, and Malta (Figure 4).

The above considerations were confirmed by the results of the analyses of the relationship r_{xy} between the values of stimulants or destimulants describing sustainable development of cities and communities and their absolute growth P_A in 2010-2019. There are significant negative relationships between almost all analysed variables (except X_{02} and X_{05}). This means that if the value of the analysed stimulants, such as X_{07} (share of buses and trains in total passenger transport) and X_{09} (municipal waste recycling rate), was lower in a given EU country in 2010, there was a higher absolute growth in the value of this indicator between 2010 and 2019. This trend indicates the development of sustainable cities and communities. In the case of the two other analysed stimulants, that is the variables X_{02} and X_{05}, no significant correlations with the absolute growth of P_A were found, which means no significant changes in the direction of sustainable development of cities and communities of EU countries in terms of the formation of settlement space and the provision of wastewater treatment systems (Table 3).

Table 3.
Relationships r_{xy} between the value of indicators – stimulants or destimulants describing sustainable development of cities and communities in 2010 and their absolute increases/ decreases P_A in 2019 (base year = 2010) in EU countries (27)

Variable X & Variable Y	r(X,Y)	R^2	t	p	Important
$X_{01}2010:P_{AX01}2019$	**-0.707**	**0.500**	**-4.997**	**0.000**	**27**
$X_{02}2010:P_{AX02}2019$	0.247	0.061	1.250	0.223	26
$X_{03}2010:P_{AX03}2019$	**-0.396**	**0.156**	**-2.154**	**0.041**	**27**
$X_{04}2010:P_{AX04}2019$	**-0.451**	**0.204**	**-2.528**	**0.018**	**27**
$X_{05}2010:P_{AX05}2019$	-0.283	0.080	-1.448	0.161	26
$X_{06}2010:P_{AX06}2019$	**-0.767**	**0.588**	**-5.977**	**0.000**	**27**
$X_{07}2010:P_{AX07}2019$	**-0.470**	**0.221**	**-2.663**	**0.013**	**27**
$X_{08}2010:P_{AX08}2019$	**-0.854**	**0.729**	**-8.042**	**0.000**	**26**
$X_{09}2010:P_{AX09}2019$	**-0.554**	**0.307**	**-3.327**	**0.003**	**27**
$X_{10}2010:P_{AX10}2019$	**-0.584**	**0.341**	**-3.595**	**0.001**	**27**

Source: own work based on Eurostat (2021). Database, Available online https://ec.europa.eu/eurostat/data/database, 3.11.2021.

The analyses showed significant negative correlations between all analysed destimulants of sustainable development of cities and communities and their changes in 2010-2019. This means that if the value of a particular destimulant was higher in a given country, then there was a significantly greater decrease in the value of the analysed variable in those countries. Thus, in countries with the highest household overcrowding (X_{01}), poor housing conditions (X_{04}), with significantly more people exposed to noise (X_{03}) and air pollution (X_{08}), and with relatively more residents exposed to traffic danger (X_{06}) and crime in their neighbourhood of residence (X_{10}), there was a proportionately largest significant decrease in the values of these destimulants in the analysed period of 2010-2019. In contrast, in countries with relatively better household living conditions, less air pollution and noise exposure, and greater life safety, the decline was significantly smaller. These relationships clearly demonstrate the development of sustainable cities and communities over the last decade in EU countries (Table 3).

4. Summary

Sustainable development of cities and communities has become a priority for EU countries (27), which is why for years they have been monitoring indicators to assess the occurring changes. However, the activities of the countries are not equally intensive, and the results of the calculations have led to some interesting observations. Summarising the results of the conducted survey, it should be stated that the EU Member States (27) are significantly differentiated in terms of household living conditions, environment/infrastructure, and safety at home, and this differentiation has remained at a similar level for years.

Currently, almost one in three EU citizens live in overcrowded households (most in Slovakia and Romania) and one in eight live in very poor housing conditions (most in Cyprus and Portugal). One in five EU citizens indicate that they are exposed to noise and air pollution (most in Malta and the Netherlands), and one in nine do not feel safe in their place of residence (most in Bulgaria, Greece, and the Netherlands). In comparison to other EU countries, Poland fares better only in the case of some indicators. For example, more than 45% of Polish residents live in overcrowded dwellings, although, compared to the EU average, these dwellings are relatively more often in good condition. Much more of the Polish population, as compared to other EU countries, is exposed to death in traffic accidents and to air pollution harmful to health and life. Relatively fewer Polish city dwellers are exposed to noise and danger from crime or violence. Invariably, the lack household sewage treatment systems and municipal waste recycling in Poland remains an issue.

The value of these indicators would be even less desirable for both Poland and other EU countries if positive changes towards the development of sustainable cities and communities had not taken place between 2010 and 2019. The results of the conducted study confirmed positive trends in the last decade in almost all analysed aspects. There was an increase in the value of the stimulants of development of sustainable cities and communities that were investigated in the study, and a decrease in the case of the destimulants. The results of the calculations made it possible to confirm the initial hypothesis that the last decade witnessed the development of sustainable cities and communities in the EU countries, which was evidenced by the improvement in living conditions of households, the quality of the environment/infrastructure in the place of residence, and life safety of the population, especially in those countries where a decade ago the indicators describing sustainable cities and communities were the lowest. One such country, where sustainable cities and communities were a priority, was Poland, where the rate of improvement in almost every respect was higher than the EU average (27).

Effective implementation of Goal 11 "Sustainable cities and communities" is crucial to achieving the core objectives of the 2030 Agenda for Sustainable Development. In EU countries, people's living conditions and their safety at home have improved, as well as the quality of the household environment, but not necessarily at a satisfactory level. The paper provides a plethora of useful information that should be known by city and community managers and residents of EU countries and cities. The results and conclusions may be useful for managers of economic entities, cities, and communities to make more effective decisions on how to allocate financial resources and make investments in social and technical infrastructure, safety, and environmental protection in order to develop sustainable cities and communities. It is also advisable to continue to analyse these indicators on a regular basis in order to monitor whether the disparity between EU Member States is narrowing and whether there are positive developments towards sustainable development.

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