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Research article

Dynamics of community-company interactions in quarrying regions

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ABSTRACT

Quarrying is often perceived as less damaging than large-scale mining, as it typically involves smaller-scale operations and poses fewer environmental risks. Consequently, many regions apply less stringent regulations to quarrying, resulting in reduced data collection and fewer incentives for companies to invest in related research. This regulatory leniency often neglects the social dimensions of quarrying, including its effects on local communities, land use, and cultural landscapes. Our study aims to gain deeper insights into the dynamics of community-company relationships surrounding quarries and the contextual environment influencing these relationships. We do so by exploring four communities in two quarrying locations in the Czech Republic. Our research is based on qualitative interviews with 20 participants from eight different stakeholder groups, complemented by document analyses and field observations. The analysis focuses on exploring the context and the dynamics of community-company relationships and future visions and concerns. We identify four major groups of factors that are influential on community-company relationships: a) Communication and engagement; b) Community, trust, and NIMBYism; c) Context complexity; and d) Mine size and remoteness. Our results highlight the local governing body as a key player in communication and engagement. Misinformation, often arising from knowledge gaps, misunderstandings, errors, and transparency issues, emerged as a major factor undermining effective three-party communication. We demonstrate that effective, transparent communication is essential for building strong community-company relationships and addressing future concerns surrounding quarries. This study underscores the need for proactive, transparent, and context-sensitive approaches to foster sustainable relationships in quarrying areas.

1. Introduction

In the journey towards adopting sustainable development, it becomes increasingly evident that effective decision-making processes must consider the diverse interactions between people, places, and industries. This requires addressing some of the most intricate local facets of sustainable development, including the social, economic, behavioral, and psychological dimensions underpinning individual decision-making (Svobodova, 2023; Svobodova et al., 2023). Quarrying areas, in particular, confront the challenge of either closing or intensifying aggregates extraction while adapting to new development approaches (Pasqualetti and Frantál, 2022). In these areas, the willingness of people to establish or re-establish connections with places affected by the extraction plays a central role in their future development.

Extractive companies operate to extract natural resources for profit. Despite the often adverse or even destructive impacts of their operations, they frequently hold the greatest potential for development in many remote or marginalized communities, surpassing the capabilities of local or national governments (Cheshire et al., 2014). In the past three decades, companies have been facing growing pressure from various stakeholders to re-think company-community relations, particularly to improve the way the companies interact with local communities (Yousefian et al., 2024; Buxton, 2012). The challenge lies in ensuring that the effects of these interactions are perceived positively by both the communities and companies and that communities develop in ways that align with their vision and aspirations (IIED, 2002).

In this article, we focus on quarrying, the open-cast extraction of non-metallic resources such as stone, sand, gravel, limestone, and other minerals for construction and industrial purposes (Coppin and Bradshaw, 1982). Quarrying, often classified under construction materials

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rather than the broader "extractive industry," typically garners less research attention. Supplying essential but low-value, high-bulk materials, it is often overshadowed by more profitable mining sectors. Quarrying is also perceived as less intensive and less environmentally damaging than large-scale mining (e.g., coal or metal mining), as it generally involves smaller-scale operations and lacks severe risks like toxic waste. Unlike mining sectors that attract intense scrutiny and advocacy, quarrying rarely inspires the same level of social movement or research focus.

In some jurisdictions, quarrying is subject to less stringent regulations compared to larger mining operations without mandatory environmental and social impact assessments or community engagement requirements in the permitting process (e.g. Ministry of the Environment of the Czech Republic, 2017; Queensland Government, 2024). Consequently, there is less data collected and fewer incentives for companies to support related research, resulting in a knowledge gap in the social impact domain.

Only recently has awareness grown around quarrying's social complexities, including issues like shifts in local social structures, conflicts, displacement, and health-related concerns (Kafu-Quvane and Mlaba, 2024; Barchok et al., 2022; Mebratu et al., 2021; Endalew et al., 2019) but also the potential for quarries to contribute to local identity, tourism, or biodiversity if reclaimed appropriately (Baczyńska et al., 2018; Beranová et al., 2017; Bloxam, 2009). Expanding research on the interactions between community and quarries could offer valuable insights into sustainable practices and community engagement for quarry industries with potentially complex but less overt social impacts.

This research study aims to gain deeper insights into the dynamics of community-quarrying company relationships and the contextual environment influencing the relationships. Our research objectives are to: (i) analyze the socio-economic dynamics surrounding the study quarries; (ii) identify the key factors influencing community-company relationships and interactions in the study areas; and (iii) explore stakeholder perspectives on future visions and concerns related to quarrying activities.

We investigated communities located near gravel and sand quarries within the districts of the towns of Tovačov and Suchdol nad Lužnicí in the Czech Republic. These quarries are operated by Heidelberg Materials, the largest quarrying company in the Czech market. Based on our findings, we provide recommendations for improving community relations in the study areas and conclude by highlighting the key insights gained from the study.

2. Theory

2.1. Quarries, companies and communities

Aggregates extracted by quarrying hold a profound economic value closely tied to their geographic location (Bates, 1969). Unlike most other mining commodities, aggregates derive much of their value from proximity to consumer markets. Transporting these materials is a substantial cost component and a critical factor in determining market prices (Kaliampakos and Benardos, 1999). As a result, quarries are typically located near urban centers.

Despite the seemingly lower industry profile compared to other commodities, quarrying can have long-term social, economic, and environmental impacts on the areas where deposits are extracted (Bendixen et al., 2021). Environmental disruptions from excavation include habitat loss, alterations to natural water systems near or downstream from a quarry, soil erosion, noise, vibration, and dust pollution (Salgueiro et al., 2020; Lad and Samant, 2014). These disruptions often lead to conflicts between quarrying companies and local communities, focusing on mitigation efforts, community self-determination, resource control, and land use competition (Hilson, 2002). However, quarries, despite their negative impacts, possess topographical uniqueness, educational value, and cultural significance (Baczyńska et al., 2018). Quarries can contribute to regional identity and significance (Bloxam, 2009), support tourism (Stefano and Paolo, 2017), promote geoheritage (Beranová et al., 2017), serve as venues for sports and cultural events (Chang and Chiou, 2007), and host unique wildlife habitats (Davis, 1979).

Quarrying activities cause significant disruptions to the dynamic relationships between people and places (Svobodova et al., 2023). The extent of these disruptions and their prevention depends on the effectiveness of regulatory measures and the adaptability of local communities (Svobodova et al., 2021). The capacity for adaptation varies across different locations (Owen et al., 2021). While quarrying disrupts these environments, they influence and shape existing relationships and give rise to new ones. This interaction sets the stage for place re-making where individuals engage and reconnect with their surroundings through their personal meanings and experiences (Svobodova et al., 2023). The relationships between people and their surroundings constitute a common focus across various disciplines within the social sciences, including environmental psychology, sociology, human geography, anthropology, urban studies, leisure sciences, ecology, and economics (as evidenced in a literature review by Lewicka, 2011). Despite the ongoing interest in this topic, there remain unresolved concerns regarding the theoretical understanding of the relationship between industrial development and its impact on specific places. At the same time, there is a growing acknowledgment that achieving sustainable industrial development necessitates a localized approach (Grenni et al., 2020; Ives et al., 2020). According to Verbrugge et al. (2019), it is essential to integrate both the tangible physical aspects of development and the intangible interactions between people and their environments. Key concepts like place attachment, sense of place, place-making, and place re-making play a central role in both the practical implementation and theoretical understanding of sustainable development (Svobodova et al., 2023). Understanding how individuals iteratively rebuild their connections to places that have experienced significant and lasting disruptions allows for more informed strategies to support the reconnection and reintegration of communities with their transformed environments in the face of environmental and socio-economic changes.

The extractive company plays a crucial role as a conscientious agent in the acquisition and repurposing of land, addressing both the present-day dynamics and the future revitalization prospects of the region (Bebbington and Humphreys Bebbington, 2018). Extractive company can be conceptualized as a "place within a place," acknowledging that companies establish a presence by "taking" over local spaces (Pierce et al. 2011; Kemp and Owen (2018). Their perspective highlights how power dynamics between the community and the company contribute to the creation and transformation of places. Their approach captures the various exchanges occurring within and across places defining boundaries of "company" and "community", and importantly, explaining the significance of changes to the industry's social performance.

2.2. Corporate social responsibility and community-company relations

The extractive industry has historically deprioritized corporate social responsibility (CSR), often operating in areas without social legitimacy, causing environmental and social disruption, and departing once resources were exhausted (Jenkins, 2004). Since the 1950s, the CSR discourse has urged companies to consider socio-cultural impacts, with Carroll (1991) pointing to legal, ethical, and philanthropic responsibilities, and Fordham and Robinson (2018) highlighting stakeholder relationships through communication and engagement.

In the 1970s, Shocker and Sethi (1973) introduced the concept of a "social contract" for business, later interpreted as a "social licence to operate," referring to the level of community acceptance for industry operations (Boutilier, 2014). This concept is now widely applied in the extractive sector to reflect evolving company–community relationships and the level of acceptance afforded to resource development operations (Moffat et al. 2016).

Social Impact Assessment (SIA) emerged in the 1970s as a regulatory tool for managing social impacts of projects, often integrated with Environmental Impact Assessments (Vanclay, 2003). Despite 50 years of development, SIA often remains a non-mandatory process viewed as costly by some companies (Vanclay, 2024). The extractive sector has generally lagged behind other industries in acknowledging social impacts and the consequences for local communities (Bayton and Burton, 2024; Joyce et al., 2018).

Recently, the extractive industry has increased its focus on local community relations, driven by pressure from social movements, NGOs, and strengthened legislative frameworks requiring community consultation (Worden et al., 2024; ICMM, 2023; Schwartz et al., 2021). One critical challenge is defining and managing relationships with communities. A justice-based approach to these relationships involves enhancing the quality, accessibility, and understanding of information available to affected populations and establishing effective, locally appropriate communication channels for community engagement (Gavidia and Kemp, 2017). This approach aims to support transparent and respectful interactions considered both in the relationship between local people and company representatives, as well as between local people and their representatives.

3. Operational context: quarrying in the Czech Republic

The Czech Republic has seemingly large volumes of geological reserves of exclusive gravel sands (2.101 billion m^3) (Czech Geology Survey, 2022). However, the volumes of extractable reserves are only 555 million m^3 (which represents 26% of the total geological reserves) and reserves with permitted mining are 133 million m^3, i.e. 6%. In 2021, there were a total of 158 active sand and gravel pits in the Czech Republic and their total annual production reached 11.9 million m^3. In recent years, the annual volume of sand and gravel mining in the Czech Republic has remained stable at around 11 to 12 million m^3. The prices of individual construction quarried aggregate fractions rose significantly, averaging an increase of 15–25% per ton in 2021. Based on the Czech government's evaluation of the current state and perspective of the use of building materials (Czech Geology Survey, 2021), in the next 10 years, quarried deposits of building stone and gravel will reach their available reserves and, as a result, the state's economic needs will not be satisfied.

The legal context for mining and quarrying in the Czech Republic is given by Act No. 44/1988 Coll., on the Protection and Utilization of Mineral Resources (Czech Government, 1988). The state's goals in the field of mineral resources are expressed in the strategic document Raw Materials Policy in the Area of Mineral Resources (Ministry of the Environment of the Czech Republic, 2017), including subsequent regional raw materials policies of individual regions.

The Czech Republic, formerly Czechoslovakia, was part of the Eastern Bloc from 1948 to 1989. During this period, mining and quarrying activities were maximized, prioritizing economic interests over environmental concerns and community well-being (Frantál et al., 2016). After the fall of communism in 1989, the newly established democratic government initiated programs aimed at environmental restoration of resource regions. Consequently, the mining industry experienced a notable deceleration, particularly in ores, coal, and essential building materials. To date, the aggregates sector in the Czech Republic continues to rely on quarries established before 1989 (Godány, 2021). Following the emerging trends of a post-productivism orientation towards service provision, leisure, and the commodification of rural landscape directed at recreational use (Horáková, 2010), post-soviet mine rehabilitation efforts target to increase recreational areas and natural values in post-quarrying areas (Hendrychová et al., 2020; Svobodova and Hajek, 2017).

Mining and quarrying companies operating in the Czech Republic are legally obliged to rehabilitate all areas affected by extraction at full cost. To guarantee the quality of land rehabilitation, companies pay a fee for every ton of excavated material to a bank account owned by the company and supervised by the National Mining Authority. The cost is calculated as part of the licensing process and is based on the size of the resource and an estimation of the extent of planned rehabilitation works. The National Mining Authority conducts annual onsite reviews to evaluate the success of rehabilitation to release the budget for the next year. The Authority allows withdrawals from the fund for remediation and reclamation based on a formal withdrawal request that aligns with the approved remediation and reclamation plan. The companies further pay municipalities based on the area of their land used for mining (cost per hectare in the municipality's cadastral territory). Additionally, the companies pay royalties on extracted minerals, with 38% of the revenue going to the budget of the municipality where the extraction occurs, and 62% to the state budget.

Social Impact Assessment and engagement with stakeholders and communities are not mandatory components of either the quarry permitting or closure processes. Instead, regional and local government bodies, which are considered representatives of the community, are involved in these processes. The transfer of information regarding the mining project from the councils to the communities may therefore be limited or even lacking. However, public participation is compulsory in the Environmental Impact Assessment process for projects that meet specific criteria as outlined in the Czech National Council Act no. 413/2021 on Environmental Impact Assessment.

4. Methods

Our study was designed using qualitative approaches following the ethical approval of Göttingen University. This section provides an overview of the study areas and details the methods used for data collection and analysis.

4.1. Study areas

The study focused on two locations: Tovačov and Suchdol nad Lužnicí (referred to as Suchdol) in the Czech Republic. These quarries are operated by an international quarrying company with approximately 30 sites across the country. Technologically, quarrying at those two chosen locations involves "water mining", which utilizes either clamshell dredgers or bucket and suction dredgers for extraction from greater depths or undercut excavators from the shore. This extraction process results in the creation of lakes or a network of lakes. These newly formed water bodies offer potential for various subsequent uses such as water supply, recreational activities, and conservation purposes.

4.1.1. Tovačov study area

The Tovačov study area, located in the floodplain of the Morava River in the Haná cultural region, is characterized by a warm climate, favorable rainfall, and high-quality soils predominantly used for agriculture. Historically, gravel mining was limited to a few small quarries near the town of Tovačov (now Lake III). Industrial quarrying began in the early 1950s. Today, the Tovačov quarries are a significant gravel excavation area of supra-regional importance, comprising four quarry lakes (TI, TII, TIII, and TIV– see Fig. 1a) and covering over 380 ha. The extracted gravel is transported by push boats to the port, dumped into the water, and then moved by a bucket and suction dredger to conveyor belts leading to the processing plant.

The quarries with the largest production are Lake TII and Lake TIV, with the latter also serving as a storage area for rejects from raw material processing. Lake TI serves as a reserve source of drinking water. Excavation at Lake TIII has been closed, with no plans for further operations or water utility purposes. The lake has been repurposed for recreational use, primarily sport fishing and swimming.

Tovačov, Lobodice, and Troubky are three communities in the study area. As of January 2023, Tovačov had 2,475, Troubky had 2,029, and Lobodice had 723 inhabitants (Czech Statistical Office, 2024). This

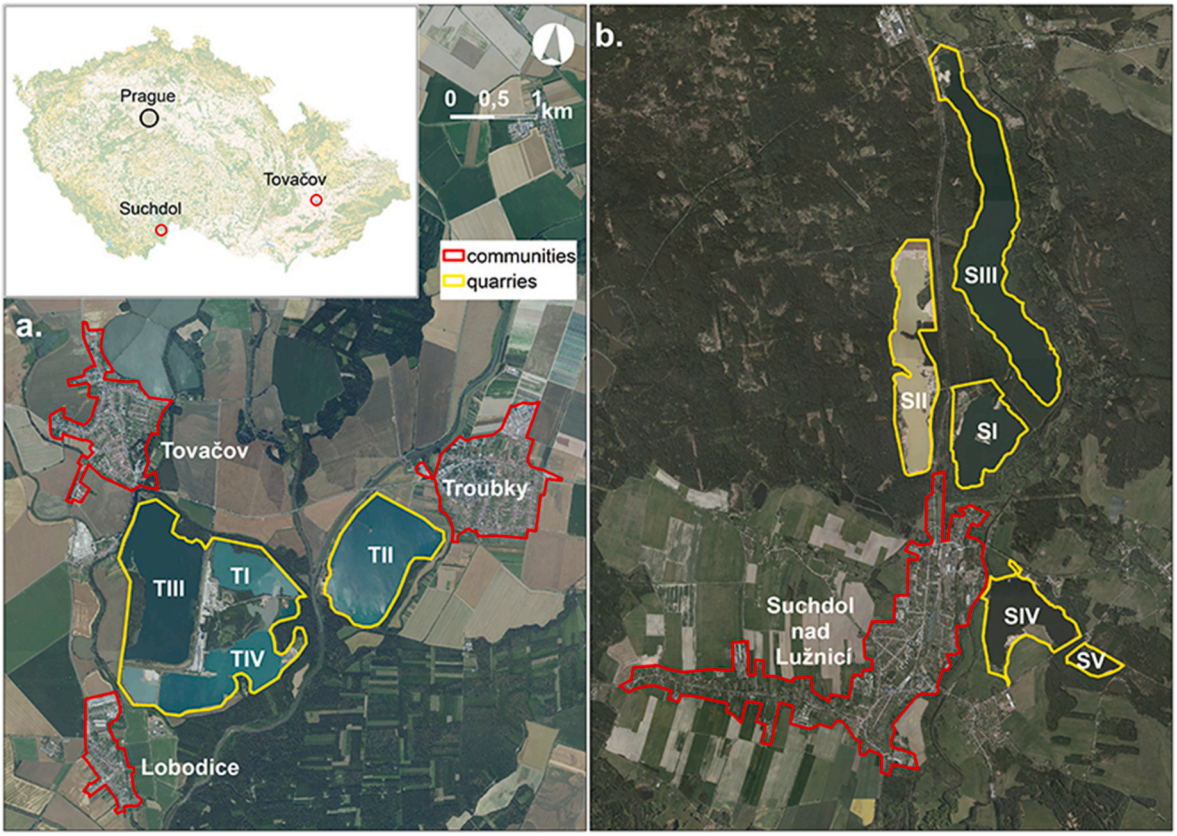

Fig. 1. Study areas and their location in the Czech Republic: a. Tovačov study area, b. Suchdol study area.

relatively small population fosters a close-knit community atmosphere. However, like many rural areas, the Tovačov study area faces challenges related to economic development and retaining younger populations. The area boasts a rich cultural heritage, with Tovačov Castle being a notable contributor to local tourism.

A significant issue polarizing the community in the Tovačov study area is the prospect of opening a new gravel pit north of Lake TIII. The Tovačov council decided to hold a referendum on this matter in October 2021. In the referendum, 900 citizens, representing 76 percent of eligible voters, expressed their opposition to the quarry opening. In contrast, 250 citizens, or 21.1%, voted in favor of it. The referendum results showed that the majority of Tovačov's inhabitants are against additional quarrying. The main concerns are the potential increase in dust and noise, the risk of disturbing the stability of houses, and the loss of fertile soil (Bajerová, 2021).

4.1.2. Suchdol study area

The area is located in the Třeboňsko Protected Landscape Area (PLA), which aims to preserve and protect natural formations, gene pools, species and ecosystem diversity, as well as the cultural and historical richness of the landscape. The global significance of PLA Třeboňsko is highlighted by its inclusion in the UNESCO World Network of Biosphere Reserves since 1977 and its designation as a Ramsar site due to its extensive wetland habitats. The natural and cultural uniqueness, including numerous lakes, swimming spots and cycling traditions, make it a popular tourist destination.

Gravel and sand extraction has been a traditional economic sector in the Suchdol study area. The area encompasses five quarries SI - SV with active, historical, or planned gravel excavation (see Fig. 1b). Currently, quarrying is active at SII and SIV. Quarrying at SII, permitted since 1980, covers 101 ha, with a planned lake area of approximately 68 ha according to the Reclamation and Rehabilitation Plan. The shoreline areas have been reforested, and the nearshore zones are left to natural succession. Quarrying at SV began after 1945 as a small-scale operation by a private owner. Quarrying at SIV, permitted in 1982, continued until 2007 when it was halted due to decreased demand and resumed in 2020. The town of Suchdol nad Lužnicí, with a population of 3607 as of January 1, 2023 (Czech Statistical Office, 2024), is located approximately 250 m from the southern boundary of the quarries.

4.2. Data collection and analysis

To better understand the socio-economic background of each study area, we conducted a document analysis of the census, mine rehabilitation plans, environmental impact assessments, master plans, and other studies related to the study areas. We further analyzed press articles and other media coverage of the sites and municipalities from the last 10 years, including social media such as Facebook and Instagram. To contextualize the gained understanding, we conducted field observation in the municipalities and the quarry sites and interviewed managers of the quarries who possess local in-depth knowledge of the study areas.

In July–August 2023 we conducted face-to-face semi-structured interviews in the Suchdol area and in October 2024, we continued in the Tovačov area. In each area, we performed 10 interviews with local stakeholders. To protect participants' privacy and rights, the standard ethical procedures of written informed consent and anonymization of published excerpts were applied. For further analyses, respondents received codes such as S01 (i.e. an interviewee number 1 from Suchdol) or T01 (i.e. an interviewee number 1 from Tovačov).

To receive a balanced sample of participants per study area, the interviewees were recruited through purposive stratified snowball sampling based on their stakeholder group. We preselected eight stakeholder groups (mining company representatives, regional and local government, community members, community organizations and NGOs, environmental and conservation groups, local businesses, tourism industry, and research institutions). The rationale behind the

selection of participants was to include people who possess high-level knowledge about the area and local communities.

The purpose of the interviews was to better understand the community-company interactions and the environment for the interactions, including the distribution of power and interests, how the community functions, and the community vision and concerns about the future of the post-mining area. In the first part of the interviews, participants self-evaluated their knowledge of the area and specified their relationship with the mining company and their role in the community. Then, they named five associations that characterized the quarries. Using open-ended semi-structured questions, we further talked about the community, the distribution of power and interests surrounding the quarries, the community-company relationships, and the future of the post-mining sites. Each interview took approximately 45 min.

Each session with an interviewee was recorded and transcribed in full. The transcripts were analyzed using qualitative focus coding, including labeling and defining categories for every theme identified in the transcript. Repeated readings of the transcripts and initial coding led to a thematic organization of data based on themes predefined in the study preparation and the development of new themes and emerging topics.

4.2.1. Sample characteristics

The sample included 18 male and 2 female participants from a total of seven stakeholder groups in the Tovačov study area and eight in the Suchdol area (Table 1).

Participants from the Tovačov area most frequently rated their knowledge as the highest, scoring 10 points on a scale of 1–10, where 1 represents the lowest knowledge and 10 is the highest. In comparison, interviewees from the Suchdol area most commonly rated their knowledge as very high, scoring 9 points.

In the Tovačov area, the interactions between participants and the quarrying company varied: two interviewees reported no interactions, seven participants collaborated with the company on a professional or voluntary basis, and one participant was an employee of the company. In the Suchdol area, four interviewees had no interactions with the company, four collaborated with the company as part of their jobs, and two were employed by the company.

Regarding participants' role in the communities, in the Tovačov area, five people were born in the communities. One participant had been living in Tovačov for 35 years but was born elsewhere. Four people did not live in the area but visited it regularly. In the Suchdol area, four participants were born in the town of Suchdol. Another four visited the community regularly, and the remaining two participants did not report any interactions with the community, only with the quarrying company.

Table 1
Sample of participants.

	Tovačov area	Suchdol area
Gender	9 male, 1 female	9 male, 1 female
Stakeholder groups	Mining company (1); regional and local government (3); community members (1); community organizations and NGOs (1); environmental and conservation groups (2); tourism (1); research institutions and experts (1)	Mining company (2); regional and local government (1); community members (3); community organizations and NGOs (1); environmental and conservation groups (2); tourism (1); research institutions and experts (1); local businesses (1)
Knowledge self-evaluation (1 the lowest, 10 the highest)	Median 9.5; average 7.9; mode 10	Median 8.5; average 8.1; mode 9
Company interactions	Employee (1); collaboration (7); no interactions (2)	Employee (2); collaboration (4); no interactions (4)
Community role	Born and live all life (5); live most of life (1); regular visits (4)	Born and live all life (4); regular visits (4); no role (2)

5. Results

The results are organized into three sub-sections discussing three research objectives: (i) contextual dynamics, (ii) the major factors impacting community-company relationships, and (iii) considerations regarding future visions and concerns.

5.1. Contextual dynamics

The contextual dynamics encompass contextualizing participants' responses through free associations and identifying the predominant characteristics describing the quarries, as well as the organizations wielding the greatest influence.

5.1.1. Contextualizing responses through free associations

As part of the interview process, we requested participants to provide five free associations that immediately come to mind when hearing about the Tovačov/Suchdol quarries. Analyzing the participants' associations enabled us to contextualize their responses and better understand their interests and perspectives.

In the Tovačov area, most participants mentioned the association "fishing" (seven times). Additionally, "beautiful nature" and "lake" were mentioned by five participants, while "clear water" and "swimming" were mentioned by four people. "Bird location" was mentioned by three participants (Fig. 2a).

In the Suchdol area, the most prevalent associations were "without rules" mentioned five times, and "swimming" also mentioned five times. Additionally, "beaches" was mentioned four times, while "recreation," "sandy banks," "fishing," and "clean water" were each mentioned three times (Fig. 2b).

5.1.2. Power and interest surrounding the quarries

In the Tovačov area, the mining company Heidelberg Materials was viewed as the most powerful entity, with its primary interest being gravel and sand quarrying. The second strongest interest concerns drinking water supply, managed by the joint-stock company Přerov Waterworks and Sewerage. The third significant interest is fishing, also overseen by the mining company. All ten participants identified these three entities as having the greatest interest and power in the area. The remaining power and interests are distributed among various stakeholders. These include smaller private construction companies operating in the area, recreational activities and swimming by locals and tourists, nature conservation and ornithology represented by the Czech Ornithological Society, water sports organized by Sokol Tovačov, hunting managed by the Haná Tovačov Hunting Association, and research and education conducted by Masaryk University in Brno. Most participants identified these activities, though in varying order. As noted by participant T10 from Tovačov (representing the stakeholder group of research institutions and experts): *" … there are of course even more interests and there are various players who are also waiting in the background for an opportunity of their own. So far, they have been pushed out of that game in the past, I mean various activities like speedboats*."

Nature protection, overseen by the Administration of the Protected Landscape Area Třeboňsko, holds the strongest interest in the Suchdol area. Gravel sand mining, managed by Heidelberg Materials, is perceived as the second most powerful interest in the area, sharing a similar level of power with the town of Suchdol. All participants identified these three parties as the most powerful in the area. Forestry managed by the Forests of the Czech Republic, drinking water storage maintained by the water utility company ČEVAK, fishing organized by the Czech Fishing Club Association, recreational activities and swimming by locals and tourists share the third biggest power and interests. The remaining power is shared by research and education activities conducted by South Bohemia University and hunting managed by the

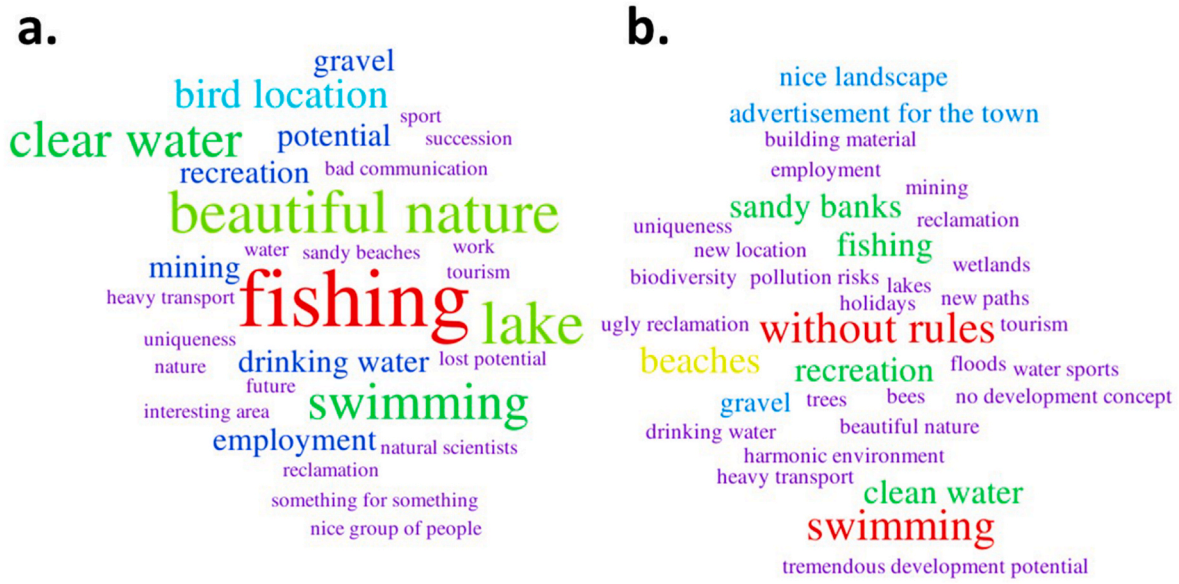

Fig. 2. Word clouds based on the frequency of free associations for the Tovačov (a) and Suchdol (b) areas. The size and color of the words correspond to their frequencies, with red indicating the highest frequency, green the second highest, then blue and purple being the lowest frequency.

Tušť Hunting Association. The significance of nature protection in the area has been emphasized by the participant S6 (community organizations and NGOs), who stated, "*An important player here is the administration of the PLA Třeboňsko, which has already influenced other key entities, particularly the major players such as the quarrying company and Forests of the Czech Republic. They usually follow.*"

5.2. Community-company relationship

Based on the interviews, observations, and document and media analyses, we identified four groups of factors that impact the community-company relationship and interactions in the Tovačov and Suchdol areas. The groups of factors and their interconnectedness are shown in Fig. 3.

The first group of factors, "Communication & Engagement," includes a closely connected set of elements identified as the most influential in shaping communication between the mining company and local communities, as well as community engagement in quarry-related decision-making processes. Interview findings highlighted that the company's approach to quarry rehabilitation and mitigating quarry impacts plays a significant role in the community-company relationship. This approach is affected by land ownership and the Czech regulatory framework,

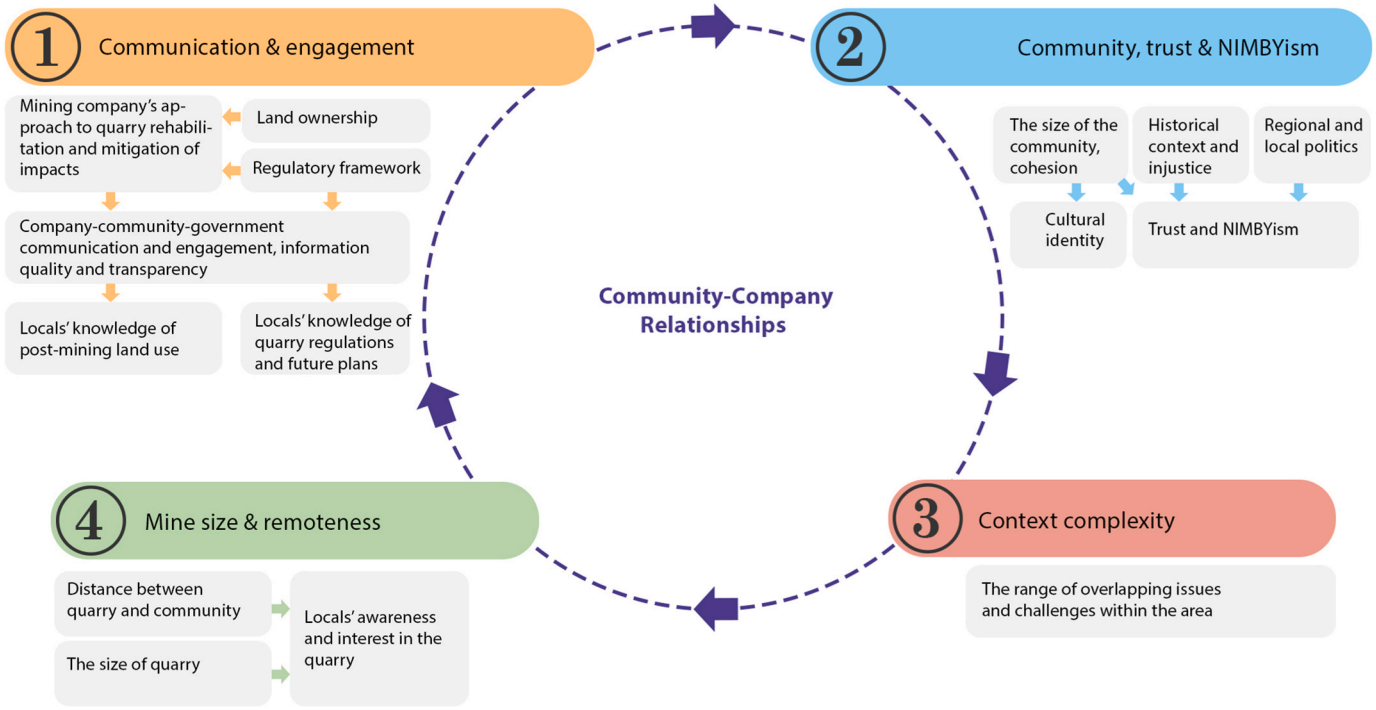

Fig. 3. Four major groups of interconnected factors that impact community-company relationships and interactions identified in both study areas. Each group represents a bundle of individual factors that interact, either reinforcing or constraining one another.

which add additional complexities. For instance, in the Suchdol area, limitations arose from policies supporting strict future land use, as the primary landowner, Forests of the Czech Republic, aimed to prioritize economically productive forests.

Company-community-government communication and engagement, along with the quality and transparency of information, was identified as another impactful factor. This factor is shaped by the company's rehabilitation approach and constraints imposed by the national regulatory framework. In both study areas, we identified misinformation stemming from a lack of knowledge, misunderstandings, misinterpretations, mistakes, and a lack of transparency in the communication between the company, communities, and municipality councils. Participants repeatedly highlighted the lack of the company's communication and engagement with the communities. Several recurrent themes related to transparency and communication have been highlighted by the participants. In the Tovačov area, the company's communication with the community emerged as the most critical topic, consistently mentioned in every interview. A significant concern was the transparency of money flows, particularly regarding the redistribution of mining bonds towards the municipalities and their citizens. Additionally, the potential instability of the subsoil that might result in the cracking of houses added to the challenges facing the relationship. In the Suchdol area, the company's communication with the community was not identified as a major concern. Participants reported good relationships with the quarrying company, summarized by the participant S8 (local business owner): "*There are no conflicts from the side of the company. They behave well, don't impose restrictions, and leave decisions to the owners, the town, and us.*" Conversely, there was a widespread appreciation for the company's nature-based restoration approach in reclaiming one of the quarries, which earned them the Quarry Life Award in 2014. The awareness of this initiative extended across all participants.

However, the involvement of the community in planning quarry closure and rehabilitation was reported to be lacking in both study areas. For instance, participant S3, a representative of the regional and local government stakeholder group in Suchdol, remarked, "*Community engagement in quarry reclamation is zero, almost zero. People are often unaware that such activities are taking place, and even if they are, they may feel reluctant to voice their opinions.*" This lack of communication and engagement adds to relatively low community awareness of regulations and future quarry plans, including limited knowledge of proposed post-mining land use.

The second group of factors, "Community, Trust & NIMBYism," includes community size and cohesion, historical context and injustices, as well as regional and local politics. These factors were found to influence cultural identity, community trust, and NIMBYism. The size of the municipality and community cohesion appeared crucial, particularly concerning the "not in my backyard" (NIMBY) effect. Tovačov, Troubky, and Lobodice, being smaller municipalities, demonstrated higher community cohesion compared to the larger town of Suchdol. Participants from the Tovačov area emphasized their strong Hanák culture and deep connection to regional customs and identity. They reported a pronounced NIMBY effect, contrasting with the perspective of Suchdol residents. Regional and local politics played a significant role in shaping this effect, especially in the lead-up to and during the October 2021 referendum concerning the potential opening of an additional gravel pit near Tovačov. During the interviews, themes of injustice surfaced and contributed to eroding trust and relationships with the quarrying company. In the Tovačov area, participants highlighted the historical injustice of land expropriation dating back to the opening of quarries under the communist regime. Conversely, in Suchdol, concerns focused on potential future injustices linked to increased production pressures amid dwindling gravel and sand reserves at national and global levels.

The third group of factors impacting community-company relationships is "Context Complexity." This group represents the range of overlapping issues and challenges within the area, which complicates and obscures the context for building these relationships. For example, the major issue in the Suchdol area, frequently highlighted in the interviews, was the lack of rules and regulations, leading participants to describe the quarries as a "grey zone." This term encapsulates the complex problems surrounding the quarries. The complexity was underscored by several issues, including an overload of tourists (cyclists and swimmers) during the summer season, even though the entry to the quarries is legally restricted, a lack of infrastructure such as parking areas and trash bins, and stringent development controls imposed by the administration of the Protected Landscape Area Třeboňsko. Participant S7, representing a stakeholder group of environmental and conservation organizations, described the situation as follows: "*It's a bit of a marketing product if you look at the website. For example, the town of Suchdol and the villages in the vicinity usually use clean water in the sand pits to attract visitors. And the other side is that to this day it's really just exploited in this way that everyone, not only the municipalities, but then the accommodation providers and property owners. They all seem to use sand pits for their profit, but nobody seems to do much for the maintenance and regulations of the tourism attracted by them. That's another thing, that no one invests in regulations and infrastructure, for example, parking, etc.*"

The fourth group of factors, "Mine Size & Remoteness," encompasses the quarry's distance from the community, the scale of operations, and the level of local awareness and interest in the quarry. Throughout the interviews, it became evident that the size of mining operations and the distance between quarries and communities in the study areas significantly influenced people's awareness and interest in the quarries, and consequently their interactions with the quarrying company. Generally, larger quarries situated farther away tended to attract less attention and awareness. This dynamic was particularly noticeable in the case of Suchdol quarries, which are expansive and located within forests and farther from the urban areas, making them less visible and accessible.

5.3. Future vision and concerns

Based on insights gathered from the interviews, the vision for the Tovačov area emphasizes several core priorities. Foremost among these is to preserve coexistence and diversity among current activities. Participants emphasized the importance of implementing clear zoning regulations tailored to different uses as a central strategy to maintain the current coexistence in the Tovačov area. Particularly establishing specific zones for recreation, fishing, and nature conservation is seen as a critical priority. Participant T10, representing the stakeholder group of research institutions and experts, articulated the necessity of decisive zoning decisions, stating, " … *to delineate the zones there with some directive decision, because I think that negotiation is not possible. Each interest group there has its optimal ideas and will not voluntarily back down from them … there will be struggles, but I believe it could settle and function over time …* "

Interviewees in the Tovačov area express substantial concerns about several pressing issues. Foremost among these is the worry about land being sold to private owners, which could result in restricted public access and potentially high fees for entry. One participant (T8, Environmental and conservation groups) pointed out, "*In the future, it's evident that when they [the quarrying company] extract gravel, they may intend to sell it, and there should already be regulations or rules in place. Once it's sold, establishing any rules will become impossible.*" Another pressing worry is the prospect of transforming areas into tourist recreation zones featuring hotels and guesthouses, which could alter the rural character of the area. These concerns highlight the community's vision to maintain the balance between development and preserving the community identity.

In envisioning the future development of the Suchdol area, participants highlighted the critical need to establish firm regulations governing parking, swimming, fishing, and nature protection. These regulations are viewed as crucial for maintaining order and sustainability amidst diverse interests and activities in the area. Additionally, there was a desire for guided recreational activities focused on SIV and

SV quarry lakes, and to manage the SI-SIII quarries as a dual-purpose area, emphasizing both water supply and nature conservation.

On the other hand, Suchdol participants expressed significant concerns regarding several pressing issues. These include fears of potential prohibitions on public access to water and the possibility of a resurgence in intensive extraction mandated by the government driven by raw material demands, potentially impacting the local environment and well-being of the communities. There is also apprehension about a decline in tourism, which could adversely affect the local economy and cultural vibrancy. Conversely, there is concern about the potential negative consequences of increased tourism, such as overcrowding and environmental strain. As one participant (S3, regional and local government) noted, "*If quarrying were to significantly expand and another lake was to be created here … the public would be divided into two camps of roughly equal size. Some agreeing with the prospect of economic activity and tourist development, while others opposing it.*"

6. Discussion

This discussion centers on three major factors impacting the community-company relationship that were revealed in our case study. These are communication and engagement, community character, trust and NIMBYism, and the context, including mine size and remoteness.

6.1. Communication and engagement

Our study highlights that the quality of communication between the quarrying company, local communities and the local governing bodies is crucial for fostering a positive perception of community-company relationships. This finding aligns with similar conclusions from other studies, including those by Mercer-Mapstone et al. (2019), Gavidia and Kemp (2017) and Hodge (2014). Mercer-Mapstone et al. (2019) found that positive community experiences with dialogue significantly strengthen relationships with company personnel. Similarly, Moffat and Zhang (2014) identified dialogue as a vital mechanism for building relationships, trust, and, more broadly, a social license to operate. Our results extend these findings by highlighting the involvement of the local governing body as a crucial participant in this communication. Under the Czech Republic's mining regulatory framework, local and regional councils play a significant role in quarry and rehabilitation planning where they decide on behalf of residents without direct community engagement. Specifically, under this legal framework, the results underscore the importance of inclusive and transparent communication channels between the company, communities, and governing bodies.

We found that the quality and transparency of information in this three-party communication are essential for shaping community-company relationships and addressing future concerns about the quarries. We identified that misinformation often arises from a lack of knowledge, misunderstandings, misinterpretations, mistakes, and a lack of transparency in communication. Such misinformation had significant negative impacts on communities, including creating confusion, fostering mistrust, and fears of the future, and influencing public opinion and behavior based on incorrect data. For example, in a referendum regarding a new gravel pit in Tovačov, 60% of participants voted negatively. According to Bajerová (2021), the primary reason was concern that houses in the area were cracking due to the extraction of gravel, leading residents to fear the same would happen to the castle if the new pit was opened. This finding aligns with the study by Svobodova et al. (2020), which indicated that the source of information about mining is the strongest factor affecting the industry's reputation. According to this study, the information obtained from the community and the mass media can contain gossip and rumors and can thus be manipulated and shaped to a greater extent by opinions rather than by facts.

In the study areas, three-party communication has been significantly influenced by the quarrying company's approach to mine rehabilitation and impact mitigation, as well as by the national regulatory framework and land ownership of mining and post-mining land. This was particularly evident in the Suchdol area, where an emphasis on natural restoration was communicated to the public through informative boards placed along paths to the quarries and via media outlets. Interviewees viewed this restoration approach very positively, highlighting it as the best practice example for the company. However, the prevailing land ownership by the Czech Forest Agency in the area, which allocates post-mining land use strictly to economically viable forests, poses limitations for the well-perceived mine rehabilitation approach.

6.2. Community identity, trust and NIMBYism

Our findings indicate that NIMBYism, or the community's opposition to new developments or projects in a local area (Brown and Glanz, 2018), has significant impacts on the relationship between a community and a mining company. According to Dmochowska-Dudek and Bednarek-Szczepańska (2017), the NIMBY syndrome usually concentrates in rural areas. In our study, communities in the Tovačov area reported a pronounced NIMBY effect, higher community cohesion, and feelings of cultural identity and belonging compared to the more urbanized area of Suchdol. According to Jacquet and Stedman (2014), communities that are tightly knit or have a strong sense of identity may be more resistant to change perceived as disruptive. Close-knit communities often value stability and may oppose developments that they feel threaten their social fabric or established way of life. As Moffat and Zhang (2014) and Hilson (2002) highlight, NIMBYism often stems from a lack of trust underpinned by effective communication between the community and the extractive company. If community members feel that their concerns are not being heard or addressed by the company, trust can erode quickly. This lack of trust can further hinder community-company relationships and interactions.

In our study, we underscored that historical experiences of injustice can profoundly undermine community-company interactions. As shown by Haslam and Tanimoune (2016), communities that have historically been marginalized or adversely affected by development often demonstrate heightened NIMBYism and a deep-seated distrust as a protective response. Before 1989, the official stance of the previous regime in the Czech Republic was that a centrally planned economy precluded any acknowledgment of social conflicts or private initiatives representing community voices. Despite bold and dogmatic assertions, dissenting voices were frequently suppressed (Dmochowska-Dudek and Bednarek-Szczepańska 2017).

Additionally, political dynamics within local communities influenced the public perception of the quarrying company, as particularly evident in the Tovačov area. In this way, issues related to land rights, environmental impacts, economic and employment opportunities, and benefits can become politicized, affecting the community-company relationship and interactions (Conde and Le Billon, 2017).

6.3. Context complexity, mine size and remoteness

The contexts in which extractive projects occur are significant determinants, not only in driving resource extraction but also in shaping social resistance (Le Billon and Sommerville, 2017). In our research, the context dynamics were revealed through free associations, particularly pronounced in the Suchdol area where the phrase "without rules" frequently emerged. This highlighted the complexity of the context in Suchdol, further compounded by the prevailing power dynamics led by nature conservation surrounding the quarries. These complexities significantly influenced the community-company relationships. In environments with higher problem complexity, building meaningful relationships is challenging due to the intrusion of various factors.

Context complexity necessitates long-term strategic planning rather than short-term fixes, fostering more sustainable and positive relationships (Luna-Nemecio et al., 2020). Addressing complex issues requires increased efforts to communicate, engage, and involve a diverse array of

stakeholders affected by a wide range of issues. Relating to the complexity, our study further demonstrates that as the distance between the community and the quarries increases, along with the size of the quarries, people's awareness and interest in the area diminish. This finding aligns with Svobodova et al. (2019), who investigated stakeholder knowledge of mining and mine rehabilitation in Australia. The lack of awareness and interest adds to the complexity of relationships and underscores the need for significant investment in multi-party communication and engagement.

7. Recommendations for the quarry company in study areas

Leading extractive companies have made substantial commitments to community engagement, poverty reduction, and human development. However, as shown in this article, a persistent gap remains in the realm of community relations practice, particularly within the quarrying industry in the Czech Republic.

Extractive companies have the opportunity to reinvest in socially responsible development, ensuring their efforts evolve alongside the communities they impact. However, the internal operations of the companies have often escaped the scrutiny of social scientists, who typically concentrate their research efforts on the social impacts of resource extraction. In our study, we illustrated that despite industry claims that corporate social responsibility is a "core competence" (Kemp and Owen, 2013), the quarrying sector has not fully embedded the community relations into its fundamental business practices.

To enhance community-company relationships and mitigate negative perceptions in the study areas, we offer five key recommendations for the quarrying company.

(1) Engage (or employ) community relations practitioners to build better connections within the study areas. These practitioners should be positioned alongside well-established and dominant professions to influence change, both within the organizational sphere and in the community. These practitioners could work on: (i) fostering company understanding of local community perspectives, (ii) bridging gaps between community and company viewpoints to foster mutual understanding, and (iii) facilitating organizational changes necessary to enhance social performance.
(2) Increase communication frequency and transparency with the community and local council to build trust, especially in Tovačov, where proactive strategies are needed to overcome strained relations. Deliver accessible information through municipal channels, periodicals, and social media, recognizing that residents often do not actively seek information.
(3) Address misinformation and clarify what can and cannot be changed, while communicating future visions and mining revenue allocation. Ensure clear communication and cooperation on issues like private land acquisitions, parking, infrastructure, and legislative frameworks to foster understanding and support.
(4) Meet and exceed regulatory requirements to address broader community expectations around sustainability, health, and quality of life. This involves going above and beyond legal obligations, which can be complex and costly.
(5) Foster long-term community relationships by respecting local culture and traditions, committing to environmental stewardship, and educating the community. Implement sustainable practices, and offer public tours, educational programs, and partnerships with environmental organizations, while remaining adaptable and responsive to new information.

8. Conclusion

Quarrying operations often face less stringent regulations and are perceived to have less severe environmental impacts than larger metal and coal mining. This results in limited attention to their social impacts from governments, researchers, and community movements. Our findings indicate that in the Czech Republic, social impact assessment and community engagement are neither required nor recommended in the quarry permitting and closure processes. Given the significant environmental and socio-economic impacts of quarrying on nearby communities, expanding research into the social dimensions of quarry operations offers valuable insights for fostering sustainable practices and improving community relations - particularly in industries with complex yet often less visible community impacts.

The quarrying company operating in the study areas is a global enterprise and the largest in the Czech aggregates market. However, our research found no community relations practitioners overseeing community-company relationships as part of the company's corporate social responsibility in these areas. We demonstrated that the quality of a company's communication and ongoing engagement with local communities and governing bodies is crucial in shaping these relationships. Additional factors—including quarry size and remoteness, the complexity of the quarrying context, community size and cohesion, and NIMBY sentiments—also significantly influence these dynamics.

Historical examples show that the success of extractive industries hinges on relationships with host communities that are built on authenticity, respect, integrity, inclusiveness, and transparency. Such relationships cannot be mandated by legislation. Instead, they arise from the attitudes and actions of the parties involved, demonstrated through cultural sensitivity, sustained dialogue, collaboration, and engagement. These attitudes and actions are the foundation of sustainable quarrying practices today.

CRediT authorship contribution statement

Kamila Svobodova: Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Kamila Botková:** Writing – review & editing, Writing – original draft. **Tobias Plieninger:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication, and no significant financial support was received for this work that could have influenced its outcome. All named authors have read and approved the manuscript, and there are no other individuals who meet the criteria for authorship but are not listed. Additionally, the order of authors listed in the manuscript has been approved by all of us.

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Data availability

Data approved for publication under the ethical approval of Göttingen University for this study are available on 10.5281/zenodo.12624618.

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