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HOW TO MONITOR LOCAL OBJECTIVES FOR URBAN CLIMATE CHANGE ADAPTATION? INSIGHTS FROM QUANTITATIVE CONTENT ANALYSIS OF SELECTED PARTICIPATORY BUDGETS IN THE UPPER SILESIAN-ZAGŁĘBIE METROPOLIS

Abstract. Subsequent analyses of participatory budgeting in Poland emphasise the popularity of environmental issues such as greenery, air quality, and sustainable transport, which should also support objectives in urban climate change adaptation (UCCA). An increasing number of adaptation projects within local standards or 'green' civic budgets are often listed among the indicators in urban adaptation plans for Polish cities. However, available research studies and urban evaluation reports show that monitoring participatory budgets poses a methodological challenge. Therefore, the aim of the article is twofold. First, it proposes a method of identifying overlaps of urban climate change adaptation objectives with descriptions of projects submitted to local participatory budgets of the Upper Silesian-Zagłębie Metropolis. For this purpose, a dictionary-based text analysis of project descriptions was performed and critically examined. The second aim was to identify trends in urban climate change adaptation objectives. Thus, the quantitative distribution of coded descriptions was evaluated to investigate how subsequent types of participatory budgets (editions, green vs. standard, implemented vs. non-implemented) differed. The results demonstrate that the available database of participatory budget projects is a rich source of information on local preferences towards issues related to UCCA. To strengthen the objectives of urban climate change adaptation, city administrations can consider additional tools, such as UCCA-related tips/inspiration and targeted calls for projects, as well as supplementing participatory budgets with other deliberative methods. However, collecting precise and calculable data on this topic based on participatory budget databases requires both methodological adjustments and careful validation.

Keywords: participatory budgeting, urban climate change adaptation, text analysis, deliberative methods, qualitative data analysis.

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JAK MONITOROWAĆ LOKALNE CELE ADAPTACJI DO ZMIAN KLIMATU W MIASTACH? SPOSTRZEŻENIA Z ILOŚCIOWEJ ANALIZY TREŚCI WYBRANYCH BUDŻETÓW PARTYCYPACYJNYCH W GÓRNOŚLĄSKO-ZAGŁĘBIOWSKIEJ METROPOLII

Abstrakt. Dostępne analizy dotyczące mechanizmu budżetu partycypacyjnego w Polsce wskazują na popularność projektów obejmujących kwestie środowiskowe, takie jak zieleń, jakość powietrza i zrównoważony transport, które powinny również wspierać cele miejskiej adaptacji do zmian klimatu (ang. *Urban Climate Change Adaptation*, UCCA). Ten trend znalazł odzwierciedlenie również w dokumentach miejskich – rosnąca liczba projektów nawiązujących do adaptacji do zmian klimatu w ramach standardowych lub tzw. zielonych budżetów obywatelskich to często pojawiający się wskaźnik wykonalności miejskich planów adaptacji. Nadal jednak, zarówno w badaniach naukowych jak i ewaluacji miejskich dokumentów, monitorowanie budżetów partycypacyjnych w zakresie adaptacji stanowi metodologiczne wyzwanie. Niniejszy artykuł bada możliwości wykorzystania w tym celu ilościowej analizy danych tekstowych. Po pierwsze, proponuje metodę identyfikacji tematyki adaptacji do zmian klimatu z wykorzystaniem kodowania słownikowego na przykładzie bazy budżetów partycypacyjnych w wybranych miastach Górnośląsko-Zagłębiowskiej Metropolii (GZM). Następnie, bada możliwości identyfikacji trendów w zakresie występowania tych treści w opisach projektów zgłoszonych do budżetów obywatelskich różnego typu (w poszczególnych latach, standardowe vs. zielone budżety obywatelskie, projekty wdrożone vs. niewdrożone). Przeprowadzona analiza wskazuje, że dostępne zestawienia treści projektów budżetów partycypacyjnych są bogatym źródłem informacji na temat lokalnych preferencji w obszarze miejskiej adaptacji do zmian klimatu. Jednak, uzyskanie precyzyjnych i porównywalnych danych wymaga zarówno dostosowań metodologicznych, jak i starannej kontroli wyników. Aby wzmacniać rozpoznawalność celów adaptacji, lokalne władze mogą rozważyć dodatkowe kroki, takie jak udostępnienie wskazówek/inspiracji działań wspierających adaptację i promowanie zgłaszania tego typu projektów w ramach budżetów partycypacyjnych, a także rozwijanie metod deliberatywnych partycypacji społecznej.

Słowa kluczowe: budżet partycypacyjny, miejska adaptacja do zmian klimatu, analiza tekstu, metody deliberatywne, analiza danych jakościowych.

1. Participatory budgets and Urban Climate Change Adaptation

Participatory budgeting has become a permanent element of the urban participatory mix in Poland (Michalska-Żyła, Brzeziński 2017; Mączka et al. 2021), significantly contributing to the public discussion on environmental issues (Rzeńca 2021). Despite challenges associated with low attendance and constraints in project implementation (Pytlik 2017; Martela et al. 2023), they remain a rich source of knowledge on local needs and social mobilisation (Kajdanek 2015; Olejniczak, Bednarska-Olejniczak 2021; Popławski 2022). Moreover, since detailed documentation of participatory budgets is publicly

available, and the procedures implemented in Polish cities are often analogous, it allows for further comparison. The composition of project categories submitted in the participatory budget is the subject of urban monitoring in several areas (Wolszon et al. 2023; Szczepańska et al. 2021; Ślebocka 2022).

In comparative analyses of participatory budgets on a global scale, their importance is similarly recognised in the context of sustainability (Sinervo et al. 2023) and climate change mitigation and adaptation (Cabannes 2021), particularly as being "a signalling tool" (OECD 2022) of changing local interest and expectations. Observable strengths of this measure for the development of environmental policy include generating innovative and locally tailored solutions (Cabannes 2021), strengthening legitimacy for local, sustainable priorities (Sinervo et al. 2023), and mainstreaming adaptation actions (Cohen 2012). Therefore, monitoring urban participatory budgets can be a valuable litmus test of changing local environmental objectives. The analyses conducted so far in Poland provide encouraging results (Bernaciak, Kopczyński 2019; Jamontt et al. 2020; Pancewicz et al. 2023). Comparable categories of participatory budget activities have already been tested, for instance, in Martela et al. (2023) as six categories: 1) urban furniture, 2) infrastructure related to physical activity, 3) communication routes, 4) classes, events, campaigns, 5) greenery, and 6) purchases of fixed assets, and for "green" priorities in Martela (2024) as twelve types of activities: Flower pots and flower beds, Greenery (general), Trees, Shrubs, Flowers and ornamental plants, Lawns, Flower meadows, Rain gardens, Green roofs/walls, Maintenance works, Concreting of spaces, Other types of greenery.

However, they explored the long-term monitoring of local environmental objectives to a lesser extent, and their comparability is limited. Similarly, city administrations interested in monitoring participatory budgets in terms of adaptation to climate change have not yet found a fitting analytical procedure (Putkowska-Smoter, forthcoming). The article aims to fill this research gap by critically evaluating a semi-automated technique of participatory budget analysis, combining dictionary-based text analysis with the quantitative distribution of codes.

1.1. Data availability

The collective case study focuses on the Upper Silesian-Zagłębie Metropolis, Poland's inaugural metropolitan union. This region, among Poland's most populous and industrialised, mirrors the mining industry-centred area's economic, social, and environmental characteristics. As of February 2024, out of the 41 municipalities within the metropolitan union, 19 have already adopted urban climate change adaptation plans. Among these, 12 were developed as part of the pilot project "Let's Feel the Climate," while six stemmed from bottom-up initiatives in subsequent cities. Additionally, one plan is undergoing social consultations, and preparations for two more documents are underway. Notably, six of these

plans have identified an increase in the number of adaptation projects in local participatory budgets as an indicator. The municipal website offers information on 27 participatory budgets from 12 different cities. To ensure greater comparability, the scope of the analysed data was limited to the years with the most substantial number of data sets, specifically, the 27 data sets from 2020 to 2022. Consistent data recording allowed for their transfer to the MAXQDA software, involving automated coding of edition, city, and the content and the status of individual activities submitted. An added variable was the type of budget, divided into standard and so-called "green" participatory budgets (with a preference for environmentally friendly projects). The basic coding unit was an individual description of one project submitted to any of the participatory budgets (from now on referred to as "descriptions"). In total, 2112 descriptions were considered. See Table 1 for the distribution of descriptions.

Table 1. The distribution of individual descriptions considered for analysis

Variables	Number of descriptions
EDITION	
2020	1015
2021	736
2022	361
CITY	
Będzin	24
Bieruń	63
Katowice	978
Lędziny	24
Mikołów	73
Mysłowice	32
Piekary Śląskie	72
Ruda Śląska	51
Siemianowice Śląskie	63
Sosnowiec	122
Tychy	346
Zabrze	264

Variables	Number of descriptions
STATUS	
VERIFIED	103
REJECTED	378
LOSING	803
WINNING	307
IN_PROGRESS	400
ADVANCED	10
DONE	111
TYPE	
Green budget	259
Standard budget	1853

Source: author's work based on open-access data

2. Identifying urban climate change adaptation objectives in projects

The contemporary development of computational text analysis presents new opportunities for conducting content analysis on more extensive and diverse qualitative datasets (Kuckartz 2014; Bryda 2014). Empirical examples demonstrate various applications in this domain, such as identifying concepts, social actors, or actions, highlighting language and genre differences, and organising texts into categories or relations based on selected criteria (Macanovic 2022). This analytical approach has proven particularly valuable in understanding social responses to climate change, which often involve defining meanings, shaping discourses (Bińczyk 2018), invoking values (Hulme 2009), and debating social norms (Norgaard 2011). The "text as data" approach, a rapidly evolving field within computational text analysis, encompasses lexical-based analysis, text classification, and natural language processing (Nelson 2020). Various tools for such analysis are now available in popular qualitative data analysis software like MAXQDA and Atlas.ti, as well as through dedicated packages in programming languages like R and Python.

Even if it still might be challenging to obtain a satisfactory depth of analysis and overcome linguistic sensitivity, first attempts to use a lexical-based approach to study climate change adaptation, both internationally (Sodoge et al. 2023) and in the Polish context (Masik, Gajewski 2021) inspires for further

methodological exploration. In this study, similar to studies mentioned above on local environmental objectives in Polish participatory budgets, the descriptions of collected projects were coded with research-driven categories (here: related to urban climate change adaptation, "UCCA-related"). However, the categories were then inductively confronted with the text to form dictionaries of words related to the code's meaning. This approach enabled the automatisation and replicability of coding and recoding and performed precise calculations on coded datasets (here: a code co-occurrence and quantitative distribution of codes between editions, project's status, and budget's type).

The coding procedure consisted of several steps and combined inductive coding with quantitative data analysis. First, an initial inductive analysis of a test dataset of participatory budgets from other cities allowed us to identify the language of core activities related to the objectives of urban climate change adaptation in terms of greenery, water provision, sustainable transport, energy savings, pollution elimination, and wild animals. The objectives of UCCA were then further tested according to the vital vulnerable sectors of urban adaptation plans. The publication Let's Feel the Climate (2018), summarising the first wave of Polish urban adaptation plans, indicated nine vulnerable city sectors: Water and wastewater management, Public health, Transport, Energy, Spatial management, High-density areas, Biodiversity, Tourism, and Heritage. After a series of refinements based on the test database, city documents and a literature review, the 17 categories were clarified and described using dictionaries (as saved search terms of the MAXQDA Text Search function) composed of sets of Polish words that should help to identify urban climate change adaptation objectives in the quantitative content analysis. See the Supplementary Information for the list of saved search terms.

Several challenges emerged during coding, confirming previous observations that the effectiveness of text-based research tools depends on a given language's grammar and writing systems (Kwartler 2017; Dombrowski 2020). In the case of this analysis, for instance, the use of simplified one-word terms coding did not allow for capturing negation. Verification of whether a given project does not contradict its linguistic meaning (e.g., the demand to create parking spaces instead of a green square) was done manually. Also, the ambiguity and symbolic significance of terms related to greenery (e.g., "sztuczna trawa", "ogród jordanowski", "skatepark") was challenging to overcome by the selected software and required additional verification and coding adjustments. Finally, a more abstract range of activities related to vulnerabilities and accessibility, which was also associated with an open catalogue of possible solutions, was not translatable into an effective dictionary.

Another challenge was effectively coding entire descriptions, as the software allows only code phrases, sentences, or paragraphs. First, the search results based on the developed dictionaries were coded as sentences. Then, using the MAXQDA Complex Coding Query function with the commend "If inside", action descriptions containing meaningful sentences were coded accordingly to developed

categories. Most descriptions were assigned to several categories at the same time. Therefore, the unit of further coding analysis were fragments of text which could be encoded with several codes simultaneously.

To validate the coding, descriptions encoded with only one code were manually verified (the verification was intended to determine whether the description was encoded correctly and could be assigned to an additional category). As a result, the code tree was reorganised: a) the "Heat" category became a sub-code for the Greenery and Water category, b) the Nature Eco Sustainability category became a sub-code for Social activities, c) the "Cycling Walking" code was recoded into Cycling and Vulnerabilities (merged with "Risks"), d) the "Air pollution measures" category has been added to the "Pollution" category. Finally, descriptions not coded with pre-defined UCCA-related categories were coded as "Other projects" and verified by word cloud overview. They were mainly about the reconstruction of playgrounds, renovation and purchase of new items for local libraries, renovation of sidewalks and roads, and creation of parking lots.

Table 2 displays the frequency table of descriptions with and without the potential to support urban climate change adaptation, showing absolute numbers and relative frequency (percentage of descriptions coded by listed pre-defined codes on adaptation or not). This frequency measure can be used to monitor the overall representation of this issue in participatory budgets. It also provides a frequency table of encoded fragments, showing absolute numbers and relative frequency (percentage of fragments coded by listed pre-defined codes on adaptation).

Table 2. The frequency table of encoded descriptions and fragments – in total

	Number of coded descriptions	**Relative frequency of coded descriptions**
Main codes		
Other projects	1079	51
UCCA-related codes	1033	49
SUM	2112	100
UCCA-related codes		
	Number of coded fragments	**Relative frequency of coded fragments**
Greenery	573	32
Social activities	216	12
Nature Eco Sustainability	*140*	*8*
Cycling	193	11
Pollution	146	8

Table 2. Continued

	Number of coded descriptions	**Relative frequency of coded descriptions**
Air pollution measures	*6*	*0,33*
Water	136	8
Lighting	90	5
Wild animals	84	5
Vulnerabilities	80	4
Emergency services	45	2
Public transport	41	2
Cats Dogs	29	2
Climate Adaptation	18	1
Heat	6	0,33
SUM	1803	100

Source: author's work based on open-access data

The Code Matrix Browser function helped explore the code's co-occurrence (see Table 3). While the category of Emergency services was mainly exclusive, the rest tended to co-occur with each other. Sub-codes tend to co-occur with their parent-codes: Heat with Greenery and Water, and Nature Eco Sustainability with Social activities and Greenery. Among codes that demonstrated a co-occurrence with the most significant number of codes were Pollution, Greenery, Water, and Wild Animals. The highest overlaps (apart from subcodes) were among Greenery and Social activities and Greenery and Pollution.

Table 3. The codes co-occurrence

Coding tree	Greenery	Heat	Social activities	Nature Eco Sustainability	Cycling	Pollution	Air pollution measures	Water	Lighting	Wild animals	Vulnerabilities	Emergency services	Public transport	Cats Dogs	Climate Adaptation
Greenery		5	118	91	72	81		76	33	54	22		20	11	9
Heat	5					1		5	1	1			1		
Social activities	118			137	22	27		31	13	28	13	2	5		3

Coding tree	Greenery	Heat	Social activities	Nature Eco Sustainability	Cycling	Pollution	Air pollution measures	Water	Lighting	Wild animals	Vulnerabilities	Emergency services	Public transport	Cats Dogs	Climate Adaptation
Nature Eco Sustainability	91		137		16	25		25	12	28	6		5		3
Cycling	72		22	16		40		14	20	8	13		11	2	
Pollution	81	1	27	25	40		2	16	11	7	12	2	4	4	3
Air pollution measures						2						1			
Water	76	5	31	25	14	16			8	14	7	3	5		9
Lighting	33	1	13	12	20	11		8		3	6		4		
Wild animals	54	1	28	28	8	7		14	3		3		1	6	1
Vulnerabilities	22		13	6	13	12		7	6	3				1	1
Emergency services			2			2	1	3							
Public transport	20	1	5	5	11	4		5	4	1				1	
Cats Dogs	11				2	4				6	1		1		
Climate Adaptation	9		3	3		3		9		1	1				
Number of the codes co-occurred	**12**	**6**	**11**	**10**	**10**	**14**	**2**	**12**	**10**	**12**	**10**	**4**	**10**	**6**	**7**

Source: author's work based on open-access data

The dictionary-based text analysis identified several intersections between urban climate change adaptation objectives and descriptions submitted to local participatory budgets. Despite the limited use of words directly related to adaptation, mitigation, and climate change, almost half of the submitted descriptions can potentially support the objectives of UCCA. Therefore, even if the phrasing differs, UCCA is accepted locally.

Similarly to other studies on participatory budgets in Poland, the analysis confirmed that greenery-related activities are already recognised and actively implemented locally. This is an opportunity to enhance the adaptation efforts of urban administrative units by coordinating their activities while implementing participatory projects. For example, this could involve creating green routes or corridors between different urban areas or introducing new green initiatives to complement existing ones.

The extensive number of submissions in this category demonstrates the need for creating guidance and ideas on effectively promoting urban nature in response to climate change. This could include factors like selecting suitable plant species and incorporating rainwater collection. Recognising "green" aspects can also be used for educational purposes, such as promoting other urban climate change adaptation dimensions. The first five codes (Greenery, Social activities, Cycling, Pollution and Water) constituted over three-fourths of all fragments coded with adaptation-related codes. They correspond to some extent with the category described by Cabannes (2021), "a response to exact and immediate climatic effects", so they "tend to address effects of climate change. The passage suggests that besides "Cycling", which could be seen as a long-term solution to reduce emissions in public transport, the other projects are small-scale local adjustments, often in response to specific environmental challenges. This implies that a public discussion about long-term urban changes to tackle climate change would require additional participatory measures, such as civic panels.

3. Tends in trends in urban climate change adaptation objectives

In the next step, a quantitative distribution of codes was evaluated to examine how subsequent types of participatory budgets (editions, green vs. standard, implemented vs. non-implemented) differed. Due to differences in the length of descriptions and the number of reported activities in the analysed cities, the frequency table of encoded fragments between cities was not calculated.

3.1. Editions

Table 4 shows the frequency table of encoded descriptions among three analysed editions in absolute numbers and relative frequency [% of descriptions coded by listed pre-defined codes on adaptation or not]. The chi-square homogeneity test was performed (adapted from Geisler, Swarts 2019) to examine if subsequent editions have the same distribution of codes. A significant difference exists between the observed and expected frequencies of the coded descriptions in each edition, $X2\ (2, N = 2112) = 30.81$, $p < .00001$. Among significantly different code distributions, in 2022, there was a higher share of the "UCCA-related" category and a lower share of the "Other projects" category.

Table 4. The frequency table of encoded descriptions – three editions

Codes	Number of coded descriptions			Relative frequency of coded descriptions		
	2020	**2021**	**2022**	**2020**	**2021**	**2022**
Other projects	560	381	138	55	52	38
UCCA-related codes	455	355	223	45	48	62
SUM	1015	736	361	100	100	100

Source: author's work based on open-access data

Table 5 shows the frequency table of encoded fragments in absolute numbers and relative frequency [% of fragments coded by listed pre-defined codes on adaptation].

Table 5. The frequency table of encoded fragments – three editions

UCCA-related codes						
	Number of coded fragments			Relative frequency of coded fragments		
Editions	2020	2021	2022	2020	2021	2022
Greenery	220	207	146	31	32	34
Social activities	81	84	51	11	13	12
Nature Eco Sustainability	*44*	*56*	*40*	6	9	9
Cycling	99	65	29	14	10	7
Pollution	53	48	45	7	7	10
Air pollution measures	*2*	*0*	*4*	0,3	0,0	1
Water	57	48	31	8	7	7
Lighting	36	36	18	5	6	4
Wild animals	28	32	24	4	5	6
Vulnerabilities	34	33	13	5	5	3
Emergency services	24	12	9	3	2	2
Public transport	22	10	9	3	2	2
Cats Dogs	12	11	6	2	2	1

Table 5. Continued

UCCA-related codes						
	Number of coded fragments			Relative frequency of coded fragments		
Climate Adaptation	6	8	4	1	1	1
Heat	0	1	5	0,0	0,2	1
SUM	718	651	434	100	100	100

Source: author's work based on open-access data

The results demonstrate that submissions to the participatory budget can dynamically respond to changing local demand. However, the list of topics for submitted projects remains stable. This may indicate the strength of this measure in generating and testing new responses to already identified core challenges.

3.2. Types

Table 6 shows the frequency table of encoded descriptions among two analysed types of budgets (green and standard) in absolute numbers and relative frequency [% of descriptions coded by listed pre-defined codes on adaptation or not]. Again, the analysis based on the chi-square test of homogeneity was performed to examine if two types of budgets have the same distribution of codes. In this case, there is a significant difference between the observed and expected frequencies of the coded descriptions in each type, $X2\ (1, N = 2112) = 294{,}52$, $p < .00001$. Intuitively, green budgets have a lower share of the "Other projects" category among significantly different code distributions and a higher-than-expected share of the "UCCA-related" codes.

Table 6. The frequency table of encoded projects – two types of budgets

Codes	Number of coded descriptions		Relative frequency of coded descriptions	
	Standard	Green	Standard	Green
Other projects	1076	3	58	1
UCCA-related codes	777	256	42	99
SUM	1853	259	100	100

Source: author's work based on open-access data

Table 7 shows the frequency table of encoded fragments in absolute numbers and relative frequency [% of fragments coded by listed pre-defined codes on adaptation].

Table 7. The frequency table of encoded fragments – two types of budgets

UCCA-related codes				
	Number of coded fragments		Relative frequency of coded fragments	
Type	**Standard**	**Green**	**Standard**	**Green**
Greenery	345	228	26	47
Social activities	151	65	11	14
Nature Eco Sustainability	82	58	6	12
Cycling	187	6	14	1
Pollution	130	16	10	3
Air pollution measures	6	0	0,5	0
Water	103	33	8	7
Lighting	86	4	7	1
Wild animals	38	46	3	10
Vulnerabilities	75	5	6	1
Emergency services	45	0	3	0
Public transport	31	10	2	2
Cats Dogs	28	1	2	0
Climate Adaptation	13	5	1	1
Heat	2	4	0,2	1
SUM	1322	481	100	100

Source: author's work based on open-access data

The results reveal that issuing "calls" for particular projects, in this case focusing on green initiatives, has effectively popularised certain activities and could be utilised to promote other areas of local involvement. This is especially noteworthy as the results directly align the submitted descriptions with established priorities. However, the increasing share of "green" descriptions does not correspond to increased projects with convergent UCCA goals, such as addressing water-related issues or heat prevention.

3.3. Status

Calculating a frequency table of encoded descriptions among implemented (status: IN_PROGRESS, WINNING, DONE, ADVANCED) and not-implemented (status: LOSING, REJECTED, VERIFIED) projects was also possible. Again, there is a significant difference between the observed and expected frequencies of the coded descriptions in these two types of projects, X2 (1, N = 2112) = 24,95, p < .00001. Among significantly different code distributions, there is a lower share of the "Other projects" coding category among implemented projects and a higher-than-expected share of the "UCCA-related" codes. (See Table 8).

Table 8. The frequency table of encoded descriptions – two types of implementation status

Codes	Number of coded descriptions		Relative frequency of coded descriptions	
	Implemented	Not Implemented	Implemented	Not Implemented
Other projects	367	712	44	55
UCCA-related codes	461	572	56	45
SUM	828	1284	100	100

Source: author's work based on open-access data

Table 9 shows the frequency table of encoded fragments in absolute numbers and relative frequency [% of fragments coded by listed pre-defined codes on adaptation].

Table 9. The frequency table of encoded fragments – two types of implementation status

UCCA-related codes				
	Number of coded fragments		Relative frequency of coded fragments	
Type	Implemented	Not Implemented	Implemented	Not Implemented
Greenery	300	273	37	27
Social activities	110	106	14	11
Nature Eco Sustainability	80	60	10	6
Cycling	40	153	5	15
Pollution	41	105	5	10

UCCA-related codes				
	Number of coded fragments		Relative frequency of coded fragments	
Type	Implemented	Not Implemented	Implemented	Not Implemented
Air pollution measures	0	6	0,0	1
Water	56	80	7	8
Lighting	27	63	3	6
Wild animals	58	26	7	3
Vulnerabilities	25	55	3	5
Emergency services	25	20	3	2
Public transport	17	24	2	2
Cats Dogs	9	20	1	2
Climate Adaptation	9	9	1	1
Heat	5	1	0,6	0
SUM	802	1001	100	100

Source: author's work based on open-access data

The results show that more projects related to adaptation have been implemented. The breakdown of subcategories shows that this increase is mainly due to projects related to greenery. However, this may be because there is a focus on prioritising "green" projects in dedicated budgets.

4. Conclusions

The findings illustrate that the existing database of participatory budget projects serves as a valuable repository of data regarding local sentiments on matters pertaining to UCCA. In line with past studies, the findings validate the popularity and prominence of environmental concerns, specifically activities related to greenery, within the participatory budgets of the Upper Silesian-Zagłębie Metropolis.

Nevertheless, the dictionary-based analysis offers further insights. Firstly, it was estimated that almost half of the descriptions from the analysed database may concern various aspects of UCCA, even though they usually do not directly mention this topic. Secondly, a stable trend was observed in the distribution among

multiple elements of UCCA in project descriptions. Still, most UCCA-related fragments address direct, observable, local environmental problems. Therefore, the quantitative distribution of coded descriptions and fragments suggests that a participatory budget database could be regularly monitored to identify potential trends in project submissions. For instance, this could be used to ascertain whether and to what extent the list of project topics changes from edition to edition or to validate the effectiveness of targeted "calls for projects".

On the other hand, applying the 'text as data' approach to the available participatory budgets database revealed several challenges and still has some methodological limitations. Firstly, the attempt to balance the simplicity and repeatability of the analysis procedure with the accuracy of the coding limited the possibilities for in-depth analysis. In addition, manual verification was required, compromising the effectiveness of a semi-automated technique. Secondly, the quantitative analysis of qualitative data ultimately needed to combine two independent procedures: qualitative (based on the functions of available software) and quantitative (based on the adaptation of a statistical tool). This exposed the analysis to the double risk of limitations associated with both methods. One solution was summarising a research protocol in a set of comments programmed in R or Python. However, its use would require additional programming skills and pre-preparation of the input data.

In conclusion, monitoring the UCCA issue based on a participatory budget database can be a valuable source of local environmental targets. However, several methodological adjustments were necessary in the case presented, based on a cautious review of both the process and the results obtained. Also, due to the specific selection of the sample and the criteria for identifying adaptation actions (based on urban adaptation plans), it is advisable to verify the proposed method of analysis on a more prominent and randomised database. The target method for identifying categories of search terms can be developed in a participatory manner or in the context of identifying local adaptation priorities, which is enabled by this methodological proposal's flexible, data-driven nature.

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Supplementary Information for the article

Tested dictionaries to identify urban climate change adaptation objectives in the quantitative content analysis of participatory budgets (PB).

Category of PB actions	**Search terms**	**Examples of related actions from Polish urban adaptation plans**	**Vulnerable city sectors (Let's feel the climate, 2018)**
Air pollution measures	czujni*	*"rozbudowa monitoringu jakości powietrza w mieście", "poprawa jakości powietrza"*	Public health
Cats Dogs	pies psy psa kot koty psami kotami psem kotem czworonog*	*"budowa nowego schroniska dla zwierzą w lokalizacji eliminującej zagrożenia dla zdrowia i życia zwierząt", "poidełka z wodą dla zwierząt"*	Biodiversity
Climate adaptation	klimat klimatu klimatem adaptacja adapt* mityga* suszę suszy	*"kształtowanie struktury funkcjonalno-przestrzennej, w tym terenów zielonych, które regulują klimat lokalny, retencjonują wodę łagodząc zarówno skutki suszy jak i powodzi"*	Public health
Cycling	rower*	*"Wsparcie dla zrównoważonej mobilności: rozbudowa sieci ścieżek rowerowych z infrastrukturą (stojaki, wiaty) w miejscach publicznie dostępnych i ograniczenie ruchu samochodowego w śródmieściu"*	Transport
Cycling walking	rower* przejście* pieszych piesi	*"powiązanie systemu komunikacji pieszej i rowerowej z układem ciągów zieleni miejskiej i podmiejskiej"*	Transport
Emergency services	ratownictw* straża* pogoto* reanima* osp OSP ratownicz*	*"Zwiększenie możliwości reagowania na zagrożenia ze strony służb kryzysowych i Straży Miejskiej", "Wzmocnienie służb ratowniczych z uwzględnieniem zmian klimatycznych"*	Public health

Category of PB actions	**Search terms**	**Examples of related actions from Polish urban adaptation plans**	**Vulnerable city sectors (Let's feel the climate, 2018)**
Greenery	drzew* ziele* łąk* *krzew* nasadz* traw* park parkiem parku zielo* ogród* ogrodo*	*"Zwiększenie powierzchni miejskich terenów zieleni, zwartej i przyulicznej, terenów użyteczności publicznej, rewitalizacja skwerów, alei i parków", "tworzenie ogrodów kieszonkowych"*	Biodiversity Spatial management
Heat	upal* upał upałem upału	*"Łagodzenie zagrożeń wynikających z fal upałów i miejskiej wyspy ciepła"*	Public health
Lighting	lamp* świetln* led*	*"Realizacja działań w zakresie rozwoju energooszczędnego systemu oświetlenia przestrzeni publicznych"*	Energy
Nature Eco Sustainability	przyrod* eko* zrówno* natura*	*"Edukacja klimatyczna i ekologiczna wraz z rozwojem bazy dydaktyczne", "Rozwój współpracy w zakresie badań naukowych środowiska miejskiego w aspekcie diagnozy zagrożeń klimatycznych dla mieszkańców, infrastruktury miejskiej oraz przyrody"*	Public health
Pollution	zanieczyszcz* śmieci* emisj* węgla węglowego	*"Współpraca z przedsiębiorcami i przedstawicielami sektora przemysłu w zakresie ograniczenia emisji zanieczyszczeń do środowiska i wsparcia dla inwestycji w OZE", "Stosowanie rozwiązań ograniczających dopływ zanieczyszczeń do odbiorników wraz ze spływem powierzchniowym"*	Public health
Public transport	termomo* tramwaj* autobus*	*"Dostosowanie systemu komunikacji publicznej do zagrożeń", "Poprawa warunków podróży komunikacją zbiorową"*	Transport

Category of PB actions	**Search terms**	**Examples of related actions from Polish urban adaptation plans**	**Vulnerable city sectors (Let's feel the climate, 2018)**
Risks	zagrożen* ryzyk* wrażliw*	*"Opracowanie systemu prognoz wpływu zagrożeń klimatycznych z uwzględnieniem rozwoju miasta", "Przegląd i korekta istniejących planów zarządzania kryzysowego w mieście w zakresie wystąpienia zagrożeń"*	Public health
Social activities	wspól* sąsiedzki sąsiedzkie sąsiedzki sąsiedzkich sąsiad sąsiadka sąsiedzi współprac* zaangaż*	*"Edukacja społeczna: promowanie postaw proekologicznych i współodpowiedzialności za jakość życia i bezpieczeństwo w zmieniających się warunkach klimatycznych", "tworzenie ogrodów kieszonkowych, które mogą pełnić także funkcje społeczne, jako miejsca integrujące mieszkańców"*	Public health
Vulnerabilities	Inductive coding (no dictionary available)	*"Tworzenie sieci wsparcia dla osób starszych", "Instytucjonalne i organizacyjne wzmocnienie odporności miasta na zmiany klimatu lub na ekstremalne zjawiska klimatyczne", "Zwiększenie dostępności miejskiej, niskoemisyjnej komunikacji publicznej"*	Public health
Water	wodn* tężni* źród* rzek* zbiorn* retencj* deszcz* nieck* zraszacz* studn* wody poide* fontann*	*"budowa i rozwój systemu błękitnej i zielonej infrastruktury", "budowa systemu optymalizacji zużycia wody w mieście", "Zwiększenie dostępności do wody na obszarze Miasta"*	Water and waste water management
Wild animals	zwierzą* zwierzę* jeży* jerzyk* motyl* owad* przczo* pszczó* ptak* dziki kaczk* dzików	*"Czynna ochrona siedlisk przyrodniczych i gatunków chronionych", "Kształtowanie struktur przestrzennych zapewniających utrzymanie różnorodności biologicznej"*	Biodiversity