

Narratives on cutting down trees on private land. A comparison of urban and rural municipalities in Poland using the Q-deliberation method

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ABSTRACT

Increased development in rural and urban areas leads to a decrease in tree cover and reduces the ecosystem services that trees provide. Municipal authorities must consider managing trees on private land to ensure that residents have access to trees and green spaces. In doing so, they must frequently confront conflicting stakeholder views, which are driven by diverse public and private interests and impacted by the type of landscape in question. In this paper, we investigate stakeholders' views on tree removing on privately owned land, as represented by narratives about tree management in urban and rural municipalities, to assess whether a deliberation process can alter these views. We rely on the theory of wicked problems and apply two measurements by Q-method in two municipalities in Poland ($N = 38$ in both cases), with an intervening deliberation session between each measurement. The results reveal that, before the deliberation, narratives were divided mainly around the issue of where the right to decide about tree removing should reside. This division was visible in both municipalities, but was particularly pronounced in the rural one. The division was sharp and straightforward, and was linked with deeply shared values. After the deliberation, the narratives shifted and a new division emerged around the issue of how to organize the decision-making process and decision-making criteria. Moreover, after deliberation, the narratives of participants from both municipalities coalesced to a much greater extent than previously. The results prove that, although wicked problems do not have unambiguous solutions, deliberation processes can influence views and are instrumental in facilitating better informed tree management.

1. Introduction

Trees are a vital part of the human environment and provide a range of ecosystem services (ES). These are direct benefits which the natural environment delivers to people and which positively affect human well-being in the form of, for example, wood, fruit, shade, and beauty (Reid et al., 2005; Chen et al., 2019). In the last 40 years, public perceptions have changed from the prevailing view of trees as a commodity to a less commodified one in which the cultural values and ES of trees play more pronounced roles (Tarrant and Cordell, 2002). At the same time, there is significant tree canopy loss in some parts of the world (Morgenroth et al., 2017; Nowak and Greenfield).

Many cities worldwide have experienced declining tree canopies (Daniel et al., 2016; Guo et al., 2019) as a result of new commercial and residential developments (MacFaden et al., 2017). In addition, in rural areas with developing infrastructures (such as new buildings, roads, power lines, and irrigation systems), competition for space is intensified due to changes in agricultural practices and the planting, growing, and removing of trees (Lin et al., 2021; Feldt et al., 2020; Suchocka et al., 2019b).

Trees on private land (backyards and gardens) represent a significant proportion of green space, accounting for up to 50–60% in some areas (Clark et al., 2020; Daniel et al., 2016), and have therefore been incorporated into the formal management of green areas (Phillips and

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Atchison, 2018; Lagbas, 2019; Rall et al., 2019; Dai et al., 2019) as part of broader shifts in environmental management. Inclusion of private land in environmental policy and management is now integral to forest management (Hendee and Flint, 2014), biodiversity conservation (Coronel-Arellano et al., 2018; Kamal et al., 2015), and flood risk governance (Hartmann et al., 2019). Rights over trees on private land are, however, a problematic issue. On the one hand, a tree on private land can be considered the landowner's private good which he or she has rights over. On the other hand, the same tree can provide public ES (Locke et al., 2017) (e.g., air purification) or disservices (e.g., branches falling on pavements) beyond the private parcel of land. Imposing regulations on the management of trees on private property, although justified, can be perceived to violate the owner's property rights and can raise tensions.

The cultural and environmental importance of trees, occasioned by changing public perceptions and altered land use patterns, has elevated the significance of tree management on the sustainable development agendas of urban and rural areas (Chiesura, 2004; Li et al., 2017). However, all of this makes tree management a social-environmental issue for which it is impossible to define an optimal solution due to both uncertainty about future environmental conditions (e.g., changing land use practices) and intractable differences in social values (changing public perception of trees). Such problems are classified as 'wicked problems' (Duckett et al., 2016).

Studies of how tree management is regulated on private lands are as yet rare. The few existing studies indicate that many local governments control tree management on private land, but this is not always the case (Clark et al., 2020). In some places there are no regulations for tree management on private land (e.g., in some cities in Australia (Daniel et al., 2016) and the United States (Clark et al., 2020)). In Poland, the mandatory permission needed to remove trees on private land was lifted in 2017, leading to controversy about the potential for unlimited tree removal (Przewoźna et al., 2021a; Kronenberg et al., 2021). Prohibition of tree removal on private land without a permit or a veto right (objection) by local government applies in some European countries and some cities in the United States. It is deemed to be ineffective, however, as permission for the removal of trees is almost always granted, poorly enforced, reliant on the skills and motivations of local government staff, or limited only to certain trees, e.g., heritage trees (Clark et al., 2020; Conway and Urbani, 2007).

The perceived value of trees and social demand for green areas vary depending on the landscape. People's places of abode may strongly influence their perceptions of trees. The research of Suchocka et al. (2019a) indicated that more arboriphobes live in villages and small towns, while inhabitants of big cities rarely see the dangers imposed by trees. Existing research focuses mainly on urban areas, particularly large cities (Luederitz et al., 2015; Kendal et al., 2020), and there is little research on trees in smaller towns (Feltynowski and Kronenberg, 2020; McConnachie and Shackleton, 2010). Rural areas are essentially ignored in this context, although it is known that there are significant disparities in ES demand and supply between urban and rural areas (Kroll et al., 2012). In this article, we fill this gap by investigating the lability of views on tree management and their removal on private land in both rural and urban areas in Poland. Informing about removing trees on private land is mandatory in Poland; if the municipality does not object within 30 days, the tree can be cut down, although abolition of any kind of permission for several months in 2017 ignited a public debate on the issue.

This article is structured as follows: Section 2 - literature review and conceptual framework; Section 3 - description of methods; Section 4 - results; and Section 5 - discussion and conclusions of the results.

1.1. Conceptual framework

Tree management is a complex issue, especially as regards restrictions on tree management on private land. Competing needs and views concerning greenery, property rights, the balance between

private-public interests, and land use - combined with political and ideological opinions - all lead to a complex conundrum. Various types of regulatory mechanism for tree management have been introduced, but the private-public dilemma remains particularly difficult to resolve. This stems from the specific characteristic of tree management that it shares with other fields of environmental management and suggests the existence of a wicked problem. Within this conceptual framework, 'tame problems' and their solutions are those that can be defined without serious controversy and are associated with straightforward cause-effect interventions, whereas 'wicked problems' are conceptually defined but have no clear solutions (Duckett et al., 2016; Rittel and Webber, 1973). The latter are characterised by uncertainty and either lack a single exact solution or multiple solution pathways; or lack both well-defined conceptual definition and definitive solutions (Heifetz and Heifetz, 1994).

Tree management involves: (i) complexity and interdependency of problem components, which create feedbacks and nonlinear responses to management interventions; (ii) significant uncertainty; (iii) unintended consequences; (iv) divergence in the values and decision-making power of multiple stakeholders; and (v) mismatches in the spatial and temporal scales of ecological and administrative processes (Duckett et al., 2016; DeFries and Nagendra, 2017). Issues are complex and cannot be resolved in a predictable, straightforward way. There is a lack of generalisable approaches for testing potential solutions. Tree management is also characterised by ambiguity regarding the problem definition, a lack of consensus about the system boundaries (Guimarães et al., 2018), uncertainty involving the causality of relationships between problems and potential solutions, disagreement surrounding important normative elements (e.g., values, interests) (Hisschemöller and Hoppe, 2018) and multiple conflicting management views in the decision-making process (Guimarães et al., 2018). Previous research showed variability in peoples' views on the issues. Peoples' views on the attributes in question shift to support the emerging choice (Simon and Spiller, 2016). Thus, any solution requires a comprehensive, strategic, and multi-scale approach (Rittel and Webber, 1973; DeFries and Nagendra, 2017; Duckett et al., 2016).

Narrative theory was used to assess views on tree management on private land, as well as the lability of these views (Koch et al., 2021). Within this framework, narrating is a form of communication that is central to community functioning and present in environmental governance. People interact with the natural environment and construct narrations which are stories that help them to understand the social and natural environments and form their identity. During collective narrating activities, people co-produce narratives which are stories shared at a group level. These stories are malleable and in flux due to retelling by a multitude of actors. Narrations and narratives may not differ in terms of their content or structure. However, they do differ in terms of 1) scale dimension as narrations are related to direct social relationships while narratives derives from group level interactions; and 2) temporal dimension as narrations are ephemeral individual interpretations whereas narratives are enduring cultural artefacts. Guided by narrative theory, we assume that the views are manifested in residents' group narratives. They are relatively permanent but susceptible to change resulting from their ongoing formation in individual narratives - the lability of peoples' views.

In our case, narrations and narratives on tree management on private land are shaped by two strongly polarizing factors. The first factor is constituted by social dilemmas arising from conflicts between individual and collective interests. This issue is discussed extensively in the environmental management literature as e.g., "tragedy of the commons" and "common pool resources dilemma" which show that long term collective interest will be jeopardized by maximizing short-term benefits by individuals (Bagavathiannan et al., 2019; Hardin, 1968; Ostrom, 1990). Proposed solutions require the cooperation of parties. However, the benefits of cooperation also extend to non-co-operators, which disincentivises individuals to contribute to the common good. It applies to many areas of environmental management but specifically to tree

management, where property-level decisions appear too narrow for effective management and including a landscape-scale view is needed (Bagavathiannan et al., 2019). This involves coordination and centralisation to overcome the myopia of narrow individual interests and to balance private and public benefits.

The second polarizing factor derives from differences within stakeholders' views on what benefits they receive from trees. Although the public generally place value in trees (Paniotova-Maczka et al., 2021, 2023; Fernandes et al., 2019), differing views are held regarding the specific benefits of trees. More than 20 ES are identified in the literature, but individuals and interested parties may value some while disregarding others. Moreover, besides ES provided by trees, there are also "disservices" such as dry leaves, rotten fruit, or falling branches which could have financial implications or negatively affect quality of life (Cariñanos et al., 2016; Kronenberg et al., 2021). Further, the same tree product can be a desirable ES in some conditions and an unwanted disservice in others. For instance, a shadow cast by a tree in a concrete car park could be seen as beneficial, but a shadow that prevents daylight from entering into someone's house could be seen as negative. On an aggregated level, this poses a serious challenge for tree management as both perspectives must be considered in order to develop sustainable solutions (Ellis et al., 2019).

Change of the co-produced narratives manifests in acts of communication. In our research, this communication takes the form of deliberation. Deliberation is understood as a "process by which individuals sincerely weigh the merits of competing arguments in discussions together" (Fishkin (2009) p. 33). Deliberation is not an ordinary conversation, since its centrepiece is the answer to the questions of the collective political will - about what should be done. It is distinguished from ordinary conversation by five conditions (Fishkin (2009) p. 34). The more these conditions are met, the higher is the quality of deliberation: 1) participants are given access to reasonably accurate information that they believe to be relevant to the issue (Information); 2) arguments offered by one side or from one perspective are answered by considerations offered by those who hold other perspectives (Substantive balance); 3) the major positions in the public are represented by participants in the discussion (Diversity); 4) the extent to which participants sincerely weigh the merits of the arguments (Conscientiousness); and 5) arguments offered by all participants are considered on merit regardless of which participants offer them (Equal consideration).

There are two main rationales for applying deliberation in tree management. First, decision-making deals with uncertain systems. Funtowicz and Ravetz (1993) noted that the level of uncertainty varies among different systems. In some systems, the level of uncertainty is low, the processes are deterministic, and policies can rely on straightforward judgments. However, such scenarios apply to rather technical parts of social life with tame problems. In most cases, decisions take place in systems with high uncertainty. For many areas, the current level of knowledge makes evidence-based solutions unfeasible. When the results of policies cannot be precisely predicted, deliberation appears to be a method of resolving fuzzy decision-making. Deliberation helps conceive solutions and share responsibility for decisions (Mayega et al., 2021; Huyen and Anh, 2018; Fishkin, 2010).

A second rationale for applying deliberation is ambivalence about stakeholders' expectations and views. Although judgments of utility were traditionally treated as a given and enabled Bayesian calculations, it is revealed that rigid assumptions of this paradigm lead to unrealistic results (Jaeger, 1998). It is assumed that hedonic views belong to individuals who only regard their own egoistic interests. In fact, views involve collective ethical convictions about justice, fairness, etc. Therefore, views and the inevitable incomplete preference ordering are built socially for each novel situation. Deliberation is not solely focused on consensus finding, which is impossible to achieve by the nature of wicked problems (Pigmans et al., 2019; Karpowitz and Mansbridge, 2005). Rather, it aims to actively stimulate participants' understanding of one another's viewpoints, values, interests, etc. and can reduce or

prevent conflicts between stakeholders (Paniotova-Maczka et al., 2021).

Deliberation is not, however, an ideal solution. It is a theoretically grounded way of high quality communication that creates opportunities for mutual learning and decision-making where a decision is particularly difficult to reach. Deliberation may or may not bring change of participants views, and, if it does, it may only be temporary and depend on many contextual factors such as the age, education or gender of the participants (Himmelroos and Christensen, 2012; Muhlberger, 2020; Eveland and Thomson, 2006). Previous research has shown, for example, that women, people with a medium level of knowledge, and those who are middle-aged tend to be the most susceptible to change after deliberation, while older people are the least susceptible to change (Suiter et al., 2014).

1.2. The case of tree management as a wicked problem in Poland

An interesting case for analysing the management of trees as a wicked problem is a "natural experiment" involving removal of trees in Poland. In December 2016, the Polish Nature Protection Act was changed to abolish landowners' mandatory requirement to apply for a permit to cut down trees. This went into force on January 1, 2017 and led to controversy as the media reported tree removing on a dramatic scale. On March 1, 2017 a protection period was introduced which suspended tree removal to protect nesting birds, and in June 2017 the mandatory information on the intention to cut down a tree on private land with the veto right by the municipality was implemented. These changes produced dilemmas of legal, social, and environmental importance relating to resolution of conflict which concerns property rights; private and public interest, benefits and costs; and various attitudes towards nature protection.

Furthermore, public opinion on cutting down trees was divided. Approximately half of Poles supported restrictions, while half supported owners' rights to make decisions without hindrance (Głowacki, 2017).

Media in Poland report controversies concerning trees related to the change of the Polish Nature Protection Act in 2017, especially when trees are cut down. This applies to individual trees, tree avenues and larger green areas. Such cases are usually noted in cities, but reports also include such incidents in rural areas. Removal of trees often occasions protests, particularly when roadside trees are targeted. Typically, individuals, groups, and organisations oppose cutting down trees by advancing a variety of health, recreational, aesthetic, and environmental rationales. Sometimes these voices counter the demands of opposing societal groups that would like trees to be removed because they are viewed as a nuisance or for technical reasons (e.g., danger to underground infrastructure). Table 1 assesses the Polish case of tree management in terms of the characteristics of a wicked problem (Duckett et al., 2016).

2. Methods

Our study applies a Q-deliberation method to investigate stakeholders' narratives on tree management and their lability. The research was conducted in two municipalities in Poland: one urban and one rural. This describes: 1) the case study areas; and 2) the research method and procedure.

2.1. Case study areas

We conducted our study in the urban municipality of Raciborz and the rural part of Nysa municipality in Poland (Fig. 1). Our rationale was to select two areas that reflected differences in the ES provided by trees in urban and rural landscapes. These two municipalities are typical for Poland in terms of sociodemographic and environmental indicators. Raciborz is an urban municipality of 55,000 inhabitants (Statistics Poland, 2019) in the Slaskie Voivodeship (province) in southern Poland. According to the Database of Topographic Objects, it represents a

Table 1
The Polish tree-cutting case analysed as a wicked problem.

Characteristic	Description of the analysed case
1. Indefinable (and non-generalisable): contested formulation of a problem, explanation of a problem to determine solutions.	The indefinability of the problem stems from the fact that it involves at least several complex issues that cause controversy and different understandings of the problem among stakeholders: (i) protection of trees endangered by the lifting of restrictions on easy removal; (ii) exercising of rights of ownership; (iii) perceived aesthetics of the landscape; (iv) influence on inhabitants health; and (v) quality of life. Moreover, stakeholder perspectives may change depending on the situation, e.g., a different tree (although similar to the previous one) may be treated differently by the same actor.
2. Ambiguously bounded: fuzzy and ill-defined boundaries of the system within which the problem appears among stakeholders.	The ambiguity is occasioned by the property rights to the land on which the tree is located. On the one hand, the law deprives a landowner of the right to make decisions about trees. On the other hand, trees on private land are outside public management by municipal authorities. Individual actors can variously define the extent of the consequences of cutting down a tree: from the perspective of their garden, neighborhood, municipality, and country (legislative regulations) to the planetary perspective (environmental protection in general). Moreover, the problem also concerns the extent of the consequences of cutting down a tree in the social sense, e.g., Who is affected?; What administrative department does such a matter fall under (environmental protection, spatial planning, roads management)?
3. Temporally exacting: no “stopping rule” to allow the analysis of a temporarily stable system, as systems are evolving, often non-linearly.	The change of regulations consequently involves trees removal. The change in regulations also leads to ignorance of the current law by inhabitants. Due to spatial planning, individual land-use decisions and changing views, the tree cover in municipalities keep changing. There is no “optimal” tree cover.
4. Repercussive: proposed solutions are value-laden and ideologically contested. There is not a definite set of potential solutions. There is not a trial-error procedure for solutions validity. Solutions are not true or false. They change the nature of a problem and do not necessarily solve it.	Proposed solutions to trees’ management are entangling environmental values with other values, such as liberties concerning the disposition of one’s property. It causes collisions with side effects that are profoundly problematic. A proposed solution, i.e., the novelisation of the Nature Conservation Act was the ‘one-shot operation’ with the problem persisting that some uncontrolled tree removal has already been done. Moreover, while returning to tighter regulations could lead e.g., to less tree planting because landowners will not want the fact of owning a tree to somehow restrict them from managing their land.
5. Doubly hermeneutic: understanding of wicked problems is constantly challenged by active subjects who can change their practices just as understanding of those practices is developed, condemning failed attempts to these problems based on a specific understanding of the behaviours involved.	Various groups of stakeholders have different interpretations of the situation, e.g., is there a need to protect trees on private land or not? Landowners speculate that regulations can change and adjust their behaviour in advance. For instance, expected stricter regulations on tree removal inclines one to remove trees quickly before the anticipated regulation changes. The

Table 1 (continued)

Characteristic	Description of the analysed case
6. Morally consequential: wicked problems demand action, creating moral dilemmas as solutions are uncertain while there is a moral obligation to act.	media can also present information in ways that can lead to multiple divergent interpretations of the problem and lead to various behavioral consequences e.g. individuals are intentionally planting non-removable (highly protected) trees with the aim of provoking their neighbours or obstructing new developments. Although the existing problem calls for action, each solution produces morally ambiguous consequences, e.g., more protective tree policies involve conflicts with the economic and social liberties related to trees as a private good.

Source: based on Duckett et al. (2016).

medium-sized city in Poland whose area includes 7.1% forest and wooded areas (National Geoportal, 2019). Nysa is an urban-rural municipality, and we focused only on the rural part. Like Raciborz, it is located in southern Poland in the neighbouring Opolskie Voivodeship. The rural part of Nysa municipality has 13,000 inhabitants (Statistics Poland, 2019). Forest and woodland coverage constitutes 11.4% of its area.

2.2. Research procedure and realisation

2.2.1. Background of Q-deliberation

In our research we proposed to use the Q-deliberation method by connecting Q-methodology with deliberative polling.

Q-methodology is a mixed qualitative and quantitative method applied in social science research which provides a reproducible measure of individuals’ self-referential, holistic viewpoints (Watts and Stenner, 2005). Participants are requested to assemble their viewpoint on a topic by sorting purposefully selected statements along a continuum from disagreement to agreement. From each participant we obtain a unique sorting of statements which, within the framework of our study, represents that participant’s individual narration. Next, all sortings are correlated to identify patterns of shared meanings which, in our analytic framework, represent narratives. Usually Q-study consists of six distinct steps: 1) Identification of the concourse of statements; 2) Selection of statements: Q-set; 3) Selection of participants: P-set; 4) Sorting of statements: Q-sort; 5) Factor analysis; and 6) Factor interpretation (see Brown (1980) for an introduction to Q-methodology and Dziopa and Ahern (2011) for a review of Q methodology studies).

Deliberative polling is a public consultation method based on public opinion survey and public deliberation. According to Fishkin (2021), the question to be answered is “what would the public think should be done, if they could consider the issue under good conditions?”. “Good conditions” means access to accurate, evidence-based considerations weighing for and against the proposed policy alternatives or proposed actions, opportunity for extended discussion to probe the issues in depth, and effective opportunities for the deliberators to have their questions answered as the discussions proceed. Deliberative polling usually consists of five steps: 1) an initial representative survey of public opinion; 2) selection of participants in the initial survey to participate in deliberation; 3) receipt of balanced information by the deliberation participants in the lead up to deliberation; 4) deliberation in plenary and small groups sessions; and 5) a second public opinion survey administered to those who participated in deliberation. Information about the whole procedure, including its results, are disseminated to the public and policy-makers through media coverage.

The main distinctive feature of the Q-deliberation method is the replacement of two public opinion surveys using a questionnaire derived from deliberative polling with, instead, two measurements using Q-

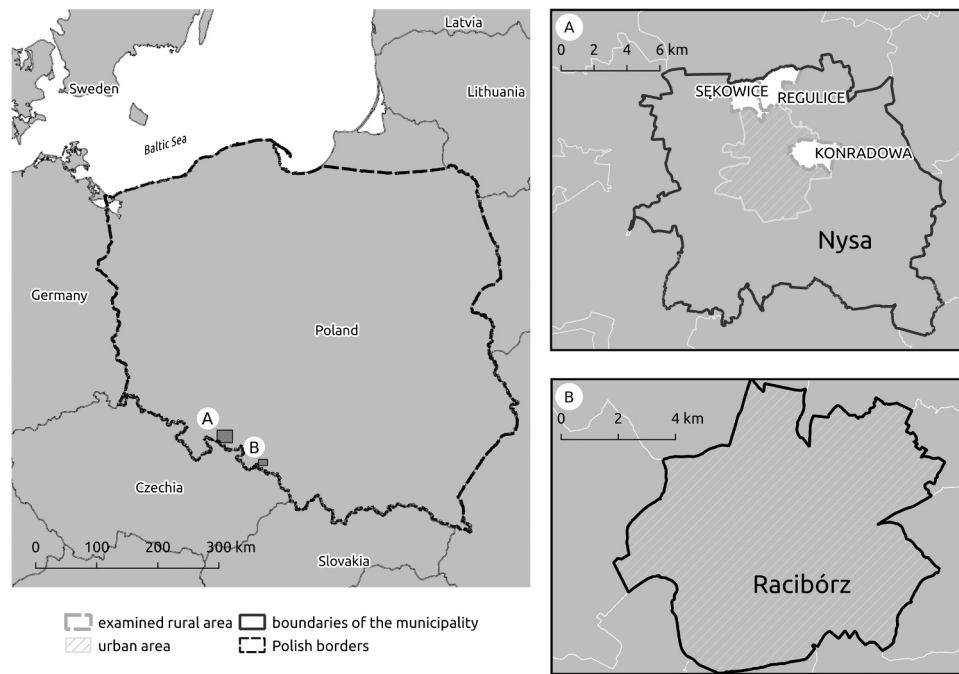


Fig. 1. Case study areas.
Source: the authors.

methodology. In designing this procedure we took note of the work of Ho (Ho, 2016), who argues that opinion surveys allow researchers to measure (e.g., viewpoints of a particular topic) using a normative, uni-dimensional scaling approach. However, the results of such a method are difficult to translate into practice as measurement is numeric and does not permit understanding of how viewpoints are constructed because each of their elements (e.g., statements which represent a particular opinion) is evaluated separately. Q-methodology enables this understanding because each item is evaluated by the respondent in relation to other items and is not limited solely to numeric results. Therefore, the sorting statements of each respondent can be considered holistically so as to provide in-depth information about their viewpoints and enable practical use of the findings. Dynamic measurement of narratives to understand lability using Q-methodology has not previously been attempted (Bauer, 2018).

2.2.2. Research procedure

This section outlines and describes our Q-deliberation procedure (see Fig. 2). Detailed scenario of Q-deliberation is contained in the supplementary materials attached to this paper. The research was conducted from April 2019 to January 2021.

2.2.2.1. Identification of the concourse. The concourse is a comprehensive collection of statements on an investigated topic obtained from various sources. The statements are not to be proven true or false. In this study, the concourse is made up of statements related to values, opinions, and beliefs regarding trees on private land which were gathered from answers to the following question: “When should landowners be allowed to decide on the removing of trees in their area?”. This was put to participants in a geo-questionnaire (Czepkiewicz et al., 2018; Janowski et al., 2016; Keenan and Jankowski, 2019) administered in both municipalities (Przewoźna et al., 2021b). Statements were also collected through a comprehensive review of scientific literature, press, and other sources. We came up with 121 statements.

2.2.2.2. Selection of statements: Q-set. The Q-set is a sample of statements selected from the concourse. The selected statements should be

balanced and representative of the diversity in the concourse. To achieve this, the research team conducted a workshop to critically analyse the statements and eliminate repetitions. A list of 46 statements was identified during this process. To validate the accuracy of the selected statements, a critical assessment workshop was then conducted with nine scientific experts in the social and environmental sciences (including Sociologists, Geographers and Ethnologists). These experts were asked to sort the 46 statements, comment on their content, and assess the number of statements. This process resulted in 36 statements which were sent to four high profile practitioners: 1) an expert in public consultation; 2) an expert in environmental management; 3) an expert from an environmental NGO; and 4) the head of an environmental protection unit in the municipality. Practitioners were requested to assess how understandable each statement was, to propose changes in particular statements, and to suggest new ones if necessary. The final Q-set was comprised of 33 statements assigned a random number (see Tables 5–8 in Results.).

2.2.2.3. Selection of participants: P-set. The P-set is the group of respondents selected to participate in the Q-study. The P-set usually includes a small number of purposively selected participants who each receive the Q-set together with instructions on how to sort them. The aim is to have participants carefully consider how the statements relate to each other (Brown, 1993).

Although the group of participants does not have to be representative, it should be between 30 and 60 people (Dziopa and Ahern, 2011; Matinga et al., 2014). The sample in our research comprised 38 people in each municipality. Participation was voluntary and recruitment was done using media announcements, contact with municipality administration, and through local leaders. After the initial recruitment process, participants included in the final P-set were contacted via e-mail or telephone. The final selection aimed to maximize social and demographic heterogeneity (Table 2).

2.2.2.4. Sorting of statements: Q-sort. Q-sort is the data collection phase in a Q-study. Respondents are self-directed in a sorting process using a fixed template Q-grid that forms a pyramid and reflects a normal

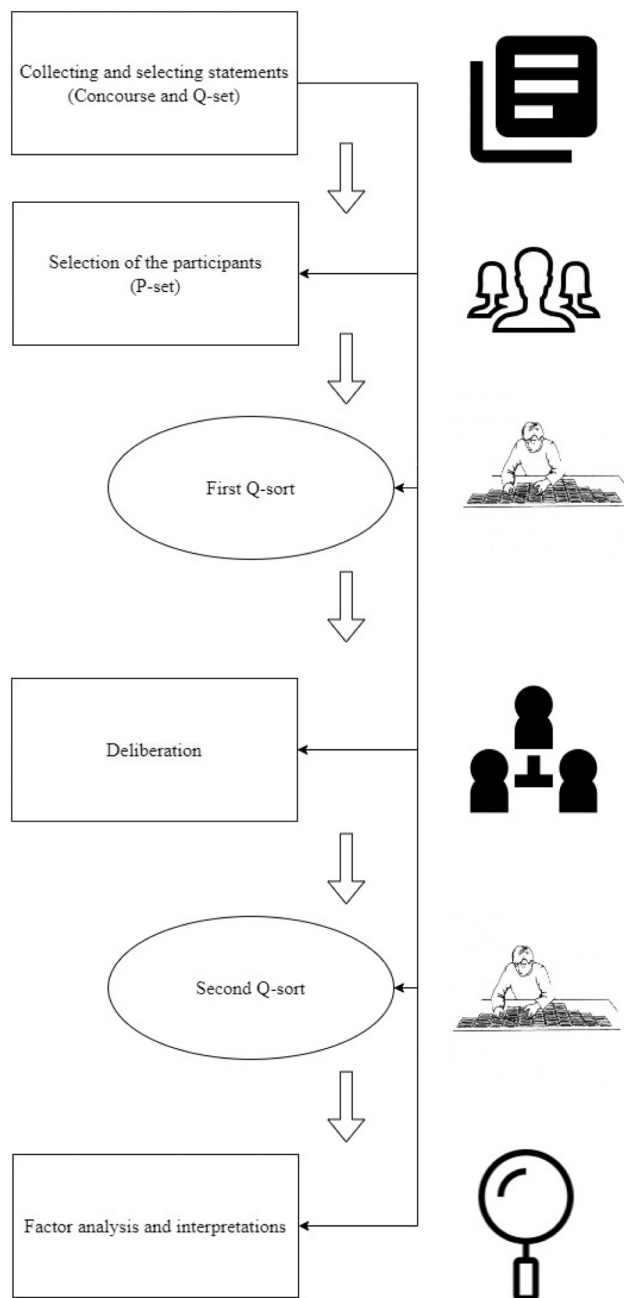


Fig. 2. Research procedure.
Source: the authors.

Table 2
Sociodemographic characteristics of the studied sample.

Characteristics		Raciborz, N = 38	Nysa, N = 38
Gender	Male	50%	51%
	Female	50%	49%
Age	15–24 years	5%	0%
	25–34 years	8%	3%
	35–44 years	26%	18%
	45–54 years	13%	41%
	55–64 years	16%	15%
	over 64 years old	32%	23%
Education	Primary	8%	0%
	Vocational	8%	28%
	Secondary	39%	41%
	Higher	45%	28%

Source: the authors.

distribution curve. The pyramid contains as many boxes as the number of statements. A Q-sort is completed either manually or with the use of online software (Brown, 1996). In our study, we developed a Q-grid based on Fisher and Brown (Fisher and Brown, 2015 [67], which we implemented in manual A0 paper sheet versions (Lutfallah and Buchanan, 2019) [64] (Picture 1). The Q-sort was conducted twice. The first Q-sort occurred before deliberation in each municipality, and the second Q-sort occurred after deliberation in each.

2.2.2.5. Deliberation. After the first Q-sort and before deliberation, participants listened to presentations and received briefing materials prepared by experts.

Four presentations (approximately 10 min each) focused on existing problems with trees management in each municipality, research on trees and green areas in each municipality (2 presentations), and an overview of existing opinions about the removing of trees (to show diversity). The presentations, which were delivered by Geographers, Sociologists, and representatives of the environmental protection unit in each municipality, were neutral and introduced participants to deliberation using plain language. Briefing materials objectively summarized all presentations and included the principles for plenary sessions and small group discussions. Presentations were five pages long and mostly in bullet-point style because participants had a relatively short time (half a day) to work with them before the second Q-sort.

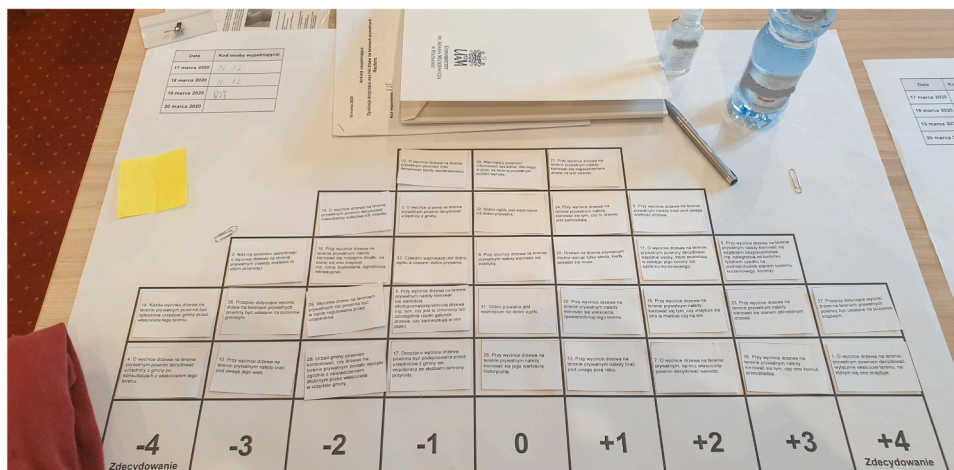
Deliberation in both municipal groups was divided into two sessions (Picture 2) plenary deliberation; and 2) small groups of up to eight people in five 20-minute rounds. Each participant was given free accommodation and received a moderate financial reward.

The Q-deliberation (Picture 2) occurred in a hotel situated outside each municipality and transport was provided to ensure that the maximum number of participants could attend. For logistical and economic reasons, the Q-deliberation in each municipality lasted one-and-a-half days to ensure that the same people could participate in the Q-sort before and after deliberation.

The deliberation sessions were conducted in compliance with the COVID-19 pandemic safety rules. Participants were equipped with masks and disinfectants. Due to safety concerns, the first session was postponed until the epidemic situation in Poland seemed to be under control and official restrictions had been significantly reduced. During this time, we were in contact with the participants, some of whom had to withdraw due to the change of date and were replaced by participants from the reserve list.

2.2.2.6. Factor analysis. Unlike other methods which use factor or component analysis to identify factors that explain a small number of characteristics among a large sample of participants, Q-methodology instead uses a limited number of participants and finds correlations between the different sorts made by them. The correlations between the individual Q-sorts (narrations) are then the basis for extracting factors, i. e. shared narratives. The non-shared narratives are disregarded as non-significant - there are insignificant factors in the factor analysis. The researcher determines the number of factors to be extracted based on the empirical material, as the number of narratives that exist cannot be otherwise inferred. According to the Kaiser-Guttman criterion (Bussell, 1998), however, factor eigenvalues should be larger than one and a minimum number of two criterion (Watts and Stenner, 2012), significantly loading Q-sorts for each factor, i.e. having at least two participants that correlate with statistical significance. An additional method to determine the number of factors is a scree plot which allows us to observe how the proportion of variations explained by subsequent factors change. The principle is to leave those factors before a long mild fall down.

The extracted factors are subsequently rotated to best explain the sorts, using varimax methods. The rotated factors are then used to create factor arrays in the form of idealized Q-sorts representing the identified



Picture 1. An example of Q-grid filled by one of the participants during the study. Photo: Patrycja Przewoźna.



Picture 2. Q-deliberation in rural case study area. Photo: Marcin Mielewczyk.

narrative expressed through each factor. For this study, a principal component analysis (PCA) was used for factor extraction, followed by varimax rotation (e.g., (Zabala and Pascual, 2016) using Ken-Q Analysis software (Banasick, 2019). In our research we conducted four separate analyses for two Q-sorts in two municipalities.

2.2.2.7. Factors interpretation. Construction of meaningful narratives is enabled by interpretation of the factors' arrays. The developed narratives do not represent the whole population of narratives under investigation, but they should represent main existing narratives related to the investigated topic. During the process of interpretation we focused on statistically significant statements, i.e. distinguishing and consensus statements.

Distinguishing statements refer to those that were ranked significantly differently in one factor compared with all other factors. Consensus statements are those that do not significantly distinguish between any two factors.

To ensure consistency of results, narratives identified in each Q-measurement (there were two measurements in each case study area) were interpreted by one person from the research team, and then interpretations of narratives were checked by other members of the team to identify and correct interpretation inconsistencies. Finally, the research team conducted group workshops in which all inconsistencies were identified, discussed and addressed.

3. Results

Two measurements using Q-methodology were conducted in each of the rural and urban areas: a pre- deliberation measurement and a post-deliberation measurement. Four measurements were thus obtained. Each measurement was analysed separately, and comparisons were then made both within and between the case study areas.

We present the results in two parts: 1) quantitative analysis; and 2) qualitative analysis. The extraction of factors is presented in the quantitative section and the narratives (based on the identified factors) are described and compared in the qualitative analysis.

3.1. Quantitative analysis

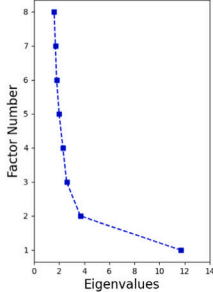
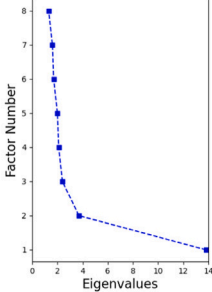
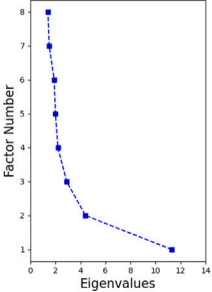
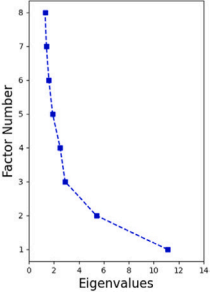
Based on independent statistical analyses of each of the four Q-methodology measures, we obtained three factors in each case. Factor groups account for 48–52% of explained variance (Table 3). The number of participants loaded significantly ($p < 0.05$) to factors (F) in analysed cases (Table 4).

3.1.1. Rural case study

In pre-deliberation measurement in the rural case, the first factor (F1) represents the dominant narrative (Table 4). However, the difference is slight compared to the second factor (F2). Both factors have around one-third of the participants' load significantly, while the third

Table 3

Characteristics of factors in all analysed cases. F-Factor, E-Eigenvalues, %EV - % Explained variance, %CEV - Cumulative % Explained variance. Grey colour means factors are included in further analysis. *Eigenvalues are rounded to one-tenth.

Analyzed case	Rural pre-deliberation				Rural post-deliberation			Urban pre-deliberation			Urban post-deliberation		
	F	E*	%EV	%CEV	E*	%EV	%CEV	E*	%EV	%CEV	E*	%EV	%CEV
Basic characteristics of factors in all analyzed cases	F1	11.7	31	31	13.8	36	36	11.3	30	30	11.1	29	29
	F2	3.7	10	41	3.7	10	46	4.4	12	42	5.4	14	43
	F3	2.6	7	48	2.4	6	52	2.9	8	50	2.9	8	51
	F4	2.3	6	54	2.1	6	58	2.2	6	56	2.5	6	57
	F5	2	5	59	2	5	63	2	5	61	1.9	5	62
	F6	1.8	5	64	1.7	4	67	1.9	5	66	1.6	4	66
	F7	1.7	4	68	1.6	4	71	1.5	4	70	1.4	4	70
	F8	1.6	4	72	1.3	3	74	1.4	4	74	1.3	3	73
Scree plot													
Participants loaded significantly ($p < .05$) on 3 factors for further analysis	33				33			36			38		

Source: the authors.

Table 4

Number of significantly loading participants in each factor.

Cases	Factor 1	Factor 2	Factor 3
Rural pre-deliberation	13	12	8
Rural post-deliberation rural	16	9	8
Urban pre-deliberation urban	17	10	9
Urban post-deliberation urban	18	13	7

Source: the authors.

factor (F3) has less than a quarter. There is a visible change in the post-deliberation rural case as the first factor (F1) represents a notably dominant narrative with more than 40% of the participants load significantly. In contrast, less than a quarter of the participants load significantly on each of the two other factors.

3.1.2. Urban case study

In the pre-deliberation urban case measurement (Table 4), the first factor (F1) in each of two pre-deliberation measurements represents a dominant narrative, with more than 40% of participants loading significantly on this factor. In contrast, about a quarter of the participants load significantly on each of the two other factors (F2 and F3) in the two pre-deliberation measurements. In the post-deliberation urban case, there is a visible change as the first factor (F1) represents almost half of the participants' load significantly in each of two post-deliberation measurements, the second factor (F2) more than one third, and third factor (F3) represents less than one fifth in each of two post-deliberation measurements.

3.2. Qualitative analysis

The interpretation of factors to identify coherent narratives (hereinafter referred to as “narratives”) is presented below. Based on this, we have assigned names to the narratives which aim to reflect the core of their argument and the description of change between particular measurements. Pre- and post-deliberation measurements in the rural case are described first, followed by descriptions of the pre- and post-deliberation measurements in the urban case.

3.2.1. Rural case

The dominant narrative in the pre-deliberation rural case (Table 5) was named “**Municipality consult, verify and decide**” (statements: 5, 4, 28, 23, 1, 22, 3, 20, 30, 24, 11, 29, 7, 12). It generally ascribes the right to decide on tree cutting to the municipality, which consults the owner and verifies the reasons for tree removal. The second narrative, “**Owner decide**” (statements: 1, 3, 4, 5, 7, 10, 12, 16, 17, 20, 21, 24, 28, 29, 30, 33), gives the right to make the final decision on tree cutting to the owner, who prioritises consideration of whether a tree is bothersome to others. However, the owner is not dictated to by anyone in deciding a course of action. The third narrative, “**Nature matters**” (statements: 1, 3, 4, 5, 7, 8, 12, 14, 18, 20, 24, 28, 29, 30, 31, 32), does not emphasise who should decide on the tree removal but draws attention to several criteria (especially ecological/natural criteria) on which the decision should be based. Additionally, it assigns more importance to the public good.

In the post-deliberation rural case (Table 6), the first dominant narrative is dubbed “**There is a need for objective rules**” (statements: 1, 2, 6, 7, 10, 11, 14, 18, 20, 21, 25, 27, 28, 29, 30, 31, 32, 33). It

Table 5

Rural pre-deliberation Q-measurement: The Q-statements with their z-score (Z) and Q-score (Q) for each narrative (N). N1: "Municipality consult, verify and decide"; N2: "Owner decide"; N3: "Nature matters". For statements that are distinguishing for the narratives ($p < 0.05$) the score numbers are boldfaced for the narratives ($p < 0.01$) the score numbers are boldfaced and underlined.

No.	Statement	Rural pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
1	Cutting down a tree on private land should be the decision of the landowner alone.	<u>0.08</u>	<u>0</u>	<u>2.08</u>	<u>4</u>	<u>-0.59</u>	<u>-1</u>
2	No one should decide to cut down a tree on private land (this should be left to the forces of nature).	-1.44	-3	-1.16	-3	-1.23	-3
3	Cutting down a tree on private land should be decided by the municipal officials alone.	<u>0.00</u>	<u>0</u>	<u>-0.89</u>	<u>-3</u>	<u>-1.64</u>	<u>-4</u>
4	Cutting down a tree on private land should be the decision of municipal officials, after consulting with the landowner.	<u>1.42</u>	<u>3</u>	<u>-0.09</u>	<u>0</u>	<u>-0.66</u>	<u>-2</u>
5	When cutting down a tree on private land, the ecological/natural value of the tree should be the primary consideration (eg. whether it is a protected or particularly rare species or whether birds live there).	<u>2.21</u>	<u>4</u>	<u>0.87</u>	<u>2</u>	<u>1.60</u>	<u>4</u>
6	When cutting down a tree on private land, safety should be the primary concern (e.g., distance from a building, risk of falling on the road/sidewalk, the condition of the root system/branches).	1.44	3	1.71	4	1.64	4
7	Cutting down a tree on private land should be the decision of both the landowner and their neighbours.	<u>-1.51</u>	<u>-4</u>	<u>-2.31</u>	<u>-4</u>	<u>-0.14</u>	<u>0</u>
8	When cutting down a tree on private land, the aesthetics should be the primary concern.	0.13	1	0.24	1	<u>1.41</u>	<u>3</u>
9	When cutting down a tree on private land, the size of the tree should be the primary consideration.	0.00	0	-0.14	0	0.42	1
10	When cutting down a tree on private land, the age of the tree should be the	1.17	2	<u>0.10</u>	<u>1</u>	1.20	2

Table 5 (continued)

No.	Statement	Rural pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
11	primary consideration. Cutting down a tree on private land should be a joint decision by all people who live within the reach of its root system or branches.	<u>-1.10</u>	<u>-2</u>	-0.21	0	-0.11	0
12	Cutting down a tree on private land should be decided by anyone interested in it.	<u>-1.67</u>	<u>-4</u>	<u>0.10</u>	<u>1</u>	<u>-0.97</u>	<u>-2</u>
13	When cutting down a tree on private land, the time of year should be the primary consideration.	1.55	3	1.18	2	0.81	1
14	Every time a tree is cut down on private land, the landowner should report it to the municipality.	-0.38	-1	-0.35	-1	<u>-0.98</u>	<u>-2</u>
15	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	-1.29	-3	-0.87	-2	-1.28	-3
16	When cutting down a tree on private land, whether it bothers someone should be the primary concern.	0.55	2	<u>1.65</u>	<u>3</u>	0.37	1
17	The decision to cut down a tree should be made by municipal officials in cooperation with nature conservation services.	0.34	1	<u>-1.67</u>	<u>-4</u>	0.15	0
18	When cutting down a tree on private land, the type of plot on which it is located (eg. agricultural, construction, horticultural, recreational) should be the primary concern.	-0.43	-1	-0.67	-2	<u>0.95</u>	<u>2</u>
19	When cutting down a tree on private land, whether it is located in the city or the countryside should be the primary consideration.	0.11	1	-0.12	0	-0.08	0
20	Cutting down a tree on private land should be allowed only if a new one is (going to be) planted.	<u>-0.79</u>	<u>-2</u>	<u>-0.37</u>	<u>-1</u>	<u>1.45</u>	<u>3</u>
21	When cutting down a tree on private land, the density of	-0.24	-1	<u>0.53</u>	<u>2</u>	-0.25	-1

(continued on next page)

Table 5 (continued)

No.	Statement	Rural pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
22	the trees in the area should be the primary consideration. When cutting down a tree on private land, the size (area) of the land should be the primary consideration.	0.06	0	− 0.35	− 1	− 0.63	− 1
23	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	0.60	2	1.19	3	1.24	3
24	When cutting down a tree on private land, whether the tree is self-seeded should be the primary consideration.	− 0.88	− 2	− 0.10	0	− 1.48	− 3
25	When cutting down a tree on private land, its historical value should be the primary consideration.	1.61	4	1.29	3	1.04	2
26	Provisions for cutting down trees on private land should be established at the municipal level.	0.40	1	− 0.26	− 1	0.18	1
27	Provisions for cutting down trees on private land should be established at the national level.	− 0.45	− 1	− 0.80	− 2	− 0.77	− 2
28	The municipal office should verify whether a tree on private land has been cut down in accordance with the declaration made by the owner.	1.10	2	− 1.45	− 3	0.23	1
29	Cutting down trees on private land should not be regulated by officials.	− 1.23	− 3	0.45	1	− 0.01	0
30	The tree feller should inform neighbours as to why a tree on private land was cut down.	− 0.81	− 2	− 0.31	− 1	− 1.90	− 4
31	The private good is more important than the public good.	− 0.06	0	0.10	1	− 0.55	− 1
32	The public good is more important than the private good.	− 0.58	− 1	− 0.42	− 2	0.89	2
33	Sometimes the public good is more important, and sometimes the private good is more important.	0.10	1	1.08	2	− 0.29	− 1

Source: the authors.

Table 6

Rural post-deliberation Q-measurement: The Q-statements with their z-score (Z) and Q-score (Q) for each narrative (N). N1: “There is a need for objective rules”; N2: “Decision is done by municipal officials after consultations”; N3: “The influence of the authorities should be limited to the necessary minimum”. For statements that are distinguishing for the narratives ($p < 0.05$) the score numbers are boldfaced for the narratives ($p < 0.01$) the score numbers are boldfaced and underlined.

No.	Statement	Rural post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
1	Cutting down a tree on private land should be the decision of the landowner alone.	1.21	3	− 0.08	− 1	2.10	4
2	No one should decide to cut down a tree on private land (this should be left to the forces of nature).	− 1.88	− 4	− 1.30	− 3	0.67	2
3	Cutting down a tree on private land should be decided by the municipal officials alone.	− 1.09	− 3	− 1.05	− 2	− 1.19	− 2
4	Cutting down a tree on private land should be the decision of municipal officials, after consulting with the landowner.	− 0.74	− 2	1.26	3	− 0.68	− 2
5	When cutting down a tree on private land, the ecological/natural value of the tree should be the primary consideration (eg. whether it is a protected or particularly rare species or whether birds live there).	1.56	4	1.56	3	1.52	3
6	When cutting down a tree on private land, safety should be the primary concern (e.g., distance from a building, risk of falling on the road/sidewalk, the condition of the root system/branches).	2.24	4	0.69	1	1.24	3
7	Cutting down a tree on private land should be the decision of both the landowner and their neighbours.	− 2.13	− 4	− 1.05	− 2	− 1.39	− 3
8	When cutting down a tree on private land, the aesthetics should be the primary concern.	− 0.05	0	0.78	2	0.13	0
9	When cutting down a tree on private land, the size of the tree should be the primary consideration.	0.06	0	− 0.04	0	0.27	1
10	When cutting down a tree on private land, the age of the	0.33	1	1.65	4	1.16	3

(continued on next page)

Table 6 (continued)

No.	Statement	Rural post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
11	tree should be the primary consideration. Cutting down a tree on private land should be a joint decision by all people who live within the reach of its root system or branches.	– <u>1.15</u>	– <u>3</u>	– 0.18	– 1	0.27	1
12	Cutting down a tree on private land should be decided by anyone interested in it.	– 0.58	– 1	– <u>1.71</u>	– <u>4</u>	– 0.46	– 1
13	When cutting down a tree on private land, the time of year should be the primary consideration.	0.98	2	1.11	3	1.06	2
14	Every time a tree is cut down on private land, the landowner should report it to the municipality.	– <u>0.69</u>	– <u>1</u>	<u>0.08</u>	<u>0</u>	– <u>1.37</u>	– <u>3</u>
15	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	– 1.12	– 3	– 1.00	– 2	– 1.41	– 3
16	When cutting down a tree on private land, whether it bothers someone should be the primary concern.	0.42	1	– <u>0.18</u>	– <u>1</u>	0.65	1
17	The decision to cut down a tree should be made by municipal officials in cooperation with nature conservation services.	– 0.91	– 2	<u>0.95</u>	<u>2</u>	– 1.30	– 2
18	When cutting down a tree on private land, the type of plot on which it is located (eg. agricultural, construction, horticultural, recreational) should be the primary concern.	<u>0.68</u>	<u>2</u>	0.15	1	– 0.20	– 1
19	When cutting down a tree on private land, whether it is located in the city or the countryside should be the primary consideration.	0.07	0	0.07	0	– 0.11	0
20	Cutting down a tree on private land should be allowed only if a new one is (going to be) planted.	– <u>0.72</u>	– <u>2</u>	0.16	1	– 0.12	– 1
21	When cutting down a tree on private	<u>0.09</u>	<u>1</u>	– <u>1.20</u>	– <u>3</u>	<u>0.68</u>	<u>2</u>

Table 6 (continued)

No.	Statement	Rural post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
22	land, the density of the trees in the area should be the primary consideration. When cutting down a tree on private land, the size (area) of the land should be the primary consideration.	0.00	0	– 0.22	– 1	0.14	0
23	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	1.40	3	1.05	2	0.89	2
24	When cutting down a tree on private land, whether the tree is self-seeded should be the primary consideration.	– 0.15	– 1	– <u>1.19</u>	– <u>2</u>	– 0.30	– 1
25	When cutting down a tree on private land, its historical value should be the primary consideration.	<u>1.07</u>	<u>2</u>	2.05	4	1.78	4
26	Provisions for cutting down trees on private land should be established at the municipal level.	0.44	1	0.35	1	– <u>1.65</u>	– <u>4</u>
27	Provisions for cutting down trees on private land should be established at the national level.	<u>0.74</u>	<u>2</u>	– <u>0.04</u>	<u>0</u>	– <u>1.43</u>	– <u>4</u>
28	The municipal office should verify whether a tree on private land has been cut down in accordance with the declaration made by the owner.	<u>0.02</u>	<u>0</u>	<u>0.91</u>	<u>2</u>	– <u>0.97</u>	– <u>2</u>
29	Cutting down trees on private land should not be regulated by officials.	– 0.31	– 1	– <u>1.48</u>	– <u>3</u>	0.13	0
30	The tree feller should inform neighbours as to why a tree on private land was cut down.	– <u>1.00</u>	– <u>2</u>	– <u>1.57</u>	– <u>4</u>	– 0.52	– 1
31	The private good is more important than the public good.	<u>0.54</u>	<u>1</u>	0.10	1	– 0.05	0
32	The public good is more important than the private good.	– <u>0.49</u>	– <u>1</u>	– 0.06	0	0.27	1
33	Sometimes the public good is more important, and sometimes the private good is more important.	<u>1.16</u>	<u>3</u>	– <u>0.57</u>	– <u>1</u>	<u>0.20</u>	<u>1</u>

Source: the authors.

emphasises the decisive importance of pre-established rules (preferably nationally determined) that should protect objective values (such as safety) based on clear criteria (e.g., type of plot). Certainly, the issue of removing trees should not be left to third parties (e.g., neighbours), nor to blind chance. Property rights are of secondary importance (although the perspective slightly prioritises the private good). In the second narrative, **“Decision is done by municipal officials after consultations”** (statements: 1, 2, 4, 6, 8, 10, 12, 14, 16, 17, 21, 24, 27, 28, 29, 30, 33), the final decision regarding tree removing on private land should be taken by municipal officials after extensive consultation with the landowner (in the first instance) and nature conservation services. However, third parties (neighbours or anyone else who is interested) should not influence decisions. The authorities should also be obliged to monitor the tree cutting to ensure compliance with the submitted declarations. However, it is difficult to say whether they should be consulted on each cut made. Among the important criteria to be considered in the decision-making process are the tree's age and, to a lesser extent, aesthetic considerations. In turn, the third narrative, **“The influence of the authorities should be limited to the necessary minimum”** (statements: 1, 2, 6, 10, 14, 21, 26, 27, 28, 29, 30, 33), emphasises limiting the influence of national and local authorities to monitoring only. The decision-maker should be the owner (or forces of nature), and the only important rule to be considered is the density of the trees in the area.

3.2.2. Urban case

In the pre-deliberation urban case (Table 7), the first dominant narrative can be called (similarly to the pre-deliberation rural case) **“Municipality consult, verify and decide”** (statements: 1, 3, 4, 6, 10, 11, 12, 17, 18, 20, 21, 22, 24, 29, 30) where the final decision regarding tree removing on private land should be taken by municipal officials after extensive consultation with the landowner (in the first instance) and nature conservation services. However, the officials themselves should not make the decision without consulting the owner. The tree density criterion and whether the tree is self-seeding do not affect the decision-making on tree removing. Among the important criteria to be considered in the decision-making process are the tree's age and, to a lesser extent, aesthetic considerations. The second narrative, **“Safety first”** (statements: 3, 4, 5, 6, 7, 8, 11, 12, 14, 15, 16, 17, 18, 20, 22, 25, 26, 28, 30, 31, 32, 33), emphasises as the key criteria for decision-making safety considerations and whether the tree is generally bothersome to a particular party. The third narrative, **“Locally determined stabilisation”** (statements: 2, 3, 4, 6, 7, 11, 12, 17, 18, 19, 20, 22, 27, 30), emphasises safety issues and the impact of the tree on the lives of individual community members.

In the post-deliberation urban case (Table 8), the first dominant narrative was **“The municipality takes care of nature protection”** (statements: 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 21, 24, 26, 27, 28, 29, 32). This gives the right to decide on the cutting down of trees to the municipality in cooperation with nature conservation services, as it allows protecting natural value and the public good. The second narrative, **“Context matters, not the type of the decisive body”** (statements: 2, 3, 5, 6, 7, 10, 11, 12, 13, 18, 19, 21, 24, 27, 28, 29, 30, 31), does not indicate which authority has to decide on the cutting down of trees. It rather points out that the most important considerations when cutting down trees are the safety of the inhabitants of surrounding areas and the natural values provided by the tree. The third narrative, **“The influence of the authorities should be limited to the necessary minimum”** (statements: 3, 5, 6, 7, 10, 11, 12, 13, 16, 18, 19, 21, 24, 25, 27, 28, 29, 33), emphasises that the right to decide on the removing of trees should not be established from above or at a legislative level. It should rather be negotiated and decided by ordinary people, including neighbours and those with a direct interest in the issue, who are within the geographic vicinity of the tree (e.g., roots, branches).

Table 7

Urban pre-deliberation Q-measurement: The Q-statements with their z-score (Z) and Q-score (Q) for each narrative (N). N1: “Municipality consult, verify and decide”; N2: “Safety first”; N3: “Locally determined stabilisation”. For statements that are distinguishing for the narratives ($p < 0.05$) the score numbers are boldfaced for the narratives ($p < 0.01$) the score numbers are boldfaced and underlined.

No.	Statement	Urban pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
1	Cutting down a tree on private land should be the decision of the landowner alone.	– <u>1.25</u>	– <u>3</u>	1.42	4	1.30	3
2	No one should decide to cut down a tree on private land (this should be left to the forces of nature).	– 1.39	– 4	– 1.59	– 4	– <u>0.92</u>	– 2
3	Cutting down a tree on private land should be decided by the municipal officials alone.	– <u>0.05</u>	<u>0</u>	– <u>2.01</u>	– <u>4</u>	– <u>0.99</u>	– <u>2</u>
4	Cutting down a tree on private land should be the decision of municipal officials, after consulting with the landowner.	<u>1.07</u>	<u>2</u>	– <u>1.00</u>	– <u>2</u>	– <u>1.90</u>	– <u>4</u>
5	When cutting down a tree on private land, the ecological/natural value of the tree should be the primary consideration (eg. whether it is a protected or particularly rare species or whether birds live there).	2.22	4	<u>1.20</u>	<u>3</u>	1.85	4
6	When cutting down a tree on private land, safety should be the primary concern (e.g., distance from a building, risk of falling on the road/sidewalk, the condition of the root system/branches).	<u>1.40</u>	3	<u>2.38</u>	<u>4</u>	<u>0.88</u>	2
7	Cutting down a tree on private land should be the decision of both the landowner and their neighbours.	– 1.63	– 4	– 1.24	– 3	– <u>0.21</u>	<u>0</u>
8	When cutting down a tree on private land, the aesthetics should be the primary concern.	– 0.42	– 1	<u>0.38</u>	<u>1</u>	– 0.79	– 2
9	When cutting down a tree on private land, the size of the tree should be the primary consideration.	0.15	1	0.50	1	0.41	1
10	When cutting down a tree on private land, the age of the tree should be the	<u>1.51</u>	<u>4</u>	0.59	2	0.88	2

(continued on next page)

Table 7 (continued)

No.	Statement	Urban pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
11	primary consideration. Cutting down a tree on private land should be a joint decision by all people who live within the reach of its root system or branches.	– 0.60	– 1	0.37	1	– 0.09	0
12	Cutting down a tree on private land should be decided by anyone interested in it.	– 0.73	– 1	– 0.05	0	– 1.26	– 3
13	When cutting down a tree on private land, the time of year should be the primary consideration.	0.75	2	0.89	2	1.28	3
14	Every time a tree is cut down on private land, the landowner should report it to the municipality.	0.42	1	– 1.35	– 3	0.37	1
15	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	– 0.99	– 2	– 1.54	– 3	– 0.64	– 1
16	When cutting down a tree on private land, whether it bothers someone should be the primary concern.	– 0.24	0	1.31	3	– 0.41	– 1
17	The decision to cut down a tree should be made by municipal officials in cooperation with nature conservation services.	0.62	1	– 0.94	– 2	– 0.29	– 1
18	When cutting down a tree on private land, the type of plot on which it is located (eg. agricultural, construction, horticultural, recreational) should be the primary concern.	– 0.35	– 1	0.12	0	– 0.79	– 2
19	When cutting down a tree on private land, whether it is located in the city or the countryside should be the primary consideration.	– 0.28	0	– 0.09	– 1	– 1.58	– 3
20	Cutting down a tree on private land should be allowed only if a new one is (going to be) planted.	0.73	1	0.22	0	1.24	2
21	When cutting down a tree on private land, the density of	– 0.80	– 2	0.51	1	0.20	0

Table 7 (continued)

No.	Statement	Urban pre-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
22	the trees in the area should be the primary consideration. When cutting down a tree on private land, the size (area) of the land should be the primary consideration.	– 0.56	– 1	0.73	2	– 1.73	– 4
23	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	1.38	3	1.32	3	1.39	4
24	When cutting down a tree on private land, whether the tree is self-seeded should be the primary consideration.	– 0.92	– 2	0.34	1	0.07	0
25	When cutting down a tree on private land, its historical value should be the primary consideration.	1.43	3	0.70	2	1.35	3
26	Provisions for cutting down trees on private land should be established at the municipal level.	– 0.10	0	– 0.99	– 2	– 0.47	– 1
27	Provisions for cutting down trees on private land should be established at the national level.	– 0.16	0	0.08	0	– 0.73	– 1
28	The municipal office should verify whether a tree on private land has been cut down in accordance with the declaration made by the owner.	0.94	2	– 0.64	– 2	0.68	1
29	Cutting down trees on private land should not be regulated by officials.	– 1.16	– 3	– 0.47	– 1	– 0.16	0
30	The tree feller should inform neighbours as to why a tree on private land was cut down.	– 1.11	– 2	– 0.62	– 1	0.72	2
31	The private good is more important than the public good.	– 1.19	– 3	0.00	0	– 0.99	– 3
32	The public good is more important than the private good.	0.87	2	– 0.28	– 1	0.66	1
33	Sometimes the public good is more important, and sometimes the private good is more important.	0.41	1	– 0.25	– 1	0.66	1

Source: the authors.

Table 8

Urban post-deliberation Q-measurement: The Q-statements with their z-score (Z) and Q-score (Q) for each narrative (N). N1: "The municipality takes care of nature protection"; N2: "Context matters, not the type of the decisive body"; N3: "The influence of the authorities should be limited to the necessary minimum". For statements that are distinguishing for the narratives ($p < 0.05$) the score numbers are boldfaced for the narratives ($p < 0.01$) the score numbers are boldfaced and underlined.

No.	Statement	Urban post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
1	Cutting down a tree on private land should be the decision of the landowner alone.	<u>-1.38</u>	<u>-4</u>	0.45	1	0.75	2
2	No one should decide to cut down a tree on private land (this should be left to the forces of nature).	-1.32	-3	<u>-2.03</u>	<u>-4</u>	-1.08	-3
3	Cutting down a tree on private land should be decided by the municipal officials alone.	<u>0.56</u>	<u>1</u>	-1.28	-3	-0.81	-2
4	Cutting down a tree on private land should be the decision of municipal officials, after consulting with the landowner.	<u>1.43</u>	<u>4</u>	-0.39	-1	-0.60	-2
5	When cutting down a tree on private land, the ecological/natural value of the tree should be the primary consideration (eg. whether it is a protected or particularly rare species or whether birds live there).	2.12	4	1.72	4	1.14	3
6	When cutting down a tree on private land, safety should be the primary concern (e.g., distance from a building, risk of falling on the road/sidewalk, the condition of the root system/branches).	<u>0.90</u>	<u>2</u>	<u>2.18</u>	<u>4</u>	<u>1.58</u>	<u>4</u>
7	Cutting down a tree on private land should be the decision of both the landowner and their neighbours.	-1.11	-3	-1.51	-4	<u>0.27</u>	<u>1</u>
8	When cutting down a tree on private land, the aesthetics should be the primary concern.	-0.29	0	0.30	1	0.27	0
9	When cutting down a tree on private land, the size of the tree should be the primary consideration.	<u>-0.43</u>	<u>0</u>	0.55	2	0.73	1
10	When cutting down a tree on private land, the age of the	<u>0.51</u>	<u>1</u>	<u>1.12</u>	<u>3</u>	<u>-0.63</u>	<u>-2</u>

Table 8 (continued)

No.	Statement	Urban post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
11	tree should be the primary consideration. Cutting down a tree on private land should be a joint decision by all people who live within the reach of its root system or branches.	-0.78	-1	-0.40	-1	<u>0.88</u>	<u>2</u>
12	Cutting down a tree on private land should be decided by anyone interested in it.	-1.03	-2	-1.49	-3	<u>1.52</u>	<u>3</u>
13	When cutting down a tree on private land, the time of year should be the primary consideration.	-0.47	-1	<u>0.90</u>	<u>2</u>	<u>0.25</u>	<u>0</u>
14	Every time a tree is cut down on private land, the landowner should report it to the municipality.	<u>1.24</u>	<u>2</u>	-1.13	-2	-1.48	-3
15	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	-0.88	-2	-1.23	-3	-0.55	-1
16	When cutting down a tree on private land, whether it bothers someone should be the primary concern.	0.19	0	0.30	1	<u>1.55</u>	<u>4</u>
17	The decision to cut down a tree should be made by municipal officials in cooperation with nature conservation services.	<u>1.04</u>	<u>2</u>	-0.91	-2	-1.00	-2
18	When cutting down a tree on private land, the type of plot on which it is located (eg. agricultural, construction, horticultural, recreational) should be the primary concern.	-0.69	-1	1.40	3	<u>0.82</u>	<u>2</u>
19	When cutting down a tree on private land, whether it is located in the city or the countryside should be the primary consideration.	-0.81	-2	<u>0.14</u>	<u>0</u>	-1.86	-4
20	Cutting down a tree on private land should be allowed only if a new one is (going to be) planted.	0.68	1	0.43	1	0.26	0
21	When cutting down a tree on private	-0.54	-1	-0.17	-1	<u>0.81</u>	<u>2</u>

(continued on next page)

Table 8 (continued)

No.	Statement	Urban post-deliberation					
		N1		N2		N3	
		Z	Q	Z	Q	Z	Q
22	land, the density of the trees in the area should be the primary consideration. When cutting down a tree on private land, the size (area) of the land should be the primary consideration.	− 0.42	0	− 0.15	− 1	− 0.27	0
23	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	1.32	3	1.36	3	1.31	3
24	When cutting down a tree on private land, whether the tree is self-seeded should be the primary consideration.	− 1.00	− 2	− 0.05	0	− 0.53	− 1
25	When cutting down a tree on private land, its historical value should be the primary consideration.	0.91	2	0.89	2	− 0.32	− 1
26	Provisions for cutting down trees on private land should be established at the municipal level.	<u>0.51</u>	<u>1</u>	− 0.53	− 2	− 0.47	− 1
27	Provisions for cutting down trees on private land should be established at the national level.	<u>0.14</u>	<u>0</u>	<u>0.80</u>	<u>2</u>	− <u>2.35</u>	− 4
28	The municipal office should verify whether a tree on private land has been cut down in accordance with the declaration made by the owner.	<u>1.35</u>	<u>3</u>	− 0.07	0	0.52	1
29	Cutting down trees on private land should not be regulated by officials.	− <u>1.26</u>	− <u>3</u>	− <u>0.38</u>	− <u>1</u>	<u>0.36</u>	<u>1</u>
30	The tree feller should inform neighbours as to why a tree on private land was cut down.	− 0.66	− 1	− <u>1.20</u>	− <u>2</u>	− 0.58	− 1
31	The private good is more important than the public good.	− 1.41	− 4	<u>0.14</u>	<u>1</u>	− 1.15	− 3
32	The public good is more important than the private good.	<u>1.36</u>	<u>3</u>	0.09	0	− 0.05	0
33	Sometimes the public good is more important, and sometimes the private good is more important.	0.26	1	0.14	0	<u>0.71</u>	<u>1</u>

Source: the authors.

3.3. Differences between pre- and post-deliberation narratives in the rural case

In the pre-deliberation rural case, a clear opposition was visible between the dominant first narrative of giving the right to decide to the municipality (after public consultation and verification) and the second narrative of giving the right to decide to the landowner. The third narrative (“Nature matters”), while less important to who had the final right to make decisions, was distinguished by the fact that the key issues in it were related to the various benefits provided by nature in the form of a tree: natural value, aesthetic value, etc.

Analysis of the post-deliberation rural case results revealed that the dominant narrative was no longer focused on the final decision-maker, but rather emphasised the need for clear rules at the national level - the most important of which is safety considerations. There was a need to balance public and private good, neither of which were dominant. The first narrative is focused on working out rules. It is similar to the third narrative before deliberation, but the two narratives differ significantly in terms of detail. The second narrative gives the right to decide to the municipality and resembles the dominant first narrative before deliberation. In contrast, the third narrative keeps government influence to a minimum. The landowner should have the right to make a decision, which resembles the second narrative before deliberation.

Deliberation caused a distinct shift in the hierarchy of existing narratives (Fig. 3) by enhancing decision-making criteria (organisational considerations) and suppressing the municipality-landowner opposition.

3.4. Differences between pre- and post-deliberation narratives in the urban case

During the pre-deliberation measurement in urban cases, the dominant narrative supported the municipality’s right to make decisions about tree removing after consulting with the owner and conservation specialists, thus not allocating full decision-making rights to the landowner. The second narrative focused on the safety and comfort of the various people affected by a tree. However, it did not consider whose right (public or private) is more important; these statements oscillated in the middle of the Q-sorting grid. In contrast, the third narrative was characterised by maintaining the local stabilisation of tree management. In the post-deliberation measurement, the dominant first narrative was streamlined with greater emphasis on the fact that the municipality (after consultation) should decide whether to cut down a tree on private property. This was guided primarily by environmental considerations and a higher priority was given to public good over private good. As in the pre-deliberation, the second narrative focused on safety considerations but extended them to include additional circumstances such as environmental considerations or the nature of the plot of land while also favouring the development of regulations at the national level. Similar to the second narrative before deliberation, the third narrative shifted from locally established stabilisation (which is no longer present) towards paying attention to issues of safety and the impact on the lives of individual community members. Unlike in the rural case, there was no change in the hierarchy of the individual narratives. The dominant narrative after deliberation is mainly the same as the one before deliberation. Graphically, this change is illustrated in Fig. 4.

3.5. Similarities between pre- and post-deliberation narratives in rural and urban cases

Statements that do not distinguish between any pair of narratives are called consensus statements. These are statements with either general agreement across the narratives or general disagreement across the narratives.

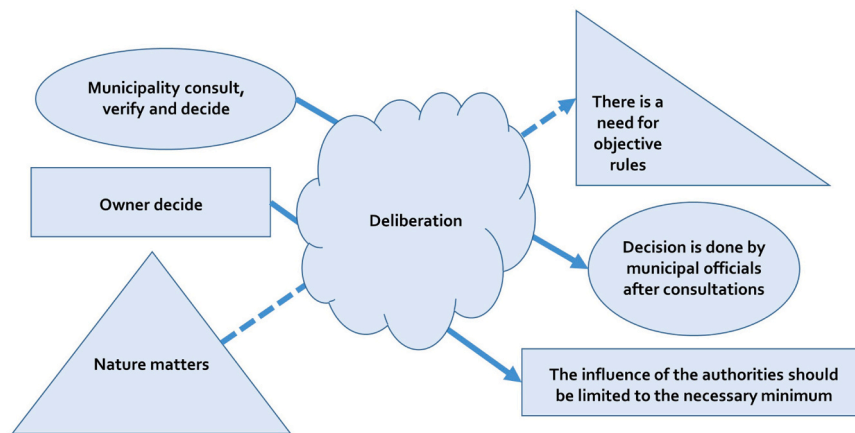


Fig. 3. Changes of narratives in the rural case. A continuous arrow indicates the direction of change and a high similarity between the pre-deliberation narrative and the post-deliberation narrative. A dashed arrow indicates the direction of change and some similarity between the pre-deliberation narrative and the post-deliberation narrative.

Source: the authors.

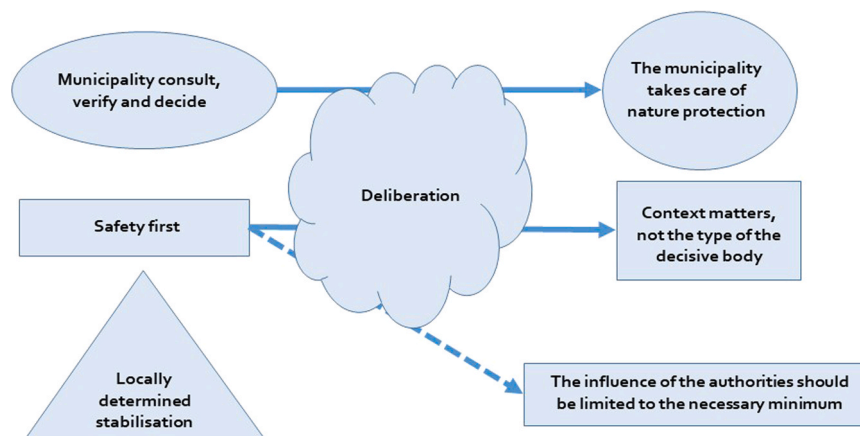


Fig. 4. Changes of narratives in urban case. A continuous arrow indicates the direction of change and a high similarity between the pre-deliberation narrative and the post-deliberation narrative. A dashed arrow indicates the direction of change and some similarity between the pre-deliberation narrative and the post-deliberation narrative.

Source: the authors.

3.5.1. Similarities between pre- and post-deliberation narratives in the rural case

Consensus statements in the pre-deliberation measurement of rural cases (Table 9) prioritise aspects that express safety concerns and historical tree value as criteria for tree removal on private land. However, matters should not be left to the forces of nature, made collectively by the villagers, or be established at the national level.

With regard to consensus statements in the post-deliberation measurement in rural cases (Table 10), we can generalise that the narratives express natural value, the season of the year, and the health condition of a tree to be essential criteria for tree removal on private land. Moreover, there is also consensus that residents of the village should not decide on tree removal on private land, and that full decision-making should be left to the municipality. Therefore, there was no significant change, but rather a slight shift in emphasis compared with before deliberation.

3.5.2. Similarities between pre- and post-deliberation narratives in the urban case

When considering consensus statements during the pre-deliberation measurement in the urban case (Table 11), we can generalise that the narratives express a key criterion before deliberation. At the same time, decision-making on tree removal on private land should consider the

condition and health of the tree, as there was also slight support for the size of a tree as a decision-making criterion.

Concerning consensus statements in the post-deliberation measurement in the urban case (Table 12), we can generalise that the narratives still express a key criterion while decision-making on tree removal on private land should also take tree health into consideration. In addition, there was slight support for the compensation mechanism. No good (private or public) can be identified as more important; the balance should depend on the context of the situation. However, the latter could be confusing, as there was also a distinguishing statement for the third narrative. Some support was evident for private good to be given higher priority in the second narrative.

3.5.3. Similarities between rural and urban cases

When it comes to comparing the consensus statement between the rural (post-deliberation measurement) and the urban (post- and pre-deliberation measurement) cases, the only similarity is the high support for statement 23 (a Q-score of at least 2 for all identified narratives): "When cutting down a tree on private land, the health/condition of the tree should be the primary concern". The condition and health of the tree can thus be considered a universal criterion.

Table 9

Consensus statements in pre-deliberation measurement in rural case for each narrative (N). N1: "Municipality consult, verify and decide"; N2: "Owner decide"; N3: "Nature matters". "+" means agreement and "-" means disagreement in Q-score. All listed statements are non-significant at $p > 0.01$, and those flagged with an * are also non-significant at $p > 0.05$.

Statement no.	Statement	N1	N2	N3
6 *	When cutting down a tree on private land, safety should be the primary concern (e.g., distance from a building, risk of falling on the road/sidewalk, the condition of the root system/branches).	+ 3	+ 4	+ 4
25	When cutting down a tree on private land, its historical value should be the primary consideration.	+ 4	+ 3	+ 2
2 *	No one should decide to cut down a tree on private land (this should be left to the forces of nature).	- 3	- 3	- 3
15	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	- 3	- 2	- 3
27 *	Provisions for cutting down trees on private land should be established at the national level.	- 1	- 2	- 2

Source: the authors.

Table 10

Consensus statements in post-deliberation measurement in rural case for each narrative (N). N1: "There is a need for objective rules"; N2: "Decision is done by municipal officials after consultations"; N3: "The influence of the authorities should be limited to the necessary minimum". "+" means agreement and "-" means disagreement in Q-score. All listed statements are non-significant at $p > 0.01$, and those flagged with an * are also non-significant at $p > 0.05$.

Statement no.	Statement	N1	N2	N3
13 *	When cutting down a tree on private land, the time of year should be the primary consideration.	+ 2	+ 3	+ 2
23	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	+ 3	+ 2	+ 2
3 *	Cutting down a tree on private land should be decided by the municipal officials alone.	- 3	- 2	- 2
15 *	Cutting down a tree on private land should be decided by the inhabitants of the village or housing estate.	- 3	- 2	- 3

Source: the authors.

Table 11

Consensus statements in pre-deliberation measurement in urban case for each narrative (N). N1: "Municipality consult, verify and decide"; N2: "Safety first"; N3: "Locally determined stabilisation". "+" means agreement and "-" means disagreement in Q-score. All listed statements are non-significant at $p > 0.01$, and those flagged with an * are also non-significant at $p > 0.05$.

Statement no.	Statement	N1	N2	N3
23 *	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	+ 3	+ 3	+ 4
9 *	When cutting down a tree on private land, the size of the tree should be the primary consideration.	+ 1	+ 1	+ 1

Source: the authors.

4. Discussion and conclusion

The paper has explored a set of issues that exemplify a wicked problem: narratives of varying pathways for cutting down trees on

Table 12

Consensus statements in post-deliberation measurement in urban case for each narrative (N). N1: "The municipality takes care of nature protection"; N2: "Context matters, not the type of the decisive body"; N3: "The influence of the authorities should be limited to the necessary minimum". "+" means agreement and "-" means disagreement in Q-score. All listed statements are non-significant at $p > 0.01$, and those flagged with an * are also non-significant at $p > 0.05$.

Statement no.	Statement	N1	N2	N3
23 *	When cutting down a tree on private land, the health/condition of the tree should be the primary concern.	+ 3	+ 3	+ 3
20 *	Cutting down a tree on private land should be allowed only if a new one is (going to be) planted.	+ 1	+ 1	0
33	Sometimes the public good is more important, and sometimes the private good is more important.	+ 1	0	+ 1

Source: the authors.

private land. Given societal demand for greenery, inclusion of trees located on private land within the jurisdiction of tree management by public authorities is a justified approach. However, this requires an understanding by the authorities of the intricacies and nuances of disparate public views on the subject, as represented by complex and often opposing narratives. The main features and lability of such narratives were investigated in this research. Various narratives were identified and contrasted using different characteristics of trees, decision-making, and property rights as focal points of environmental management. A deliberation stimulus between two Q-sort measurements enabled respondents to confront their narratives.

The analysis shows that before deliberation, narratives were divided mainly around the question: where is the right to decide situated? The distinction between public and private interests appeared to be pronounced and the division between the two was rather sharp, linked apparently to deeply internalised values. Opposing views on the right to decide about removing trees - specifically, whether it should reside with the landowner or the municipality - are clearly visible, especially in the rural case. In urban areas the private interest is less pronounced. This suggests that different approaches to tree management should be taken between rural and urban areas.

The analysis reveals that a deliberation process can lead to certain shifts in residents' views. However, comparison of the rural and the urban cases shows that these changes are not uniform and depend on the initial states. After deliberation, the narratives were divided mainly around how to organise the decision-making process. In rural municipality a change was visible also in the narrative hierarchy, while the urban municipality generally evolved without changing the narrative hierarchy. This is because in the rural case before deliberation, the "Nature matters" narrative, the third of the identified narratives, was the only one that emphasized organizing the tree management process - specifically around environmental issues. In contrast, after deliberation, this narrative was reflected in the first (dominant) narrative, "There is a need for objective rules", in which environmental criteria were among other criteria to be considered (along with e.g., safety criteria). Such hierarchy change was not visible in the urban case as the first (dominant) narrative before deliberation, "Municipality consult, verify and decide", was also reflected after deliberation in the first (dominant) narrative, "The municipality takes care of nature protection".

It can be argued that in rural areas where interests of private owners are more keenly articulated, deliberation tends to lean towards searching for objective rules for organizing decision-making. In urban areas, decision-making is seen as the domain of the municipality, albeit with limitations. The municipality is charged with managing the protection of nature without overstepping the discretion it is permitted. In both urban and rural cases, the role ascribed for the municipal authorities appears

significant but their power is mitigated, by rules - in the rural areas and by consultations - in urban areas.

Interestingly, after deliberation, both municipalities seem to be more similar in their existing narratives. This may prove that, although wicked problems do not have unambiguous solutions, it is possible to manage them more reasonably using deliberation.

Considering the characteristics of wicked problems (Duckett et al., 2016), our study shows that the deliberation stimulus led to transition from indefinable problem to one that can be defined to a certain extent and softened the sharp division of views between opponents and supporters of restrictions on tree removing on private land. In addition, the shift from individualised, seemingly intransigent and even transcendental values to an approach which recognises common criteria that are important at both individual and community levels (e.g., safety, ecology, sentiment) certainly helps to render the multiple narratives of a problem more accessible and more negotiable, both in conceptual and in practical terms (Kenter et al., 2016, 2015). Previous research suggested this could be an effect of the transformative process of deliberation and learning, as the views of individuals or groups are not pre-formed (Irvine et al., 2016). The process where participants spend time thinking and become familiar with often unfamiliar or unconsidered issues is more likely to approximate implications if the issue were to become a reality (Irvine et al., 2016). Therefore, the issue of cutting down trees on private land can be transformed and less doubly hermeneutical. This approach does not focus on moral consequences (e.g., whether a particular issue or solution is acceptable or unacceptable for some groups), but on shared narratives which are more practicable and easier to integrate into management processes in local communities.

There are, of course, differences between reducing contradictions in narratives, developing acceptable procedural solutions, and accepting the effects they will produce in the future. The Q-deliberation approach does not solve the controversies surrounding cutting down trees on private land. Nevertheless, as a method of stakeholder participation, it can provide insights on the dominant narratives in the local community and inform strategic approaches that could help to improve the legitimacy of management (Orchard-Webb et al., 2016) and diminish division (Schroeter et al., 2016). This conclusion is in line with suggestion that the interactive participation of rural stakeholders can make the optimisation of green infrastructure more impartial (Lin et al. (2021)). Nonetheless, it needs to be stressed that (a) participation is a process rather than a 'one-shot action', and (b) the aim is not to achieve a "true" solution but merely to make the process more impartial. It is noteworthy that both deliberations resulted in transformation of existing narratives by expanding the criteria on which future decisions should be based.

In light of the above discussion our study contributes to the Polish tree removal debate. The debate reflects the general polarisation of attitudes toward trees resulting in vast contestation of management decisions regarding tree removals on private land. Our study reveals (a) the dimensions of public understanding of the issue and (b) certain lability (changeability) of the opinions. Therefore, there is a potential to work out solutions concerning tree removal via public engagement processes.

4.1. Limitations

Our results have six limitations. First, the effects and durability of deliberation could be limited. Previous research points to the "danger" of return by the participants' to their pre-deliberation views because they forget the information and arguments presented during the deliberation process. The mechanism of "forgetting" or "retreating" from the views acquired during the deliberations is difficult to track and capture without ongoing longitudinal research (Setälä et al., 2010; Luskin et al., 2002).

The second limitation is that the need for better criteria and procedures concerning tree management on private land was at least partially a product of the Q-deliberation methodology, which introduced objective considerations in selected statements, e.g., the health or

size of the tree rather than a finding through the research process. We argue that this limitation is not of high importance as the objective considerations in selected statements were present in both Q-sorts before and after deliberation, and the results showed that before deliberation, focus on them was lower than after deliberation. In addition, asking respondents about specific issues (also, e.g., in surveys or individual interviews), such as the importance of the health or size of the tree, always entails the risk that respondents will attach more importance to these issues than they usually do. However, in the case of the Q-deliberation method, which can be used to deal with "wicked problems" during public consultations, greater attention by stakeholders to aspects they had previously overlooked can even be seen as an advantage, albeit, of course, it depends on the persistence of this effect (see the first limitation).

A third potential limitation is the risk of power asymmetry among participants of the study which appears when talking about the shape of identified narratives. To some extent it could exist as in all collective actions. However, we believe that in our study, this risk was minimized because the Q-methodology allows us to limit the impact of power asymmetries between participants. There are two reasons for this: (a) Q-sorts are made individually while narratives are identified using statistical procedures. Neither of these processes is the product of a group discussion that could be dominated by individuals with more power. Within this analytical framework, one also cannot reasonably identify which group is winning, in terms of enforcing a narrative. Instead, narratives can be detected via people as "vehicles" of them. (b) Selection of study participants was carried out ensuring a high level of participant diversity. In addition, to reduce power asymmetry during deliberation, trained moderators were involved to ensure that all participants were able to share their views and that the process was not dominated by the most active participants.

The fourth limitation is that, although narratives were based on statistically produced factors, their interpretation was qualitative and there is thus a risk of low reliability of the results. Nevertheless, to reduce this risk we conducted three-stage interpretation of narratives including individual interpretation, cross-checking and collective discussion. Therefore, we believe that the results obtained have a relatively high reliability for a qualitative study and the possible bias represented by the uniqueness of one researcher's interpretation was reduced by the addition of a collective interpretation stage.

Fifth, best practice in Q-methodology studies e.g., described by Watts and Stenner (2012) and implemented by e.g., Rodhouse et al. (2021) and Kerr et al. (2018) emphasizes that interpretation should not be based solely on relative rankings of statistically significant statements. Our study includes four Q-methodology components (two per municipality) and, in order to compare the results within and across municipalities, we had to make simplifications. We therefore focused only on statistically significant statements (i.e. distinguishing and consensus statements).

Last, the cases we analyse might be viewed as highly specific. The regulatory change which occurred in Poland in 2017 created and constituted a context which might be different from other countries but certainly applied throughout Poland. Our study therefore provides a method and data set which allow verification of its conclusions in multiple other contexts in this country.

CRediT authorship contribution statement

Krzysztof Maczka: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Piotr Matczak:** Writing – review & editing, Supervision, Project administration, Investigation, Funding acquisition, Conceptualization. **Marcin Mielewczyk:** Writing – review & editing, Project administration, Investigation, Conceptualization. **Patrycja Przewoźna:** Conceptualization, Investigation, Writing - Review & Editing, Project administration, Funding acquisition. **Adam Ingłot:** Writing – review & editing, Visualization, Project

administration, Investigation, Conceptualization. **Piotr Wężyk**: Writing – review & editing, Investigation, Funding acquisition, Conceptualization. **Karolina Zieba-Kulawik**: Writing – review & editing, Conceptualization. **Paweł Hawryło**: Writing – review & editing, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.landusepol.2023.106843](https://doi.org/10.1016/j.landusepol.2023.106843).

References

- Bagavathiannan, M.V., Graham, S., Ma, Z., Barney, J.N., Coutts, S.R., Caicedo, A.L., Clerck-Floate, R.D., West, N.M., Blank, L., Metcalf, A.L., Lacoste, M., Moreno, C.R., Evans, J.A., Burke, I., Beckie, H., 2019. Considering weed management as a social dilemma bridges individual and collective interests. *Nat. Plants* 5, 343–351. <https://doi.org/10.1038/s41477-019-0395-y>.
- Banasick, S., 2019. Ken-q analysis (version 1.0.6)[software]. (<https://shawnbanasick.github.io/ken-q-analysis/>) Accessed: 1 January 2021.
- Bauer, F., 2018. Narratives of biorefinery innovation for the bioeconomy: conflict, consensus or confusion? *Environ. Innov. Soc. Transit.* 28, 96–107.
- Brown, S.R., 1980. Political subjectivity: Applications of Q methodology in political science. Yale University Press.
- Brown, S.R., 1993. A primer on q methodology. *10.15133/J.OS.1993.002*.
- Brown, S.R., 1996. Q methodology and qualitative research. *Qual. Health Res.* 6, 561–567. <https://doi.org/10.1177/104973239600600408>.
- Bussell, H., 1998. Parental choice of primary school: an application of q-methodology. *Serv. Ind. J.* 18, 135–147. <https://doi.org/10.1080/02642069800000036>.
- Cariñanos, P., Adinolfi, C., de la Guardia, C.D., Linares, C.D., Casares-Porcel, M., 2016. Characterization of allergen emission sources in urban areas. *J. Environ. Qual.* 45, 244–252. <https://doi.org/10.2134/jeq2015.02.0075>.
- Chen, X., de Vries, S., Assmuth, T., Dick, J., Hermans, T., Hertel, O., Jensen, A., Jones, L., Kabisch, S., Lanki, T., Lehmann, I., Maskell, L., Norton, L., Reis, S., 2019. Research challenges for cultural ecosystem services and public health in (peri-)urban environments. *Sci. Total Environ.* 651, 2118–2129. <https://doi.org/10.1016/j.scitotenv.2018.09.030>.
- Chiesura, A., 2004. The role of urban parks for the sustainable city. *Landsc. Urban Plan.* 68, 129–138. <https://doi.org/10.1016/j.landurbplan.2003.08.003>.
- Clark, C., Ordóñez, C., Livesley, S.J., 2020. Private tree removal, public loss: valuing and enforcing existing tree protection mechanisms is the key to retaining urban trees on private land. *Landsc. Urban Plan.* 203, 103899 <https://doi.org/10.1016/j.landurbplan.2020.103899>.
- Conway, T.M., Urbani, L., 2007. Variations in municipal urban forestry policies: a case study of Toronto, Canada. *Urban For. Urban Green.* 6, 181–192. <https://doi.org/10.1016/j.ufug.2007.07.003>.
- Coronel-Arellano, H., Lara-Díaz, N.E., Moreno, C.E., Gutiérrez-González, C.E., López-González, C.A., 2018. Biodiversity conservation in the Madresan sky islands: community homogeneity of medium and large mammals in northwestern Mexico. *J. Mammal.* 99, 465–477. <https://doi.org/10.1093/jmammal/gyx151>.
- Czepkiewicz, M., Jankowski, P., Zwoliński, Z., 2018. Geo-questionnaire: a spatially explicit method for eliciting public preferences, behavioural patterns, and local knowledge – an overview. *Quaest. Geogr.* 37, 177–190. <https://doi.org/10.2478/quageo-2018-0033>.
- Dai, P., Zhang, S., Hou, H., Yang, Y., Liu, R., 2019. Valuing sports services in urban parks: a new model based on social network data. *Ecosyst. Serv.* 36, 100891 <https://doi.org/10.1016/j.ecoser.2019.01.003>.
- Daniel, C., Morrison, T.H., Phinn, S., 2016. The governance of private residential land in cities and spatial effects on tree cover. *Environ. Sci. Policy* 62, 79–89. <https://doi.org/10.1016/j.envsci.2016.01.015>.
- DeFries, R., Nagendra, H., 2017. Ecosystem management as a wicked problem. *Science* 356, 265–270. <https://doi.org/10.1126/science.aal1950>.
- Duckett, D., Feliciano, D., Martín-Ortega, J., Muñoz-Rojas, J., 2016. Tackling wicked environmental problems: the discourse and its influence on praxis in Scotland. *Landsc. Urban Plan.* 154, 44–56. <https://doi.org/10.1016/j.landurbplan.2016.03.015>.
- Dziopa, F., Ahern, K., 2011. A systematic literature review of the applications of q-technique and its methodology. *Methodology* 7, 39–55. <https://doi.org/10.1027/1614-2241/a000021>.
- Ellis, E.C., Pascual, U., Mertz, O., 2019. Ecosystem services and nature's contribution to people: negotiating diverse values and trade-offs in land systems. *Curr. Opin. Environ. Sustain.* 38, 86–94. <https://doi.org/10.1016/j.cosust.2019.05.001>.
- Eveland, W.P., Thomson, T., 2006. Is it talking, thinking, or both? a lagged dependent variable model of discussion effects on political knowledge. *J. Commun.* 56, 523–542. <https://doi.org/10.1111/j.1460-2466.2006.00299.x>.
- Feldt, T., Karg, H., Kadaouré, I., Bessert, L., Schlecht, E., 2020. Growing struggle over rising demand: how land use change and complex farmer-grazier conflicts impact grazing management in the western highlands of Cameroon. *Land Use Policy* 95, 104579. <https://doi.org/10.1016/j.landusepol.2020.104579>.
- Feltynowski, M., Kronenberg, J., 2020. Urban green spaces—an underestimated resource in third-tier towns in Poland. *Land* 9, 453. <https://doi.org/10.3390/land9110453>.
- Fernandes, C.O., daSilva, I.M., Teixeira, C.P., Costa, L., 2019. Between tree lovers and tree haters. drivers of public perception regarding street trees and its implications on the urban green infrastructure planning. *Urban For. Urban Green.* 37, 97–108. <https://doi.org/10.1016/j.ufug.2018.03.014>.
- Fisher, J.A., Brown, K., 2015. Reprint of “ecosystem services concepts and approaches in conservation: Just a rhetorical tool?” *Ecol. Econ.* 117, 261–269. <https://doi.org/10.1016/j.ecolecon.2014.12.009>.
- Fishkin, J.S., 2009. *When the People Speak: Deliberative Democracy and Public Consultation*. Oup Oxford.
- Fishkin, J.S., 2010. Deliberative democracy and constitutions. *Soc. Philos. Policy* 28, 242–260. <https://doi.org/10.1017/s0265052510000129>.
- Fishkin, J.S., 2021. Deliberative public consultation via deliberative polling: criteria and methods. *Hastings Cent. Rep.* 51. <https://doi.org/10.1002/hast.1316>.
- Funtowicz, S.O., Ravetz, J.R., 1993. Science for the post-normal age. *Futures* 25, 739–755. [https://doi.org/10.1016/0016-3287\(93\)90022-l](https://doi.org/10.1016/0016-3287(93)90022-l).
- Głowacki, A., 2017. Dobro wspólne a prawo własności. Technical Report Centrum Badań Opinii Społecznej. ([chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cbos.pl/SPISKOM.POL/2017/K_030_17.PDF](https://www.cbos.pl/SPISKOM.POL/2017/K_030_17.PDF)).
- Guimarães, M.H., Guimomar, N., Surová, D., Godinho, S., Correia, T.P., Sandberg, A., Ravera, F., Varanda, M., 2018. Structuring wicked problems in transdisciplinary research using the social–ecological systems framework: an application to the montado system, Alentejo, Portugal. *J. Clean. Prod.* 191, 417–428. <https://doi.org/10.1016/j.jclepro.2018.04.200>.
- Guo, T., Morgenroth, J., Conway, T., Xu, C., 2019. City-wide canopy cover decline due to residential property redevelopment in Christchurch, New Zealand. *Sci. Total Environ.* 681, 202–210. <https://doi.org/10.1016/j.scitotenv.2019.05.122>.
- Hardin, G., 1968. The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. *Science* 162, 1243–1248.
- Hartmann, T., Slavíková, L., McCarthy, S., 2019. *Nature-Based Flood Risk Management on Private Land* (Eds.). Springer International Publishing. <https://doi.org/10.1007/978-3-030-23842-1>.
- Heifetz, R.A., Heifetz, R., 1994. *Leadership Without Easy Answers*. volume 465. Harvard University Press.
- Hendee, J.T., Flint, C.G., 2014. Incorporating cultural ecosystem services into forest management strategies for private landowners: an Illinois case study. *For. Sci.* 60, 1172–1179. <https://doi.org/10.5849/forsci.13-710>.
- Himmelroos, S., Christensen, H.S., 2012. Deliberative capacity and opinion change—evidence from a deliberative mini-public. In: *Political Studies Association Annual International Conference in Belfast* (pp. 3–5).
- Hisschemöller, M., Hoppe, R., 2018. Coping with intractable controversies: the case for problem structuring in policy design and analysis 1 (pp.). Knowledge, Power, and Participation in Environmental Policy Analysis. Routledge, pp. 47–72 (pp.).
- Ho, G.W.K., 2016. Examining perceptions and attitudes. *West. J. Nurs. Res.* 39, 674–689. <https://doi.org/10.1177/0193945916661302>.
- Huyen, N.T.T., Anh, N.H., 2018. Activist pr in Vietnam: Public participation via Facebook to save 6,700 trees (pp.). *Protest Public Relations*. Routledge, pp. 205–221 (pp.).
- Irvine, K.N., O'Brien, L., Ravenscroft, N., Cooper, N., Everard, M., Fazey, I., Reed, M.S., Kenter, J.O., 2016. Ecosystem services and the idea of shared values. *Ecosyst. Serv.* 21, 184–193. <https://doi.org/10.1016/j.ecoser.2016.07.001>.
- Jaeger, C.C., 1998. Risk management and integrated assessment. *Environ. Model. Assess.* 3, 211–225. <https://doi.org/10.1023/a:1019031426729>.

- Jankowski, P., Czepkiewicz, M., Młodkowski, M., Zwoliński, Z., 2016. Geo-questionnaire: a method and tool for public preference elicitation in land use planning. *Trans. GIS* 20, 903–924. <https://doi.org/10.1111/tgis.12191>.
- Kamal, S., Grodziska-Jurczak, M., Brown, G., 2015. Conservation on private land: a review of global strategies with a proposed classification system. *J. Environ. Plan. Manag.* 58, 576–597. <https://doi.org/10.1080/09640568.2013.875463>.
- Karpowicz, C.F., Mansbridge, J., 2005. Disagreement and consensus: the need for dynamic updating in public deliberation. *J. Public Delib.* 1. <https://doi.org/10.16997/jdd.25>.
- Keenan, P.B., Jankowski, P., 2019. Spatial decision support systems: three decades on. *Decis. Support Syst.* 116, 64–76. <https://doi.org/10.1016/j.dss.2018.10.010>.
- Kendal, D., Egerer, M., Byrne, J.A., Jones, P.J., Marsh, P., Threlfall, C.G., Allegretto, G., Kaplan, H., Nguyen, H.K., Pearson, S., et al., 2020. City-size bias in knowledge on the effects of urban nature on people and biodiversity. *Environ. Res. Lett.* 15, 124035.
- Kenter, J.O., O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I., Irvine, K.N., Reed, M.S., Christie, M., Brady, E., Bryce, R., Church, A., Cooper, N., Davies, A., Evelyn, A., Everard, M., Fish, R., Fisher, J.A., Jobstovogt, N., Molloy, C., Orchard-Webb, J., Ranger, S., Ryan, M., Watson, V., Williams, S., 2015. What are shared and social values of ecosystems? *Ecol. Econ.* 111, 86–99. <https://doi.org/10.1016/j.ecolecon.2015.01.006>.
- Kenter, J.O., Jobstovogt, N., Watson, V., Irvine, K.N., Christie, M., Bryce, R., 2016. The impact of information, value-deliberation and group-based decision-making on values for ecosystem services: Integrating deliberative monetary valuation and storytelling. *Ecosyst. Serv.* 21, 270–290. <https://doi.org/10.1016/j.ecoser.2016.06.006>.
- Kerr, N., Gouldson, A., Barrett, J., 2018. Holistic narratives of the renovation experience: using q-methodology to improve understanding of domestic energy retrofits in the united kingdom. *Energy Res. Soc. Sci.* 42, 90–99. <https://doi.org/10.1016/j.erss.2018.02.018>.
- Koch, L., Gorris, P., Pahl-Wostl, C., 2021. Narratives, narrations and social structure in environmental governance. *Glob. Environ. Change* 69, 102317. <https://doi.org/10.1016/j.gloenvcha.2021.102317>.
- Kroll, F., Müller, F., Haase, D., Fohrer, N., 2012. Rural—urban gradient analysis of ecosystem services supply and demand dynamics. *Land Use Policy* 29, 521–535. <https://doi.org/10.1016/j.landusepol.2011.07.008>.
- Kronenberg, J., Łaskiewicz, E., Szilo, J., 2021. Voting with one's chainsaw: What happens when people are given the opportunity to freely remove urban trees? *Landsc. Urban Plan.* 209, 104041. <https://doi.org/10.1016/j.landurbplan.2021.104041>.
- Lagbas, A.J., 2019. Social valuation of regulating and cultural ecosystem services of arroceros forest park: a man-made forest in the city of manila, philippines. *J. Urban Manag.* 8, 159–177. <https://doi.org/10.1016/j.jum.2018.09.002>.
- Li, F., Liu, X., Zhang, X., Zhao, D., Liu, H., Zhou, C., Wang, R., 2017. Urban ecological infrastructure: an integrated network for ecosystem services and sustainable urban systems. *J. Clean. Prod.* 163, S12–S18. <https://doi.org/10.1016/j.jclepro.2016.02.079>.
- Lin, Y., Shui, W., Li, Z., Huang, S., Wu, K., Sun, X., Liang, J., 2021. Green space optimization for rural vitality: insights for planning and policy. *Land Use Policy* 108, 105545. <https://doi.org/10.1016/j.landusepol.2021.105545>.
- Locke, D.H., Romolini, M., Galvin, M., O'Neil-Dunne, J.P., Strauss, E.G., 2017. Tree canopy change in coastal los angeles, 2009–2014. *Cities Environ. (CATE)* 10, 3.
- Luederitz, C., Brink, E., Gralla, F., Hermelingmeier, V., Meyer, M., Niven, L., Panzer, L., Partelow, S., Rau, A.-L., Sasaki, R., Abson, D.J., Lang, D.J., Wamsler, C., vonWehrden, H., 2015. A review of urban ecosystem services: six key challenges for future research. *Ecosyst. Serv.* 14, 98–112. <https://doi.org/10.1016/j.ecoser.2015.05.001>.
- Luskin, R.C., Fishkin, J.S., Jowell, R., 2002. Considered opinions: deliberative polling in britain. *Br. J. Political Sci.* 32, 455–487. <https://doi.org/10.1017/s0007123402000194>.
- Lutfallah, S., Buchanan, L., 2019. Quantifying subjective data using online q-methodology software. *Ment. Lex.* 14, 415–423. <https://doi.org/10.1075/ml.20002.lut>.
- MacFaden, S., Engel, T., 'Neil-Dunne, J., 2017. Tree Canopy Report: Honolulu, HI, 2013. Technical Report University of Vermont Spatial Analysis Laboratory. <https://efaidnbmnnnibpajpcglclefindmkaj/https://dlnr.hawaii.gov/forestry/files/2020/04/Tree-Canopy-Report-Honolulu-2016.pdf>.
- Matinga, M.N., Pinedo-Pascua, I., Vervaeke, J., Monforti-Ferrario, F., Szabó, S., 2014. Do african and european energy stakeholders agree on key energy drivers in africa? using q methodology to understand perceptions on energy access debates. *Energy Policy* 69, 154–164. <https://doi.org/10.1016/j.enpol.2013.12.041>.
- Mayega, R.W., Tumuhameye, N., Bua, G.M., Ssentongo, J., Adong, H., Giles, K., Neema, S., Muhumuza, C., Bazeyo, W., Fishkin, J., et al., 2021. Our land is shrinking": concerns and misconceptions impeding uptake of climate risk mitigation policies in bududa and butalejja districts in eastern uganda. *Science* 9, 109–120.
- McConnachie, M.M., Shackleton, C.M., 2010. Public green space inequality in small towns in south africa. *Habitat Int.* 34, 244–248. <https://doi.org/10.1016/j.habitatint.2009.09.009>.
- Morgenroth, J., O'Neil-Dunne, J., Apiolaza, L.A., 2017. Redevelopment and the urban forest: a study of tree removal and retention during demolition activities. *Appl. Geogr.* 82, 1–10. <https://doi.org/10.1016/j.apgeog.2017.02.011>.
- National Geoportal, 2019. Geoportal Spat. Inf. Infrastruct. (<https://www.geoportal.gov.pl/aplikacje/geoportal-krajowy>) accessed: 2021-01-01.
- Muhlberger, P., 2020. Lessons from the virtual agora project: The effects of agency, identity, information, and deliberation on political knowledge, by peter muhlberger and lori m. weber. *Regular Issue*.
- Nowak, D.J., Greenfield, E.J., 2020. The increase of impervious cover and decrease of tree cover within urban areas globally (2012–2017). *Urban For. Urban Green.* 49, 126638. <https://doi.org/10.1016/j.ufug.2020.126638>.
- Orchard-Webb, J., Kenter, J.O., Bryce, R., Church, A., 2016. Deliberative democratic monetary valuation to implement the ecosystem approach. *Ecosyst. Serv.* 21, 308–318. <https://doi.org/10.1016/j.ecoser.2016.09.005>.
- Ostrom, E., 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge university press.
- Paniotova-Maczka, D., Matczak, P., Jabkowski, P., 2021. Place attachment and views on tree management. *Front. Psychol.* 12. <https://doi.org/10.3389/fpsyg.2021.639830>.
- Paniotova-Maczka, D., Jabkowski, P., Matczak, P., Przewoźna, P., Maczka, K., Mielewicz, M., Inglot, A., 2023. Psychological and physical components in forming preferences on urban greenery management — the case of trees. *Environ. Sci. Policy* 145, 1–12. <https://doi.org/10.1016/j.envsci.2023.03.014>.
- Phillips, C., Atchison, J., 2018. Seeing the trees for the (urban) forest: more-than-human geographies and urban greening. *Aust. Geogr.* 51, 155–168. <https://doi.org/10.1080/00049182.2018.1505285>.
- Pigmans, K., Aldewereld, H., Dignum, V., Doorn, N., 2019. The role of value deliberation to improve stakeholder participation in issues of water governance. *Water Resour. Manag.* 33, 4067–4085. <https://doi.org/10.1007/s11269-019-02316-6>.
- Przewoźna, P., Hawryło, P., Zieba-Kulawik, K., Inglot, A., Maczka, K., Wężyk, P., Matczak, P., 2021a. Use of bi-temporal ALS point clouds for tree removal detection on private property in racibórz, poland. *Remote Sens.* 13, 767. <https://doi.org/10.3390/rs13040767>.
- Przewoźna, P., Inglot, A., Mielewicz, M., Maczka, K., Matczak, P., Wężyk, P., 2021b. Geo-questionnaire for environmental planning: the case of ecosystem services delivered by trees in poland. *Data* 6, 128. <https://doi.org/10.3390/data6120128>.
- Rall, E., Hansen, R., Pauleit, S., 2019. The added value of public participation GIS (PPGIS) for urban green infrastructure planning. *Urban For. Urban Green.* 40, 264–274. <https://doi.org/10.1016/j.ufug.2018.06.016>.
- Reid, W.V., Mooney, H.A., Cropper, A., Capistrano, D., Carpenter, S.R., Chopra, K., Dasgupta, P., Dietz, T., Duraipapp, A.K., Hassan, R., et al., 2005. *Ecosystems and human well-being-Synthesis: A report of the Millennium Ecosystem Assessment*. Island Press.
- Rittel, H.W., Webber, M.M., 1973. Dilemmas in a general theory of planning. *Policy Sci.* 4, 155–169.
- Rodhouse, T., Pesch, U., Cuppen, E., Correljé, A., 2021. Public agency and responsibility in energy governance: a q study on diverse imagined publics in the dutch heat transition. *Energy Res. Soc. Sci.* 77, 102046. <https://doi.org/10.1016/j.erss.2021.102046>.
- Schroeter, R., Scheel, O., Renn, O., Schweizer, P.-J., 2016. Testing the value of public participation in germany: theory, operationalization and a case study on the evaluation of participation. *Energy Res. Soc. Sci.* 13, 116–125. <https://doi.org/10.1016/j.erss.2015.12.013>.
- Setälä, M., Grönlund, K., Herne, K., 2010. Citizen deliberation on nuclear power: a comparison of two decision-making methods. *Political Stud.* 58, 688–714. <https://doi.org/10.1111/j.1467-9248.2010.00822.x>.
- Simon, D., Spiller, S.A., 2016. The elasticity of preferences. *Psychol. Sci.* 27, 1588–1599. <https://doi.org/10.1177/0956797616666501>.
- Statistics Poland, 2019. Demographics database. (<https://demografia.stat.gov.pl/BazadDemografia/StartIntro.aspx>) accessed: 2021-01-01.
- Suchocka, M., Jankowski, P., Błaszczak, M., 2019a. Perception of urban trees by polish tree professionals vs. nonprofessionals. *Sustainability* 11, 211. <https://doi.org/10.3390/su11010211>.
- Suchocka, M., Jankowski, P., Błaszczak, M., 2019b. Tree protection on construction sites — knowledge and perception of polish professionals. *Urban For. Urban Green.* 46, 126436. <https://doi.org/10.1016/j.ufug.2019.126436>.
- Suiter, J., Farrell, D.M., O'Malley, E., 2014. When do deliberative citizens change their opinions? evidence from the irish citizens' assembly. *Int. Political Sci. Rev.* 37, 198–212. <https://doi.org/10.1177/0192512114544068>.
- Tarrant, M.A., Cordell, H.K., 2002. Amenity values of public and private forests: examining the value-attitude relationship. *Environ. Manag.* 30, 692–703. <https://doi.org/10.1007/s00267-002-2722-7>.
- Watts, S., Stenner, P., 2005. Doing q methodology: theory, method and interpretation. *Qual. Res. Psychol.* 2, 67–91. <https://doi.org/10.1191/1478088705qp0220a>.
- Watts, S., Stenner, P., 2012. *Doing Q Methodological Research: Theory, Method and Interpretation*. SAGE Publications Ltd. <https://doi.org/10.4135/9781446251911>.
- Zabala, A., Pascual, U., 2016. Bootstrapping q methodology to improve the understanding of human perspectives. *PLOS ONE* 11, e0148087. <https://doi.org/10.1371/journal.pone.0148087>.