Does secondary data suffice? Protected area conflict analysis in the era of the COVID-19 pandemic

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Research Article

Keywords: nature conservation, conflicts, social sciences, mixed-mode methodology, Central and Eastern Europe, public statistics

Posted Date: June 21st, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1753761/v1

Abstract

The COVID-19 pandemic has affected an established way of analysing protected area (PA) conflicts. A compelled turn towards a broader use of secondary data evokes doubts about validity of the results unless restrictive assessment procedures are implemented. To address this need, we propose a three-fold (theory-, method-, and cross-scale simulation-driven) approach to assess usefulness of a state register dataset and a group of methods of the indicator analysis for recognizing PA conflict determinants at the regional and local level. With the ultimate aim to inform case study selection, we used 187 relevant indicators from the Polish Central Statistical Office register for a Lesser Poland region and processed them using principal component/exploratory factor and cluster analyses. We distinguished five types of PA conflict determinants in a region ('urbanity', 'agriculture', 'tourism', 'small-scale entrepreneurship' and 'sprawl') and respective groups of clusters comprising local-level units. Then, we selected one cluster to juxtapose the results with secondary data from another source (Internet content) for a specific PA. We confirmed that reported conflict issues corresponded with indicator-derived descriptors of the cluster. However, secondary data from the state register failed to address the key prerequisites of PA conflicts (parties' interests and their mutual perception). Overall, our approach can serve as a proxy for a multi-level PA conflict determinant analysis in crisis conditions such as COVID-19, provided it synthesises the results of various methodological approaches, followed by in-person inquiries in the selected case studies.

1. Introduction

The COVID-19 pandemic has afflicted considerable strain on conservation social sciences (Wardropper et al. 2021). It has not only affected human-nature relationships (Buckley 2020; Souza et al. 2021), but also hindered the process of investigating these relationships, especially when conducting in-person interviews with stakeholders (Howlett 2022; Thunberg and Arnell 2021). In the field of PA conflict, the impact of the pandemic is even more challenging for scholars. Now, as open disputes have been hindered due to social distancing requirements (Smith et al. 2021), many conflicts may have taken the layer of 'underlying conflicts' (Crespin and Simonetti 2021; Madden and McQuinn 2014; Zimmermann et al. 2020), which makes capturing actors' perceptions more demanding. This adds to other conflict-inducing challenges to managers caused by the pandemic in PA socio-ecological systems, such as the reduction of financial viability of PA stakeholders, an increase in their level of emotional stress (Smith et al. 2021), higher pressure from domestic tourists on local PAs (Strzelecka et al. 2021a), or limitations of the number of PA visitors due to pandemic restrictions (Jones et al. 2021). Simultaneously, environmental policies worldwide, such as the latest EU 2030 Biodiversity Strategy (EC 2020), require increasing efforts to designate new PAs or expand existing ones. Thus, comprehensive studies of PA conflicts remain urgently needed.

During the last two years of the pandemic, social science researchers have had to adapt their well-established methodology to new conditions. As the availability of respondents decreased and data collection in many studies were moved online (Howlett 2022), the pandemic affected the reliability of

quantitative social studies (Bueddefeld et al. 2021), influencing both study designs and sampling. Consequently, the mixed-mode methodology tends to be more often acclaimed (Dales and Kottmann 2021; Fetters and Molina-Azorin 2021) to provide information which could currently be missing from field studies. Specifically, standard data collection processes may be replaced by data triangulation using available secondary data. Such a turn in research practice requires reinforcement of the role of quality assessment at every stage of the research process, from selection of the available secondary data through various modes of its processing and analysis. However, considering the multi-level character of PA socio-ecological systems (Cumming et al. 2015), it is a case study selection stage which becomes the bedrock of any further analysis and requires utmost attention.

The use of secondary data provided by public statistical offices (census data, public statistics, and indicators) has been accepted in theories of PA conflicts (or, more broadly, CCs), especially if they are enriched with empirical social data (Rechciński et al. 2019; Redpath et al. 2013; White et al. 2009). However, there are two concerns stemming from the many conceptual frameworks. First, most secondary data indicators are assumed to present 'actual' measurements of certain conflict properties, with a positivist claim for their objectivity (Moon and Blackman 2014; Rosenberg 2008). As such, they should never be confused with stakeholders' constructions of reality, the clash of which is the actual reason for the conflict emergence (Rechciński et al. 2019; Redpath et al. 2015a; Redpath et al. 2013). Second, even if a researcher interprets the secondary data only as a proxy for 'conflict potential' (White et al. 2009) recognition, one should remain cautious about spatial mismatches of indicators that represent various groups of conflict determinants (Redpath et al. 2013). In fact, some conflict properties inherently adhere to different scales (Cash et al. 2006; Cumming et al. 2015; Rechciński et al. 2019), e.g., institutional/economic determinants to the management, jurisdictional or institutional scales, socio-cultural determinants to the network scale, and environmental determinants to the spatial scale. PA management itself relates to different geographical scales that may overlap on some levels but diverge on others, and this adds to the complexity. Specifically, the institutional framework of a PA system (here referred to as 'a spatio-institutional scale') may not fully adhere to an administrative division of a country (here: 'a spatio-administrative scale'). Although it is possible to obtain relevant indicators reduced to one of the scales, most often, the researcher faces a trade-off between a multi-determinant spectrum of the available indicators and scale-related consistency of the whole dataset.

Nevertheless, in CC studies, societal indicators are widely used (e.g. Andonegi et al. 2021; König et al. 2021; St John et al. 2021), and this is expected to increase due to the growing availability of relevant big data (Haslam 2020). However, the unification of indicator-driven results at a particular level of a certain scale is less commonly performed than, for instance, in the broader field of land use conflicts (Cieślak 2019; Cieślak and Biłozor 2021; Dong et al. 2021). In the new conditions, we argue that a multi-perspective assessment of the dataset and the entire process is required to maintain validity of multi-level PA conflict analysis.

To fill this gap, we performed a regional study, based on secondary data from the Polish Central Statistical Office register, that aimed to (1) identify the main types of PA conflict determinants in the

selected region, recognise their local-level clusters, and their spatial structure that can work as a basis for informed site selection and (2) assess the usefulness of the analyses for recognising PA conflict determinants at every stage of the research process (data collection, preparation, analysis, and triangulation). Three perspectives were used for the assessment:

1. theory-driven, to discuss the data and results from the perspective of PA conflict theory;
2. method-driven, to compare various methods of data analysis and to provide heuristics based on the comparison;
3. cross-scale simulation-driven, to verify whether the obtained premises for a case study selection (cross-level analysis of a spatio-administrative scale) correspond with evidence for a specific PA conflict (a level of a single tenure unit, spatio-institutional scale) from another source of secondary data.

The whole process was guided by the general aim of providing a proxy for scholars to study PA conflicts in a multi-level, mixed-mode manner in times of reduced access to PA stakeholders, such as the COVID-19 pandemic.

2. Methods

2.1. Study area

To ensure the best possible balance between the availability of indicators and their spatial consistency, we limited our study to a single country with a unified hierarchy of administrative units. We chose Poland to build on the existing systematic literature review of PA conflicts in this country (Rechciński et al. 2018; see Online Resource 1 for a summary). Following the referential theoretical framework for PA conflict analysis (Rechciński et al. 2019), we narrowed the spatial scope of the study to a regional level. Of the 17 NUTS2 units of Poland (CSO 2022), we selected a Lesser Poland voivodeship due to its highest diversity in terms of historical, cultural, physico-geographical, and nature conservation conditions (see section A in Online Resource 1 for a sketch map and broader rationale for the selection).

2.2. Data collection

The list of conflict factors[1] in Poland that could be presented on an interval measurement scale was prepared based on a systematic review of all relevant manuscripts stored in the Web of Science database published between 2007 and 2020 (Rechciński et al. 2018; Fig. 1, step A; see Online Resource 2 for a complete list of papers). In the case of a compound character of a reported factor (e.g., socio-economic development), we looked for variables used in the domestic literature to describe such a factor (Fig. 1, step B; Tab. A in Online Resource 3 provides a complete list of the factors, selected variables, and sources of their use).

We used secondary data indicators from the Local Data Bank of the Central Statistical Office of Poland (LDB CSO 2021), which has been widely used as a source dataset to compare local-level units (e.g.

Bartkowiak-Bakun 2017; Dziekański and Prus 2020; Pawlik and Dziekański 2021). For each of the specified variables, we checked their availability in the register at the local level [i.e., LAUs, according to Eurostat nomenclature (Eurostat 2021)]. If existent, we downloaded relevant records for all 182 municipalities in the Lesser Poland voivodeship for a set timeframe (2007–2020). Ultimately, we managed to download data for 187 variables from 80 different LDB subgroups (Fig. 1, step C).

2.3. Data preparation

The data preparation phase was guided by the intention of using principal component/exploratory factor analysis (PCA/EFA) for the initial reduction of the dataset and exploration of its latent constructs (Jolliffe and Cadima 2016; Widaman 1993). In order to cover both substantial and processual dimensions (Rechciński et al. 2019) of the analysed conflict indicators, for most of the collected variables (depending on the data availability), we calculated an arithmetic mean value for a set timeframe (2007–2020 or shorter) and a trend value, using a slope function in MS Excel. This increased the number of variables to 334 (Tab. C in Online Resource 3 for a whole list).

After normalisation or standardisation of the values (Fig. 1, step D), we performed both classification and typology of the variables into four groups of PA conflict determinants: socio-cultural, institutional, economic, and environmental (Rechciński et al. 2019). For data classification, the official structure of the LDB dataset was used. For data typology, we looked back at the rationale for using certain variables in the reviewed articles on PA conflicts in Poland. As the variables always stemmed from specific conflict factors, we used these factors to make additional assignments, retaining the one already made during the classification process (Fig. 1, step E). Consequently, some variables achieved as many as three different conflict determinant descriptors, but there were others still left with only one descriptor (see Tab. A in Online Resource 3).

As the number of variables was too large to meet PCA/EFA assumptions (Xu et al. 2013), we excluded some of the variables prior to the actual analyses (Fig. 1, step F; see Tab. C in Online Resource 3 for a complete list of variables and Online Resource 4 for exclusion criteria).

2.4. Data analysis

To control the impact of the analytical method or input data transformation on the final result, we compared the results of 18 separate analyses (Fig. 1, step G). This included combinations of the following sets of assumptions (later referred to by the acronyms in the quotation marks).

1. Principal component analysis (PCA) and exploratory factor analysis (EFA) with:
2. Mean and trend values < *μ&a* > vs. only mean values < *μ only* > as input data.
    a. (for < *μ&a* > only) normalised values < *01* > vs. standardised values < *z-sc.*> as the input.
3. Pre-defined groupings of variables based on a theoretical model of conflict determinants < *pre-def.*> vs. no such groupings < *all var.*>

a. (for < *pre-def.*> only) 1-step vs. 2-step analyses

The use of PCAs and EFAs is quite common in the field of CCs, with PCAs being used more often to reduce the number of analysed indicators (Rangel et al. 2007; Recatalá and Sacristán 2014) and EFAs to recognise latent constructs behind scale-based statements of interviewed stakeholders (Chamberlain et al. 2012; Digun-Aweto et al. 2022). We applied both as intended to achieve both aims and the mathematical outputs of the two procedures are not always similar (Widaman 1993).

All analyses were performed using IBM© SPSS© Statistics version 27. For the *< 1-step; pre-def.>* procedures, we performed four separate PCAs, one for each group of determinants. The only difference between *< pre-def. PCAs >* and *< pre-def. EFAs >* was a selection of variables for the analyses. For the PCAs, we used classified variables (each of them could have been used for one analysis only), whereas for EFAs, the same variables could have been repeated across the analyses. This intentionally violated the assumption of the orthogonal character of principal components (PCs) (Abdi and Williams 2010) and allowed us to interpret them as factors (Fs). In < *2-step* > procedures, the resulting PCs/Fs were used as input data for another PCAs[2] to reduce the final numbers of PCs/Fs to the same levels as in the *< all var.>* versions. When it was necessary, we performed dimension reduction of the variables until positive definite correlation matrix and target KMO ≥ 0.5 were achieved (Digun-Aweto et al. 2022; Yong and Pearce 2013; see Online Resource 4 for more details of the applied procedures).

To generate a geographical image of PA conflict determinants in Lesser Poland, we performed a set of clustering procedures, using the component/factor scores from the analyses with KMO values exceeding 0,5 (Fig. 1., step H). We proceeded with a hierarchical cluster analysis using Ward's method of clustering (Mingoti and Lima 2006). Every analysis was preceded by a test one, which was performed to determine the desirable number of clusters. The target numbers were specified based on the analysis of dendrograms, and each time, we selected a level of clustering at which Kraków, the capital of the region, was left as a one-element separate cluster (Fig. 1., step H; see section A in Online Resource 1 for more arguments for the decision, and Online Resource 4 for the other approach considered).

2.5. Format of results presentation

We applied a synthetic approach for the presentation of results for the first aim of the study and an analytical and case study approach for the results supporting the second aim.

To present a structure of PA conflict determinants in Lesser Poland, we compared all the obtained < *all var.*> and < *2-step pre-def.*> PCs/Fs (Fig. 1, step J). Based on the detected similarities, we distinguished five types of sets of PA conflict determinant sets. We then interpreted and described them by looking at the variables or < *1-step pre-def.*> PCs/Fs that most strongly loaded < *all var.*> or < *2-step pre-def.*>PCs/Fs, respectively.

We then collected all ten results of hierarchical clustering, which resulted in spatially informative results. As the number of clusters differed across the analyses, we classified them into five universal groups. Subsequently, for every municipality, we calculated the number of assignments for each cluster group. A

municipality was ultimately assigned to a cluster group which had been assigned most often across different versions of the analysis[3]. In the last step, some assignments were respecified based on the structure of cluster groups from versions of analyses that resulted in a larger number of clusters (Fig. 1, step J).

We assessed the usefulness of the obtained results using a comprehensive conceptual framework to study PA conflicts (Rechciński et al. 2019) as a benchmark. Specifically, we inspected whether the dataset and output were complete from the perspective of theoretical requirements (Fig. 1, step k). At the analytical stage, we compared all variants in terms of their numeric characteristics (no. of excluded variables; no. of required iterations, KMO values, no. of the determined clusters) and interpretive power. All observations have been presented in the form of lists of advantages and disadvantages of certain methods (Fig. 1, step K).

Finally, for the case study analysis, we selected one cluster of municipalities similar in terms of their PA conflict determinants, which we assessed as most closely associated with a particular PA[4] (Fig. 1, step L). Responding to the recent trend of using text mining in the field of environmental conflicts (e.g. Haslam 2020; Lee and Kim 2020), we used a Google search© engine to search all Polish websites and PDF/DOC files that included "*(name of the PA)* AND conflict* OR dispute" search terms. We downloaded all search results using Octoparse© software (Fig. 1, step M) and coded them in a MAXQDA 2020©, using a single search record as a measurement unit[5]. We applied an open coding approach (Glaser 2016), trying to recognise and name the addressed conflict issues (Rechciński et al. 2019) and then categorised the codes into a hierarchical structure (Fig. 1, step N). Finally, we qualitatively assessed whether an indicator-based description of the relevant cluster (cross-level analysis, spatio-administrative scale) was reflected in the second source of secondary data (Fig. 1, step o) describing a single tenure unit on a spatio-institutional scale. When it was necessary, we supplemented the descriptions with indicators that adhered to the latter level and scale.

[1] Following a terminology proposed by M. Rechciński et al. (2019), we differentiate conflict determinants and conflict factors. 'The latter may refer to different conflict dimensions, while (…) 'conflict dimensions' and 'conflict determinants' are two separate major conflict components.' (p. 2470).

[2] In <2-step> procedures, the extraction of factors using a principal axis method failed as communalities of some variables exceeded 1.0.

[3] In case of seven municipalities, an arbitrary decision had to be made due to the equal number of the two most frequent assignments. Ultimately, the units were classified to the 'rural loc. under transition' cluster as best describing boundary objects.

[4] Note that municipalities and PAs belong to different spatial scales [the former – to a spatio-administrative scale, while the latter – to an institutional scale, as specified by G. Cumming et al. (2015)].

There are examples of municipalities containing a number of PAs, while there are also PAs located in more than one municipality.

[5] For some of PDF/DOC files we found acceptable to assign more than one code to the search record, as they contained more complex descriptions of the conflict context, addressing more than one conflict issue.

3. Results And Discussion

3.1. Determinants of PA conflicts in Lesser Poland based on state register secondary data

The final typology of PA conflict determinants in Lesser Poland was mainly driven by the structure of economic determinants (see Online Resource 5 for an extensive presentation of all results). This can be partially explained by the predominance of economic variables in the initial dataset. However, economic PCs/Fs were also the strongest in *< pre-def.>* procedures which were performed to balance such disproportions. The 2-step procedures revealed that the top five economic PCs/Fs had their analogues in a social and partially in an environmental group of determinants. This was not the case for an institutional group of determinants which offered only one PC/F that contributed to the final cross-determinant set of PCs/Fs (Table 1).

Table 1
Typology of PA conflict determinants in Lesser Poland (see Section A in Online Resource 1 for a region-specific explanation).

Types of PA conflict determinants in Lesser Poland	**Selected < *1-step pre-def.*> principal components / factors and their description**			
	Economic	**Social**	**Institutional**	**Environmental**
1. ”urbanity”	Urban economy (well-developed infrastructure, specialised services, high but dropping share of own revenue)	Urban population and society (high population density, high employment, good access to social services)	*No clear association*	Urban environment (urbanized / industrial lands, urban greenery, water pollution)
2. “agriculture”	Agricultural economy (incl. well-developed but dropping administrative sector)	Ageing society	Large properties	Agricultural lands, high eutrophication
3. “tourism”	Tourism industry (tourist infrastructure, large no of EU grant applications)	Tourist density	*No clear association*	National parks, forests (private forest removals)
4. “small-scale entrepreneurship”	negative loads Public sector (low share of subventions and targeted grants, low total revenue per capita)	Working-class society	negative loads Large properties	*No clear association*
5. “sprawl”	Residential investments (incl. specialised services, high entrepreneurship)	Inflow of inhabitants, high standards of living	*No clear association*	*No clear association*

All five types of PA conflict determinants in Lesser Poland could be easily referred to as five universal groups of PA conflict clusters: urban-like, agricultural, tourist, other rural localities, and rural localities under transition. However, having the results of *< 1-step; pre-def.>* procedures with a larger number of PCs/Fs, we obtained a more diverse and specific final images of the 14 clusters (Fig. 2 and Table 2). In addition, the relationship between the types of PA determinants and the resulting clusters was not straightforward, as clustered municipalities were always described by a combination of component/factor scores. In other words, no municipality could be considered a perfect example of a type of PA conflict determinants. For instance, Kraków, the capital of Lesser Poland voivodeship, the second largest city in the whole country, and the only 1-element cluster on the map (Table 2., a cluster ‘0’), differed from the other clusters mostly in terms of ‘urban’ component/factor scores. However, at the same time (Kraków Municipal Office 2021; Romańczyk 2018): 1) there is still app. 7,000 ha of arable land within the administrative borders of the city (large ‘agricultural’ scores despite remaining out of

‘agricultural’ ‘3x’ clusters), 2) before the COVID-19 pandemic, Kraków received up to 14 million visitors yearly (high ‘tourist’ scores, yet out of ‘4x’ clusters), 3) over 35% of the city budget are public grants and subventions (negative ‘small-scale entrepreneurship’ scores), and 4) over the last two years, almost 20,000 new residential investments have commenced (high ‘sprawl’ scores, yet outside of ‘2x’ clusters). Finally, the extended set of clusters exposed new groups of determinants and, in some cases, the processual dimension of the determinants. This mainly concerns institutional determinants that describe a level of spatial planning in a municipality[6] and a few environmental factors (growing water pollution that describes a cluster ‘1a’ or types of cultivated crops/agricultural lands that helped in specifying rural clusters).

Table 2
List of clusters of municipalities in Lesser Poland, similar in terms of their PA conflict determinants.

No.	Merit description	Geographical description
0.	Kraków	
1.	Urban clusters other than Krakow	
1a.	Large cities with growing industry	*Oświęcim and Tarnów only*
1b.	Subregional urban centres with tourism and residential sprawl less important than in Kraków	*Bochnia, Limanowa, Nowy Sącz, Gorlice*
1c.	Urban-rural localities with strong private entrepreneurship and mild outflow of inhabitants	*North-western part of the region and 2nd - rate subregional urban centres*
2.	Rural localities in transition	
2a.	Most intense urban sprawl	*A belt of closest municipalities around Kraków*
2b.	Other rural-urban localities with strong private entrepreneurship and agriculture directed to industrial/fodder crops	*Second-rate belt around Kraków and three linear zones towards north, west and east from Kraków*
3.	Agricultural clusters	
3a.	Most intense agriculture on large-scale properties and with a strong role of public sector with an ageing society	*Most north-eastern part of the region*
3b.	Other agricultural localities with less advanced ageing process and higher share of industrial/fodder crops	*The rest of the north-eastern part*
4.	Tourist clusters	
4a.	Mass tourism with national parks and high rate of private forests removals	*Tatra NP municipalities and Czorsztyn and by the Dunajec River Gorge in Pieniny NP*
4b.	Rural tourism with forests and protected areas	*Zawoja in Babia Góra NP and other Tatra NP and Pieniny NP municipalities*
4c.	Tourism, forestry, and outflow of inhabitants	*Spa tourism municipalities in south-eastern part of the region*
5.	Other rural clusters	
5a.	Localities with forests, pastures, landscape protection and young society	*Central-southern mountainous municipalities*
5b.	Localities with higher role of private sector	*Central-western and central-eastern mountainous municipalities*
5c.	Localities with poor spatial planning	*Scattered municipalities, mostly in Tarnów subregion*

3.2. Usefulness assessment of the analyses and dataset

3.2.1. Assessment based on a theory of PA conflicts

Despite the rich character of the obtained results, their application to PA conflict studies encompasses certain limitations derived from the theory of PA conflict. This is mostly because secondary-data indicators from official data banks do not provide insight into key prerequisites of conflicts (Rechciński et al. 2019; Redpath et al. 2015a; Redpath et al. 2015b), which are conflicting interests of parties and mutual perception of these interests. The other prerequisite, the involvement of at least two conflicting parties, is also difficult to determine based only on secondary data. However, with the knowledge of the general context of PA conflicts in a certain country, it is possible to identify potential stakeholders that clash with an 'environmental coalition' (Blicharska et al. 2020; Niedziałkowski 2016) for specific clusters. In our study, these could be real estate developers and local authorities (Table 2., clusters '2x'; Zawilińska 2020), large-scale agricultural owners (clusters '3x'; Jankowiak et al. 2015), State Forest officials (clusters '4c'; Olko et al. 2011), small-scale property owners (clusters '5x'; Grodzinska-Jurczak and Cent 2011), 'tourist entrepreneurs' (clusters '4x'), or some types of tourists and private forest owners (a cluster '4a' – see subsection 3.3.3. for cross-scale confirmation). In addition, the high absolute values of different component/factor scores for Kraków support the claim that the highest potential for complexity of clashing stakeholders and interests occurs in big cities (Prins et al. 2017; Taylor et al. 2022).

As the dataset does not fully cover the definition of PA conflict, it does not reflect many attributes of the conceptual framework for studying PA conflicts. This mainly concerns attributes that represent the constructionist/constructivist part of PA conflict inquiries (Rechciński et al. 2019). Specifically, the dataset used in our study does not contain any measures of psychological and individual-level determinants of PA conflicts (Fig. 3), despite growing recognition of these aspects in current CC studies (Arbieu et al. 2021; Teixeira et al. 2021). Additionally, variables classified into social or institutional groups of determinants do not represent the crucial properties of PA conflicts, such as social norms (Jordan et al. 2020), measures of social trust (Young et al. 2016), models of decision-making, or power imbalances (Gonzalez-Hildago and Zografos 2020). Nevertheless, 'positivist' properties of conflicts can still be useful in interdisciplinary conflict analysis, provided they are interpreted only as the probable subject of further stakeholders' recognition (Rechciński et al. 2019).

Our attempts to address the processual dimension of PA conflicts (Rechciński et al. 2019) proved to be moderately successful, as the ultimate impact of trend values on the final results was not crucial (see section B in Online Resource 5 for more details). Simultaneously, the results of all EFAs confirmed the vital role of interactions across different groups of determinants (Rechciński et al. 2019), as the resulting factors were always loaded by variables from all groups. Finally, we addressed the need for data-driven PA conflict typology (Hellström 2001). In our case, results of both PCAs/EFAs and cluster analyses may work as a proxy for such typology, however we find the latter to be more informative, as clusters contain a

more ‘realistic’ combination of conflict properties (e.g. not restricted by the assumption of orthogonality of PCs) and provide a cross-level picture of the subject (Fig. 3).

Some sources of database incompleteness stem from our conservative approach for input data selection. As a trade-off, some important PA conflict properties that can be presented in the form of interval secondary data were not included into the analysis (Table 3; Tab. B in Online Resource 3).

Table 3
Selection of interval-scale PA conflict data missing in the analysis.

Data availability	Examples and evidence for their role in PA conflicts in Poland
Not in Local Data Bank (partially achievable in other datasets)	Tourism-related indicators (number of one-day visitors, structure of tourism and tourist infrastructure – e.g., length of ski lifts) - (Olko et al. 2011; Zawilińska 2020) Biological diversity - (Niedziałkowski et al. 2012a, b)
Available in LDB but only for higher levels of spatial / administrative scale	Operational data of State Forests - (Blicharska et al. 2020; Niedziałkowski et al. 2014) Share of Natura 2000 size in a municipality - (Grodzinska-Jurczak and Cent 2011; Strzelecka et al. 2021b) Hunting data - (Olko et al. 2011)
Available in LDP for a local level but only in short time sections	Most of agricultural data – (Borkowski et al. 2019; Jankowiak et al. 2015) Land use data - (Maczka et al. 2019; Wilkaniec et al. 2020) Water management investments - (Bielecka and Różyński 2014; Wiatkowski et al. 2017)

As PA conflicts, by definition (Rechciński et al. 2019, p. 2489), are connected with the existence of PAs, we inspected the role of PA-related variables in types of PA conflict determinants and stemming clusters. The role of PAs proved to be most important for a ‘tourist’ type and clusters (‘4a’ – national parks; ‘4b’, ‘4c’ – across various legal designations). Additionally, a rural cluster ‘5a’ was partially connected with protected landscape areas (more details about legal designations of PAs in Poland – section B in Online Resource 1). However, the overall impact of these variables on the results was low, which is evident from the map of clusters; 24 municipalities without PAs did not form a separate ‘non-PA’ cluster, but they were assigned to four different clusters (Fig. 2). There are at least three potential explanations for this finding. First, the share of PAs of different types was poorly correlated with the other determinants of PA conflicts described in the literature. In other words, although the coexistence of a PA and other conflict-inducing determinants fuels particular PA conflicts at the local level, the relationship might not be general at the regional level. Second, a perception of certain conflict properties may loosely correspond to their ‘positivist’ measures in the data bank, which can be verified with a constructionist/constructivist approach to PA conflict analysis. Finally, the absence of N2000 data in the dataset (Table 3), which are

presented as crucial conflict determinants by many authors (Bielecka and Różyński 2014; Grodzinska-Jurczak and Cent 2011; Maczka et al. 2019), may alter the overall result, although there is evidence that relationships between N2000 presence and a number of socio-economic indicators in Poland are meaningful only when a processual dimension is well addressed (Gutowska 2015).

3.2.2. Comparison of the methods

Despite apparent similarities among all the approaches used, their specific results may differ (Widaman 1993), which has been proved in the PA conflict study (Online Resource 5). Having analysed all the differences, we found various advantages and disadvantages of all the applied approaches (Table 4).

Table 4
An overview of the advantages and disadvantages of all the methods and input data approaches used in this study.

Advantages	Disadvantages
Mean + trend data < μ&a> (vs. mean data only < μ only>)	
• More comprehensive and complete dataset, that reflects two PA conflict dimensions (substance and processual), • More feasible interpretation of resulting components or factors, • Faster discrimination of a big city in cluster analysis, stronger functional connectivity of the city with its impact zone;	• Usually, contains a large set of data that requires, often arbitrary, data reduction measures prior their use for PCAs/EFAs, • Lower pairwise correlations between trend and mean data affects KMO measure and suitability of a whole dataset for PCA/EFA, • Trend data, when presented as both positive and negative values, are vulnerable to a scaling method,
Standardisation < z-sc.> (vs. normalisation < 01>) of data	
• Variability of data after the scaling procedure is more similar to original one, • Geographic output is more clustered – more useful for regionalisation procedures;	• Negative trend values affect linear correlations with mean data (and KMO values of a whole dataset), • More arbitrary process of determination of PCs/ Fs (large difference in eigenvalues of first PCs/Fs and the rest ones). Difficulties in interpretation of less evident PCs/Fs. Smaller number of eventual PCs/Fs included for clustering, • Less explanative character of final results due to lower share of total variance explained by the used PCs/Fs;
Pre-defined variables < pre-def.> vs. all variables < all var.>	
• In many cases, the only way to perform the analysis (all-variables approach required arbitrary deletion of numerous variables without much gaining on overall KMO value), • Allows for balancing the impact of all determinants on the final result (especially in case of large disproportion in number of variables across the group of determinants); • Offers a deeper insight into a structure of results • Better connect a dataset with a theoretical framework	• Requires a clear rationale behind assignments of variables to certain categories, • In case of 1-step approach, interpretation of resulting clusters may be demanding, as they are described by scores of many PCs/Fs
Principal component analysis < PCA > vs. Exploratory factor analysis < EFA>	

Advantages	Disadvantages
• Most effective method of data reduction (in our study, no arbitrary deletion of variables required), • Mathematically more suitable for further use in cluster analysis (component scores calculated, not – estimated) • More discriminative method (smaller number of eventual clusters);	• Requires disjunctive assignment of variables to categories which is problematic in case of conflict properties (according to the PA conflict conceptual framework, they often refer to interactions of many determinants), • Total KMO values are lower, • Less useful for exploring the underlying structure of conflict determinants (in our study, sharp separation of variables assigned to different categories), • Consequently, offers less in-depth interpretation of components (e.g., 'ageing' factor turned out to be connected with lower employment in constructions sector and better standards of living, which were represented by variables classified as 'economic' in the source data register).

To sum up, our most general heuristics are:

- *<z-sc.>* versions of the analysis did not largely contribute to the interpretation of the overall results; we suggest skipping them if the dataset contains variables with both positive and negative values.
- If the number of variables is not too high, it is necessary to perform *< μ&a >* analyses. As PA conflicts are defined as processes (Rechciński et al. 2019, p. 2489), their processual dimensions is required to be included.
- *<μ only >* analyses should be performed to verify the coherence of the entire dataset.
- *<pre-def.>* analyses should be performed in cases of visible imbalance in the number of variables across groups of determinants. In addition, they allow for better insight into the structure of the results and, if decided, to generate more specific results.
- *<all var. EFA >* is suggested for verifying the underlying structure of the whole dataset.
- For *< pre-def. EFA >* we suggest using PCA with variables not restricted to only one group of determinants. As this results in a non-orthogonal character of *< 1-step >* PCs, we suggest further performance of *< 2-step pre-def. EFA >* to obtain reliable factor scores.
- For a classic *< pre-def. PCA>*, if only results of *< 1-step >* version are explicable, *< 2-step PCA >* may be skipped, as it only reduces a total explained variance.
- Our approach to unit clustering, i.e. synthesising results from all the cluster analyses, seems to be the most objective, especially as the results are intended to work as a basis for case study selection.

3.2.3. Cross-scale case study simulation assessment

Cluster '4a' (Table 2) was selected for a case study analysis for two reasons: 1) the data-driven description of this cluster was most strongly influenced by a variable representing a specific legal designation of Polish PAs (i.e. a national park cover in the municipality) and 2) the socio-ecological system of the cluster is dominated by the role of one specific PA, the Tatra National Park (See section C in

Online Resource 1 for a sketch map), which protects the unique high-mountain landscape of the Tatra Mountains, their natural processes, specific habitats and species (including endemic and relict ones), and remnants of man-nature relationships, such as pastoral glades and manufactured legacies (Minister of Climate and the Environment 2021). The Park ranks first in terms of a number of visitors per year (3.5 million visitors in 2020, which is 26% of the total for all 23 Polish NPs; Statistics Poland 2021) and it contains ca. 15% of non-state treasury lands, which are mainly forests[7] (Minister of Climate and the Environment 2021).

These specific conditions were reflected in the indicator data-driven characteristic of the cluster '4a' (the role of tourism in local economies and high rate of private forest removals). In addition, we proved that they translate to determinants of actual PA conflict issues around Tatra NP, which were revealed in the Internet content analysis (see Online Resource 6 for a complete list of codes). Tourism-related factors are additionally amplified by an environmental determinant that cannot be captured in the data registers: Tatra Mountains are the only high mountain range in Poland (Brown et al. 2015), which not only makes them especially popular among visitors, but also diversifies its tourist stakeholders. Consequently, according to the Google search© content, the 2007–2020 conflicts in Tatra NP were engaged in by, among others:

- Alpine skiers and skiing industry (33% of all relevant records)

*Most of these conflicts concern the functioning of the cable car and a network of ski runs in the core of TNP strict protection zone – Kasprowy Wierch (section C in Online Resource 1). For decades, there has been pressure to develop the complex, which is opposed by the NP managers and environmentalists. In recent years, the following actions were postulated (*Stochlak 2016*): increase cable car capacity, opening the slopes for off-track skiing (both finally accepted under certain conditions), building a tunnel across Kasprowy Wierch, and building a water reservoir which would allow for snowing the ski runs. Additionally, there were disputes over privatisation of the state-owned cable car and property rights of the space that it traverses.*

- Polish Tourist and Sightseeing Society (abb. *PTTK*) (12%)

PTTK is a legal heir of the Tatra Society (later – Polish Tatra Society), that fought for establishment of TNP from the end of 19th century. Among others, they purchased the most valuable lands for nature conservation purposes. Moreover, for decades, PTTK has supervised and gained profits from leasing mountain huts located in TNP. In fact, not all the huts were located on PTTK properties, while the Society remained co-owners of approximately 5% of TNP lands even after its ultimate establishment in 1955 (section C in Online Resource 1). The prolonged dispute ended in 2020 with an agreement between PTTK and TNP on exchange of the properties.

- Providers of fiacre transport services for visitors of TNP (9%)

*Fiacre transport services are allowed (*Head of TNP 2018*) on the most popular 8-km tourist road in TNP leading to Morskie Oko, the largest lake in the Tatra Mountains (section C in Online Resource 1). It is supposed to maintain a tradition of past horse transport in the Tatras and to provide maintenance for several local families providing the services (*Tischner et al. 2019). *Also, it enables access to Morskie Oko for those who are unable to reach the lake on foot. However, in recent years, a few horses working on the road collapsed, which sparked intense protests by animal rights activists (*Tischner et al. 2019). *Currently, equipping the horse-drawn vehicles with an electric support is being considered, however the idea is still not acclaimed by all the stakeholders.*

- Climbers (5%)

*Although climbing is allowed in the eastern part of TNP (High Tatras), its western part (Western Tatras; section C in Online Resource 1) is almost entirely off limits for climbers (*Minister of Climate and the Environment 2021*). The two Tatra subregions differ in terms of their geological structures and prevalent genetic types of relief, which aggravates the climbers' pressure on the Western Tatras (e.g., long limestone rock walls are located only in the Western Tatras). At the same time, the high geological diversity of the Western Tatras translates into their exceptional biodiversity, which is assessed as one of the highest in the whole country (*Jodłowski et al. 2021). *This is used as a TNP managers' argument against opening the Western Tatras for climbing.*

- Ski touring practitioners (3%)

*Ski touring is allowed in TNP only along the hiking trails or within a ski complex of Kasprowy Wierch (*Minister of Climate and the Environment 2021*). In the first case, the rule is often violated as skiers tend to choose non-marked slopes for downhill skiing. This, in turn, puts negative pressure on the fauna of the Tatras. Conversely, conflicts on Kasprowy Wierch engage skiers ascending the slope and those using the slope for descents only, as the space available for both groups is restricted by the TNP (Bielański 2010).*

- Event tourists and organizers (2%)

For the last few years, one of the main New Year's Eve events held by the public broadcaster Polish Television has been organized in the town of Zakopane, ~ 2 km from the borders of TNP. However, in 2019, the concert was initially planned to be moved to a ski jumping hill of Wielka Krokiew, which is located adjacent to the borders of the park (section C in Online Resource 1). The TNP managers opposed this plan, arguing for the welfare of local fauna. Eventually, the event was held in the original location.

In addition, private forest removal was confirmed as a conflict determinant both in the cross-level analysis for a spatio-administrative scale and Internet content (2% of all relevant records) and indicator analyses for Tatra NP. Although, from a legal perspective, TNP managers supervise all the forests within the park borders, 16% of these forests are managed by the Forest Community of 8 Legitimate Villages in Witów (Minister of Climate and the Environment 2021; section C in Online Resource 1). The practice of forest management on the community's lands remains questionable, and the complexes work as

timberlands rather than as protected forests (Giergiczny and Zwijacz-Kozica 2018). The most visible difference in forest treatment between the two properties was observed after extensive treefalls in the TNP in 2013. While the community removed the dead wood and clear-cut the disturbed surfaces on their lands, TNP managers preferred leaving treefall remnants for natural processes of forest succession (please note similarities to the conflict over other Polish Man-Biosphere Białowieża Forest; Blicharska et al. 2020). For a few years after the treefall, total forest removals in TNP have remained the highest of all Polish national parks (Statistics Poland 2019), while practices of private forest management in TNP have negatively impacted the landscape perception of these lands (see Giergiczny and Zwijacz-Kozica 2018 for a visual comparison of the privately- and park-managed forest properties).

[6] Specifically, a number of land development decisions taken compared to a share of a municipality area covered by valid local spatial development plans.

[7] This is unusual for Polish national parks, even though a total share of private lands in Polish national parks seems similar (13%, Sejm Committees' Bureau 2020): the total share is strongly influenced by a structure of lands in the largest national park in Poland (Biebrza NP, outside of Małopolska), where 36% of lands, mostly agricultural, are private (Biebrza National Park 2019).

4. Conclusions

The COVID-19 pandemic has changed how we perform conservation social science. Specifically, it altered an already well-established approach to the use of secondary data. Our multifaceted assessment of the easily accessible dataset proved that it may be used as a proxy for a multi-level PA conflict determinant analysis and as a basis for informed case study selection. However, there are a few lessons learned from this study that researchers and practitioners should be aware of:

1. Data that contain no direct input from conflict stakeholders should not be interpreted as conflict-related data *per se*. Under crisis conditions such as COVID-19, we accept the utmost need to limit the scope of in-person inquiries; however, a minimum necessary insight into the stakeholders' perception frames should be retained.
2. The use of secondary data should always be guided by a comprehensive pre-pandemic conceptual framework. This helps assess the completeness of the dataset and legitimate data interpretation.
3. The results of secondary data analysis are sensitive to the applied analytical methods. Iterations of the process using different analytical approaches should be a rule of thumb, while a synthetic approach is suggested for achieving greater objectivity in case study selection.
4. The results of indicator-driven analyses should always be confronted with other types of secondary data (e.g., media reports available on the Internet).

We acknowledge that the proposed approach to assess usefulness of data (or a study design) is one of many that can be applied to the field of PA conflicts (Rechciński et al. 2017). However, there are a few general rules that can help avoid the limitations of specific processes. This includes a clear definition of

1) a general aim of assessment (here, informing a case study selection process for a comprehensive multi-level PA conflict analysis), 2) criteria of assessment (here, compliance with a theory of PA conflicts, interpretative power of the results at the regional level, and cross-scale compliance with another source of knowledge at the local level), and 3) the sequence and techniques of assessment (here, a workflow presented in Fig. 1).

Declarations

Funding

This work was supported by National Science Centre, Poland (Grant number 2015/19/N/HS4/00359, author M.R.) and Jagiellonian University in Krakow (grant number N18/DBS/000025, authors J.T., A.A., M.G.-J.).

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Data Availability

The datasets generated during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The article presents the results of a project (no. 2015/19/N/HS4/00359), financed by the National Science Centre, Poland.

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Figures

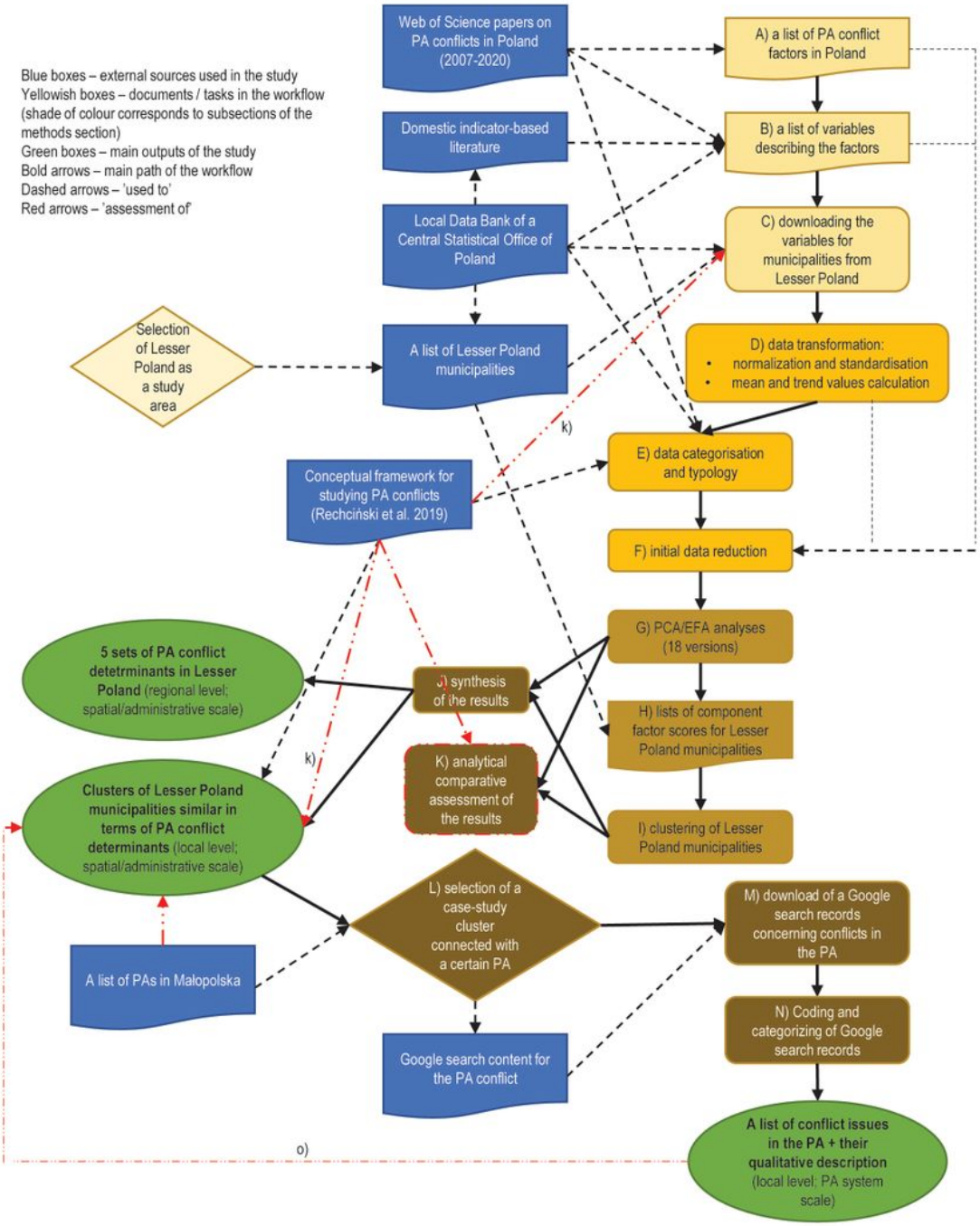

Figure 1

Workflow of the study

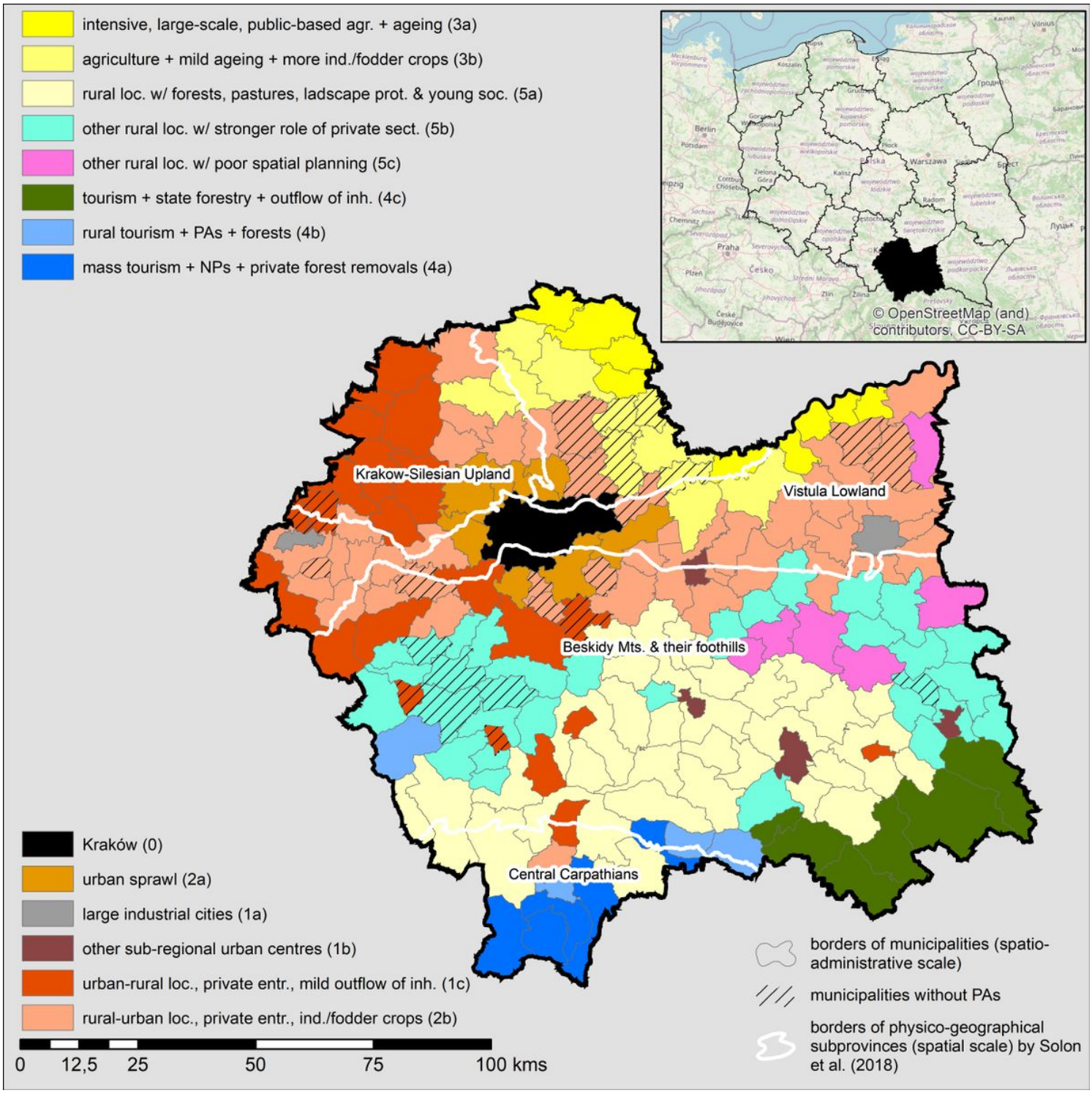

Figure 2

Spatial structure of clusters of municipalities in Lesser Poland similar in terms of their PA conflict determinants

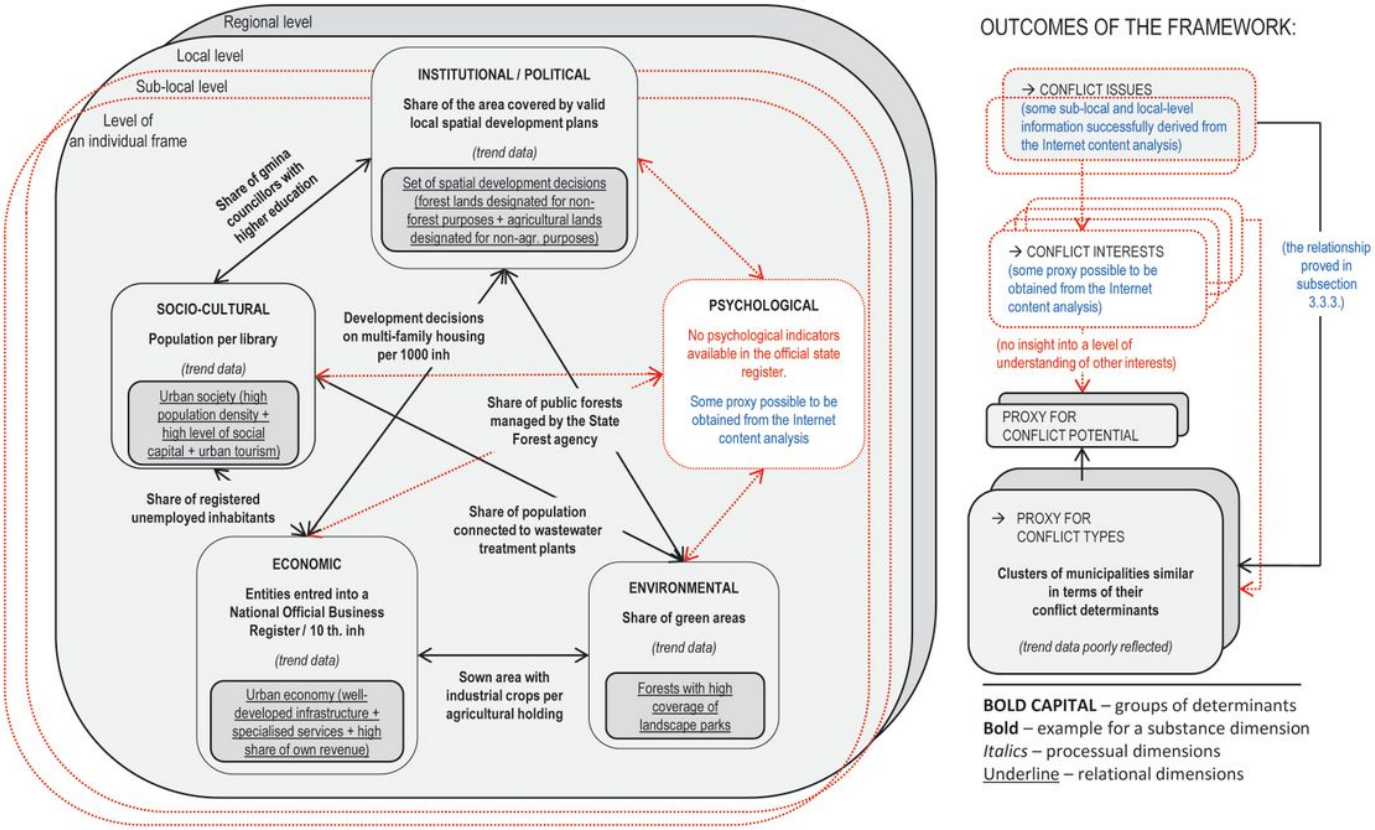

Figure 3

Examples of the analysed indicators and interpretation of results based on a conceptual framework for studying PA conflicts (Rechciński et al. 2019). The shade of boxes indicates a level on a spatial scale (light grey – local level, dark grey – regional level). Red colour indicates elements of the framework that are not reflected in the indicator-driven part of the study. Gaps that can be potentially filled in with a use of secondary data content analysis are shown in blue fonts.

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