


Research

Unveiling local knowledge: a case study on inner development and sustainable transformation in rural areas

Christoph Schwenck¹  · Jannis Pfindtner-Heise²  · Henrik von Wehrden^{1,2} 

Received: 30 October 2024 / Accepted: 10 March 2025

Published online: 31 March 2025

© The Author(s) 2025 

Abstract

The concept of inner development serves as a strategic approach for advancing sustainable transformation and mitigating land consumption in rural areas. By employing an exploratory sequential design, this study analyses local knowledge from political and administrative actors within the district of Lüneburg, Germany. Through qualitative interviews we first identified 25 potential measures for facilitating the feasibility of inner development. Subsequently, utilising Q-methodology, five distinct factors were identified that represent shared clusters of participants' opinions. Our findings reveal a spectrum of viewpoints, highlighting both consensus and divergence regarding measures to promote inner development. These findings were complemented by qualitative insights into barriers, which underscore the need for multi-level strategies that facilitate change at the local level while addressing systemic and cross-regional challenges. The integration of local knowledge emerges as essential for developing context-sensitive, place-based approaches that reflect the diverse characteristics of rural communities. In this context, we propose that the New European Bauhaus serves as a supporting framework, promoting a positive narrative around inner development and enhancing its potential for sustainability transformation. By recognising inner development as a holistic approach and aligning it with the Bauhaus initiative, rural communities are empowered to embrace integrative and sustainable solutions.

Keywords Inner development · Sustainability transformation · Local knowledge · Rural development · q-methodology · New European Bauhaus

1 Introduction

Increasing land consumption triggers multiple effects on environmental challenges concerning sustainable development [1, 2]. Following the land use implications for sustainable development, Germany and the European Union (EU) have set specific targets within the scope of their sustainable development strategies. One of the goals affiliated with the United Nations' Sustainable Development Goal (SDG) 11 within the German sustainability strategy is to reduce the average land take per day to less than 30 ha a day by the year 2030 [3]. In addition, the German and EU's government's

Christoph Schwenck and Jannis Pfindtner-Heise declare shared first authorship.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s43621-025-00999-z>.

✉ Christoph Schwenck, Christoph.schwenck@leuphana.de | ¹Centre of Methods, Leuphana University Lüneburg, Universitätsallee 1, 21335 Lüneburg, Germany. ²Faculty of Sustainability - Sustainability Education and Transdisciplinary Research Institute, Leuphana University Lüneburg, Universitätsallee 1, 21335 Lüneburg, Germany.



climate protection plans are aiming for a circular land economy, with an overall net zero land consumption, by 2050 [3]. However, the settlement and transport area continue to increase by an average of 52 ha per day over the four-year average 2019–2022 [4]. One of the most important measures for the reduction of land use change is the improvement of inner development¹ in cities as well as towns and villages by prioritising inner development and upgrading settlement areas [5–7].

In order to reduce the additional land consumption outside of the city centres, inner development as well as the renewal of town and village centres are regarded as essential measures. “Inner development before external development” serves thus as a guiding principle of spatial planning and urban development [8]. This notion centres around minimizing the designation of new building areas by utilising already developed and integrated sites with new concepts. Inner before external development is also emphasised in the German building code and in the German regional planning act.

While inner development has been an important concept in German cities for a long time, it is often not as prominently debated regarding German towns and villages. In recent years, it has been highlighted that small municipalities, in particular, possess significant small-scale spatial development potential for improving inner development, though they are not always being aware of its positive impacts [7, 9]. Here, different phases of concepts of village renewal have had impacts for many decades [10, 11]. Village centres serve multiple functions, representing not only the aesthetic image of the village but also acting as social hubs and spaces for daily supply [10]. Current processes of village renewal are strongly interlinked with questions of reducing land take, strengthening of village centres and critical verification of the necessities of new housing developmental areas [6]. For some time, many villages have been struggling with decline. These villages are often experiencing the degradation of their village centre, resulting in newly-built single-family homes at the border of the village as well as outdated and sometimes vacant buildings [10]. Already ten years ago village and town centres in Germany, serving as places of community points, were perceived as threatened, while sufficient counterstrategies did not always receive adequate attention by municipalities [12]. The German sustainability strategy also highlights the importance of the preservation of lively village centres [3].

‘New materialism’ and material approaches gained attention in rural geography and—sociology in the last years [13–15], providing further theoretical insights to the material base of village development and renewal. Rural research has a long standing tradition to focus on social, cultural and economic aspects [14] or presented the rural mainly as a symbolic construct of discourse and representation [16, 17]. Overall underrepresented in research are material approaches that highlight materiality—human bodies, material things, built houses and infrastructures, spaces—as vital part of rural research and development. Therefore, material approaches are emphasizing the interaction of human and the more-than-human in fabricating the socio-material world [13]. From this analysis, human and more-than-human are constantly exerting a mutual effect on each other, thereby always developing further as a ‘lived landscape’ [18].

Building on new materialism, Paniagua [14] refers to the importance of traditional rural buildings in the material experience of the rural population in their everyday life. The way how residents and visitors like or dislike, use or ignore, maintain or forfeit buildings or places can be seen as material practices between human and more-than-human [19]. Such houses can be understood as ‘speaking objects’ [14], that incorporate both the histories of the past and the everyday practices of the present. Rural architectural styles of the past are not only characterising the heritage and everyday experience of the rural population, but also predefining future possibilities of place-sensitive development [16]. Material approaches therefore allow to stress the social meaning of traditional and modern infrastructure, such as houses, market places or emblematic buildings, like churches, in rural areas [14, 16]. Thereby, alternative perspectives regarding heritage and transformation of rural areas can be developed [14]. While heritage is often judged as a limiting factor, there are also chances in place-sensitive active design and revitalization of the village centre for rural life itself. Furthermore, such attempts may help in the endeavours against the dispersion of villages and the consumption of new land [6].

Here, the New European Bauhaus initiative may serve as positive framework for driving a transformation towards sustainable inner development. The initiative of the European Union is an ecological, economic and cultural approach, supporting the European Green Deal in achieving carbon neutrality by using participatory and innovative processes for the transformation of everyday lives and places [20, 21]. Core values of the approach are *beautiful*, *sustainable* and *together*. By applying these values to place-specific initiatives the European Union seeks innovation in the creation of houses, places, villages and cities [22]. While the three values are difficult to capture, material approaches may be able to analyse them as the intertwining of the human and more-than-human with the everyday activities and material practices, transforming villages as lived landscapes [18]. Hence, the New European Bauhaus initiative combines the material dimension of rural life with the material practices under an joined umbrella term [16].

¹ Sometimes also referred to as “internal development”, “infill development”, “inner-city development” or “inner-urban development”.

Important elements of New European Bauhaus are the reduction of greenhouse gas emissions, improved energy efficiency, strengthening circular economy and more renewable energy sources. Also, the initiative aligns with various aspects of the Sustainable Development Goals [23]. Among others, the Bauhaus initiative connects to SDG 3 (“Good Health and Well-Being”), SDG 11 (“Sustainable Cities and Communities”) and SDG 13 (“Climate Action”) [23, 24]. While the urban focus of the New European Bauhaus has already gained much attention [21], smaller towns and villages are not as prominently represented. This is the case, even though the European Commission emphasizes that the initiative encompasses all places, including villages and rural areas [22]. The program is therefore aiming to initiate innovation for space-based transformation and vitalisation for cities, towns as well as villages.

The core values of the initiative show similarities to the aims of rural inner development. Village renewal programs are often trying to reactivate village life by creating a village centre space which feels pleasant and welcoming [10]. These are shared aims with the programs values *beautiful* and *together*. They provide a positive narrative, which may be able to guide policies and communities in rural areas towards a vision of beautiful and lively village centres as well as a more sustainable land use. However, for such a novel concept to evolve into the anticipated grass-roots movement, it has to demonstrate tangible benefits for people and communities on-site to create an impact beyond the high-level political institution European Commission, [22].

In order to develop integrative and socially robust solutions for sustainable land use in rural areas there is a necessity for local knowledge, mutual learning and collaborative action [25]. While there has been a variety of top-down political concepts to improve inner development in rural areas, established formal instruments have often not encouraged innovations sufficiently [11]. Consequently, local and situated knowledge of mayors as well as local administration regarding why and how inner development in rural areas can succeed is of relevance for grasping practical in-depth information regarding existing barriers and potential solutions. Furthermore, the issues of unsustainable land use and dispersion of villages are still far from being solved, making it necessary to continue advancing solution-oriented and socially robust knowledge by integrating knowledge from a wide range of actors [26].

In this case study, we focus on rural areas of the district of Lüneburg (Germany, state Lower Saxony) (see section Case Study). We consider the local findings as relevant knowledge for socioeconomically similar regions in Germany and beyond. Additionally, the applied methodology enables new approaches for transformative knowledge and land use-research [27].

We present results from semi-structured interviews with mayors of rural municipalities. Based on these interviews we extracted 25 items that were mentioned to enhance inner development. In an additional online-survey building on the Q-Methodology, 23 participants from municipalities and administration ranked these items based on their perceived implications. We propose to use the experience-based knowledge of mayors and administrations to gain an advanced understanding how inner development in rural areas can be successfully implemented. In the discussion we link the mayors’ insights as well as the results of the Q-Methodology to current debates on rural inner development, while drawing conclusions on the future of sustainable inner development in rural areas and scientific questions.

This paper asks how inner development can be advanced to support beautiful and lively rural areas as well as the German sustainability land use targets. The research questions are:

- What are potentials and barriers of inner development in rural areas?
- How are potentials of inner development in rural areas assessed by administrative actors and elected officials according to their feasibility?
- How can local knowledge on inner development in rural areas support sustainability transformations?

2 Case study

This study was conducted within the transdisciplinary research project SUSTIL.² One measure within the SUSTIL project is called „Regional land management for inner development in the district of Lüneburg“. Here, a wide range of activities are facilitated, such as workshops, presentations and trainings in the city of Lüneburg and in adjacent municipalities. One main part of the process is to carry out semi-structured interviews with the mayors of the municipalities. The interviews

² Full name: *Scenarios for the Implementation of the United Nations’ Sustainable Development Goals in the City and District of Lüneburg: Implications for Land Use Management.*

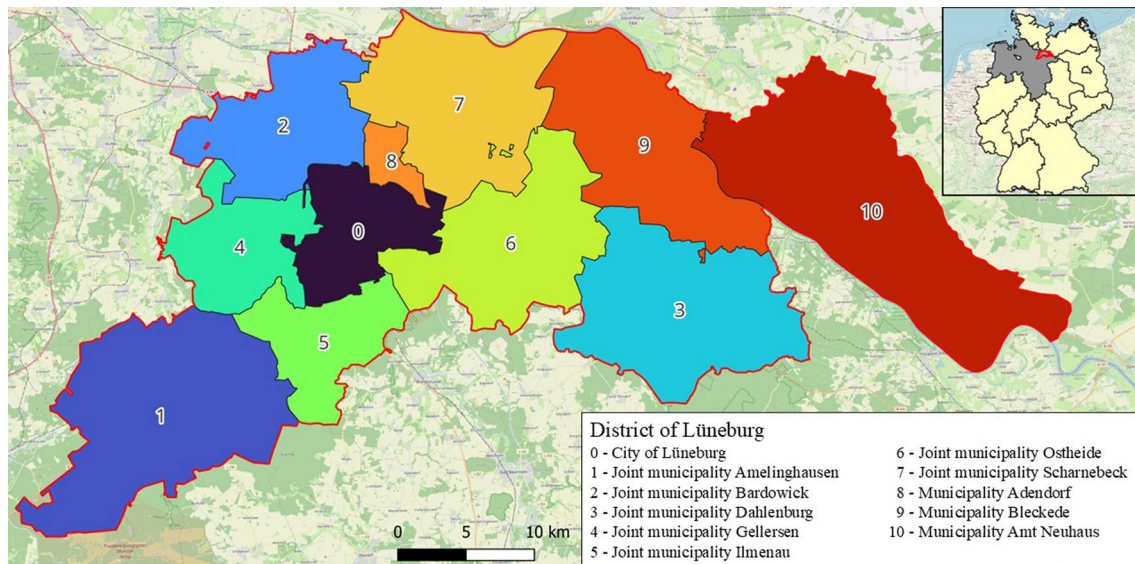


Fig. 1 Overview of municipalities in the district of Lüneburg, federal state of Lower Saxony, Germany (Data sources: Administrative Areas 1: 5 000 000 VG5000, German Federal Agency for Cartography and Geodesy 2022; OpenStreetMap)

had a twofold objective: First, to understand the topics and issues around inner development in the district of Lüneburg to prepare the subsequent events; second, to transcribe the interviews for scientific analysis (see method section).

We focus on the rural areas of the Lüneburg district (Fig. 1). The district is a sparsely populated rural area, classified within the most rural of four categories [28]. Simultaneously, as part of the Hamburg Metropolitan Region, it is integrated into an economically strong network with expectation of an overall growing population [29]. To clearly distinct the urbanized areas the city of Lüneburg with its about 73,000 inhabitants (41.3% of the district's inhabitants) [30] is excluded from the case study. In addition to the city of Lüneburg, ten other municipalities within the district are populated by roughly 104,000 inhabitants in an area of 1,253 km².³

In the light of these characteristics, the district of Lüneburg offers a compelling context for exploring sustainable inner development in rural areas. By exemplifying the tension between economic growth pressures and rural sustainability goals of a metropolitan region, the predominantly rural character allows for a focused investigation of dispersed settlements and small municipalities. The district's diversity in municipality size and demographic trends makes it representative of broader rural challenges, such as land consumption and village centre revitalization. Furthermore, the SUSTIL project serves as a framework for enabling a transdisciplinary approach that directly incorporates tangible local knowledge of relevant actors. These settings provide a valuable opportunity to generate actionable knowledge and transferable insights on promoting inner development strategies to support rural sustainability transformations.

3 Methodology

This study employs an exploratory sequential design [31] of three distinct phases (Fig. 2). The first phase consisted of a qualitative analysis of semi-structured interviews. It is followed by both a quantitative and a qualitative analysis through the Q-methodology. The qualitative interviews provide localized insights from municipal leaders, highlighting the challenges and opportunities of rural inner development [32]. The semi-structured interviews ensure that key themes are systematically addressed while allowing for flexibility to explore unanticipated insights [33, 34]. The interviews give the participants the chance to call out topics of inner development as to their personal experience and expertise. The subsequent Q-methodology phase asked participants in an online survey to rank the pre-defined items based on their

³ The German state Lower-Saxony is divided into districts, which are divided into multiple municipalities. Three types of municipalities exist: unitary municipalities; joint municipalities; (member) municipalities. Joint municipalities are an association of smaller (member) municipalities, that assume some of the municipal duties. The district of Lüneburg consists of four unitary municipalities and seven joint municipalities (containing 39 member municipalities). For better comprehension all three types will be called municipalities in the following.

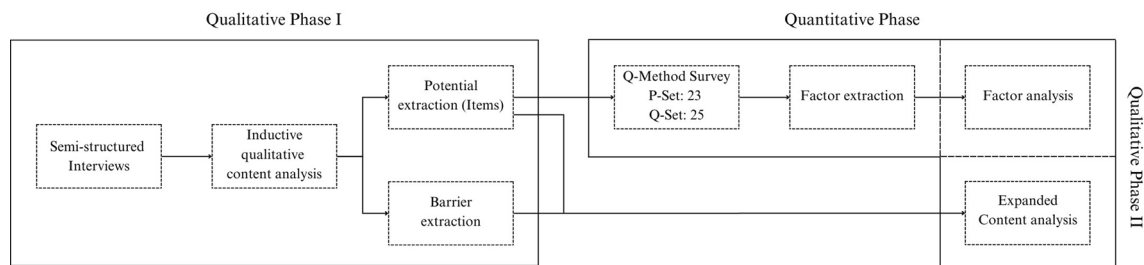


Fig. 2 Scheme of methodological design (own figure)

perspectives regarding the feasibility and outcome of each item. By that the survey allowed for a structured yet nuanced understanding of diverse opinions in contested fields. This method helps identifying clusters of consensus and disagreement among stakeholders without the loss of in-depth information, which can inform policy and conflict resolution [35, 36]. By combining both approaches, this methodology captures a wide range of perspectives from various government levels, resulting in a robust and comprehensive analysis.

3.1 Semi-structured interviews

The first research phase involved conducting semi-structured interviews. Ten mayors of the district of Lüneburg were interviewed in summer 2023 for this purpose.⁴ The interview approach allows for the extraction of deep and practical knowledge on a local level, providing important insights into opinions of mayors in the district of Lüneburg. The overall aim was to map the status and current needs regarding rural municipal development and to explore the mayors' opinions on communal inner development.

Interview questions were structured as a guideline [34] and grouped into six thematic blocks. These were (1) recent population development within the municipality, (2) the housing market and area development, (3) competition for space among a diverse group of stakeholders, (4) commercial area development, (5) current and potential inter-municipal cooperation and (6) the use of geoinformation tools for analysing development potential.

Each interview lasted between 30 to 60 min, providing detailed qualitative insights into the challenges and opportunities of inner development from the perspective of local leaders. The interviews were transcribed and analysed focusing on content and omitting nonverbal parts, such as pauses, laughing and body language. Building on a classic qualitative, summarizing content analysis according to Mayring [37] we applied a thematic iterative, inductive coding approach to identify recurring themes and issues utilizing the software MAXQDA Plus 22 [38]. The results were 40 codes and 469 coded segments across the general topics: infrastructure, legal frameworks, building, information and communication, financial incentives, and communal capacities. Following this initial coding, additional analysis was conducted to classify coded segments as potentials, barriers, both, or neither for inner development. Based on this secondary coding 12 barriers were identified, characterizing how inner development is hindered from the participants' perspectives. Building on the identified potentials, 25 items were extracted. Each item describes a potential measure for fostering inner development.

3.2 Q-methodology

The second phase of the study was designed to further explore and quantify the identified potentials. For examining subjective viewpoints and gaining a deeper understanding of a broad range of stakeholder perspectives a Q-methodology approach was employed. This method, where the participants (P-set) rank different items (Q-set) according to their subjective perspective, is especially valuable in research contexts where understanding the range of opinions, emotions, and underlying values on a conflicted field is crucial [39]. It is commonly used in social sciences, environmental studies, and policy research to reveal how different stakeholders perceive complex and often contentious issues [e.g. 40–42]. Thus, the method is valuable in identifying clusters of consensus and contention among participants, which can inform policy decisions, conflict resolution, or the development of management strategies [e.g. 43, 44]. As shown by diverse studies [45–47] it is designed to be effective with smaller sample sizes,

⁴ The district has eleven municipalities. The only municipality not included, was the City of Lüneburg, due to the focus on rather rural regions.

while the Q-set count often exceeds the P-set [44, 48]. Therefore, the method is ideal for exploratory studies, where shared subjective perspectives are focused, rather than population prevalences of conventional surveys [49, 50].

Conducted in March and April 2024, this phase involved an online survey using the software "Qsoftware" [51]. The survey was distributed to a broad range of participants, including mayors from smaller municipalities and administration employees at various levels, from county to municipal. 179 municipal and district administration employees (including mayors) as well as members of the district council were contacted, with 23 (13%) completing the survey as our final dataset.

Firstly, participants were asked regarding their role within the municipality. Participants were then required to evaluate the Q-set of the 25 items identified in the interview phase by sorting them according to their perceived potential for fostering inner-village development. The sorting process involved two steps: an initial categorization of items into "minor," "medium," and "great" potential to help participants think about the relative potential of each item. In a subsequent step, a more detailed ranking on a discrete scale from -4 ("very minor potential") to +4 ("very great potential") had to be completed. For extreme values there was only one available slot, while slots were increasing for each value towards the centre by one. Hence, the medium value 0 provided with five slots the maximum amount. The survey results were then analysed using KADE software [52], through employing the Principal Component Analysis to identify underlying factors representing similar sorting patterns of participants [39]. Typically, factors are extracted based of Eigenvalues greater 1 [35, 53]. The parsimonious number of factors was identified based on a broken stick approach. Axes were rotated using the Varimax orthogonal method [35, 54]. To minimize subjective bias automated flagging of loadings was applied. Based on this approach, 19 out of 23 loadings were significantly ($p < 0.05$) associated to a factor.

4 Results

4.1 Qualitative interview results

4.1.1 Barriers of inner development

Some overlaps were observed between the analysis of the barriers and the potentials. However, the result of the barrier analysis adds new facets to the overall picture. We found twelve barriers (B1-B12) that were mentioned more than once (Table 1). Many of the barriers refer to challenges around having a limited number of administrative employees as well as very limited time and financial resources (B3, B4, B5, B7, B10). Participants mention that outer development is more cost efficient and brings large scale changes while inner development often is much smaller scaled, does not show fast results and is more expensive (B4). Following this line of argument, it is attractive for municipalities to focus on outer development, also since there is still a widespread belief that outer development represents being a successful community (B12). Furthermore, some shared the feeling of inter-municipal competition and are therefore solely focussing on their own advantages ('insular thinking') (B8). The interviewees were also mentioning relatively high demand for single-family homes compared to rental apartments, especially within the wider context of rising rents (B2). Some mention that municipalities face difficulties in securing external funding, e.g. to support social housing (B5). Furthermore, inner development may lead to new issues, e.g. conflicts around public parking space or new playground next to apartments (B1). Sometimes the real estate owners have other goals for developing their buildings than the broader vision of the village development. Hence, the interviewees mentioned the issue of limited access to land by the municipality (B6). In some municipalities, the village centre or the historic houses already suffer from a negative image, making it more challenging to attract new investments for renewal (B9). Other mentioned that limitations due to regional planning decisions are sometimes not aligned with local demand for intensified inner development (B11).

Figure 3 shows the twelve barriers localized in a qualitative matrix with four quadrants along the axes Individual to Systemic and Local to (Cross-)Regional. Quadrant I (Systemic and Cross-Regional barriers) and quadrant III (individual and local barriers) each contain four of the twelve barriers, showcasing that there are on the one hand complex systemic barriers, which go beyond local approaches (B3, B4, B5, B11). On the other hand, there are very local issues, which need to be addressed on-site by engaged politicians, administration and communities (B1, B2, B9, B10). Others like B6 represent a mixture of local governance and systemic barriers, as the financial status of municipalities is also strongly

Table 1 Identified barriers regarding inner development in rural areas with exemplary quotes; interviews with municipal mayors in the district of Lüneburg (own representation)

ID	Barrier towards inner development	Exemplary Quotation (translation from German)
1	Advancing of inner development may lead to conflicts with residents or intensify competition for space (e.g. public parking)	"Availability of space, clash of interests. [...] The willingness to accept each other and to have a sense of community has declined. And that is of course a problem for inner development, because you want a mix."
2	Demand for single-family homes in rural areas is higher than for apartments	"And at least [anonymized] told us that when something is sold, only single-family properties are purchased. Although we actually wanted to focus on apartment buildings, on terraced houses, and maybe on linked bungalows for older people, who live next to each other and don't have as much garden, but that wasn't the case. They were just not popular."
3	Inner development can worsen environmental issues (e.g. worse flooding events) or signify other subsequent costs (e.g. sewage)	"[...] if we are now developing and also doing the inner development ourselves, we also have to think about the energy supply, and of course we reversely have to think about disposal, like wastewater etc. will not be any less polluting and it is becoming increasingly difficult to manage the whole thing properly."
4	Inner development requires significantly more planning and costs for municipalities than outer development	"And it must be said that one inner consolidation in the development plan naturally also involves a great deal of effort. [...] And the planning of existing buildings actually costs the municipality a lot of money, whereas a new development, if I have a developer or if the municipality itself can then pass the money on, I get it back."
5	Lack of funding for measures of inner development, like village-centre development, social housing or age-appropriate living facilities	"The funding opportunities are of course also interesting for the municipalities [...] Yes, so ultimately, whether it is supported, whether the possibility is there. If, for example, I now want to furnish an empty apartment and it will also be social housing. So, which can then also be offered at a low cost. Are there any funding opportunities?"
6	Limited access to land by the municipality reduces possibilities to operate	"So, a classic example here is our supermarket that we have here [...] And of course, this area, which is now actually already completely sealed, could be used much more efficiently. Because a building in the town centre could also be multi-storey."
7	Long procedures in spatial planning and renovation make inner development less attractive	"But the fact that citizens are also making much more use of their rights, simply asserting them.. And to some extent, this is understandable, but as a result, certain procedures are being drawn out forever. [...] Now the citizens are always supposed to have one more information event and another council meeting separately even more."
8	Municipalities believe in population growth and feel in competition with other municipalities	"So it must be possible for municipality A to develop without being in competition with municipality B, but without harming itself. [...] But this old way of thinking is still prevalent. And there are also enough municipalities that still work according to this old formula and designate new building areas every year."
9	Negatively perceived village centres make it difficult to attract new inhabitants and building modernisation	"Because if you badmouth an old centre of an existing old settlement, you will have a decline in values there and an inner need on the part of those who live there and want to move there to build anew elsewhere."
10	Perceived threat to the townscape by inner development	"We want to preserve certain settlement structures. If a development with six flats is added to a development of 20 houses, then the townscape will be completely destroyed at some point and this is what happens right now."
11	Regional planning limitations sometimes limit possibilities of inner development	"But the requirements of the regional planning programme also apply, of course. In other words, development outside of the main centres is limited. [...] And ultimately, it is all a bit restrained there."
12	Widespread belief that external development areas will bring more benefits to the community than inner development	"I don't know how it is with many [...], but they still think that now is the time to make a big splash and keep creating new building areas, because that's always what economic development and future prospects mean [...]"

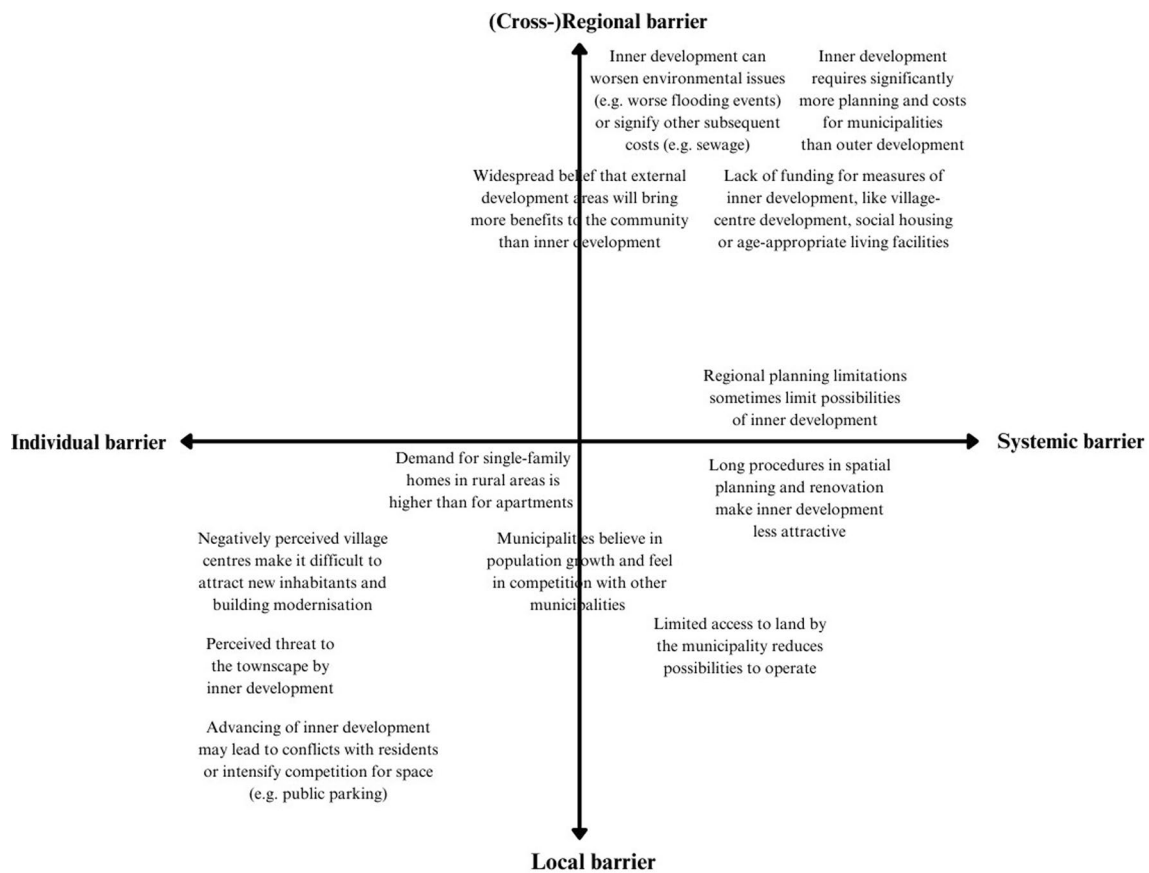


Fig. 3 Qualitative matrix of barriers with x-axis "individual barrier—systemic barrier" and y-axis "local barrier—(cross-)regional barrier" (own figure)

shaped by state and federal law. B12 cannot be positioned distinctly, as it encompasses general belief systems, that can be found at all poles of the respective axes of the matrix. Inner development faces barriers on multiple spatial levels as well as political, cultural, and societal obstacles that require coordinated efforts across both local and broader governance structures to be overcome.

4.1.2 Potentials of inner development

Table 2 depicts the 25 items (I1-I25) potentially benefiting inner development, that were sorted through the interview analysis with exemplary quotes. Exemplary quotes enable a better understanding of each item. These items do not signify any consensus on measures for inner development in rural areas, but represent a wide array of topics, issues and thoughts on the matter. By providing very open questions in the interviews we aimed to gain diverse insights into potential improvements of inner developments. Hence, all information was compiled to a list of potentially benefiting measures. The list of items does therefore not evaluate how the general opinion towards single items is.

Many items emphasize the possibilities that come with enhanced spatial planning, like better geodata management, redrafting of land use plans for new possibilities of inner development or using instruments like historic preservation to preserve the aesthetic image of the townscape as well as the original character (I2, I4, I5, I7, I13, I15, I20, I21, I25). Three items focus on issues of bureaucracy and federalism like simplifying complicated planning procedures (I1), aligning different scales of spatial planning better (I19) and enhancing the inter-municipal cooperation (I23). Others relate more to different financial issues like attractive pricing (I3), financially supporting municipalities to advance inner development (I9, I22) and social housing (I10) or even creating their own municipal housing association (I11). Citizen-oriented offers regarding inner development as well as local demographics and changing housing needs are named as well (I12, I16). The relation of inner development in rural areas with

Table 2 25 identified items from interviews that potentially benefit inner development with exemplary quotes (own translation)

Item ID	Item name	Exemplary Quote (translation from German)
1	Reduction of bureaucratic barriers in the approval procedure of planning- and construction projects in inner areas	"But these development plans are, of course, not without challenges. [...] But when I do something in the inner area, like re-planning existing structures, I also have a relatively high effort just to figure out what's actually there, what are the sealed areas, and what's even possible there?"
2	Set-up or redrafting of land-use & town plans in the centre to promote inner development	"Apart from that, we have inner densification. [...] At the moment, I think we have about [anonymized] town plans that we are working on. So clearly not outward, but rather inner densification, which we have been pushing ahead with on a massive scale here [...]"
3	Attractive pricing for housing in the town centre	"Yes, well, let me put it this way, land prices have gone up extremely. [...] So, it's very, very high, and they are usually pushed to the maximum here in the old village area as well."
4	Structural extension of floors to existing buildings in inner areas	"But we are now actually drawing up a new development plan for this area. With three full floors and an additional staggered floor. Yes, and this will also lead to such areas being used more efficiently without actually causing more sealing. Living space will be created [...]"
5	Emphasis on preserving the townscape while promoting inner development	"What we need here in [anonymized] is a more attractive design of the town itself. And we are trying to achieve this on the other hand by preserving the basic structure of the town center."
6	Expansion of traffic routes to accommodate increased mobility demand	"Inner densification often fails due to traffic and parking space issues."
7	Preservation or renovation of existing buildings (including conversion or reutilisation)	"This disfigures our village image, our village, the core of the village centre [...]. In other words, they are tearing down an old farmhouse and putting up a cuboid of eight flats. That's something the community here has been so preoccupied with and is currently dealing with, it can't go on like this."
8	Preservation and promotion of nearby agricultural businesses	"[...] we had a very strongly agricultural old village, where of course there are huge areas, where we started to lay development plans at the beginning of the 2000s [...]. And now there is a bit of a backlash because agriculture is actually moving further and further out and the pressure here is becoming extreme."
9	Additional staff in municipal administrations	"And one must be clear that inner densification within a development plan is also a significant effort. Especially the member communities, they are all managed on a voluntary basis. This is a not insignificant cost burden and quite a considerable workload."
10	Promotion of social housing	"[When you have] empty buildings [and] want to create housing and housing in them, and also make them affordable on a social level, whether there are funding opportunities for that?"
11	Foundation or expansion of a municipal housing association	"That's why we founded the housing association. We want to enter the housing market. We wanted to build apartments."
12	Citizen-oriented offers for information and participation towards the design of inner-town development	"[...] we are now initially working on this development concept, and we are doing it with citizen participation."
13	Promotion of mixed-use of residential and commercial areas in the inner town	"[Anonymized] aims to create a mixed-use area [...], with both commercial and residential use. Otherwise, it seems to be individual cases where businesses settle individually."

Table 2 (continued)

Item ID	Item name	Exemplary Quote (translation from German)
14	Political steering to promote measures to further inner development	"And of course, we also notice in politics that there is a shift [towards inner development]. Man, why don't we do that? Why don't we maintain this? [...] So, the foundations are also different."
15	Limitation of construction projects in outer areas through spatial planning	"We are pretty smart and are not consuming land in the outer areas."
16	Raising awareness for local demography, especially the change of housing needs of the elderly	"Living in old age is certainly a big issue at the municipal level, that you naturally want to offer age-appropriate living, so you don't ultimately lose all the elderly to Lüneburg or age-appropriate living units that are not on-site."
17	Raising awareness for the advantages and benefits of inner development (for politics, society, and administration)	"I expect that the citizens [...] will understand that inner development is a good method, to focus on and to do that instead of always grabbing the land at the edge."
18	Securing energy and heat supply	"When it comes to inner development, it is clear that heat supply is the issue of the next ten years, especially heat supply in existing buildings, infrastructure development for specific purposes."
19	Stronger alignment of regional spatial planning programs to municipal needs	"We are always governed administratively from top to bottom. The issues and problems that could be solved are at the bottom. And they are sometimes cast into organizational forms from above. So, when the LOP, the state planning program, comes, and it is then broken down into the regional planning program. Rules are set that don't help us locally."
20	Strengthening supply infrastructure in the town centre and avoiding outsourcing to outer areas	"I think many other communities do it wrong by putting their 'center-relevant' things outside, simply due to space reasons."
21	Increased construction of multi-family homes instead of single-family homes	"There used to be a bakery there; now there are four multi-family houses."
22	Increase in subsidies to strengthen town centres and inner development	"[...] but that [inner development] this is of course also supported by financial incentives or subsidies or something like that, so that the municipality then also becomes active there. To refurbish old vacant properties so that they can then perhaps develop them themselves to create living space."
23	Enhancement of inter-municipal communication and cooperation for collaborative infrastructure design	"And we have the problems with traffic congestion now. Unfortunately, this is completely counterproductive. When you say cooperation, it is exactly the opposite. Unfortunately, that must be said."
24	Improvement of public transportation, especially in the town centre	"The actual problems are very often traffic issues. [...] We have no buses; we have nothing at all. Public transport is a catastrophe."
25	Increased use of geodata management and analysis tools to identify inner development potential	"That's also the case when you have more of it, like all the geodata on a portal, or you say, let's deal with vacant buildings. [...] it's all great when you really have more data available."

transport links and public transport (I6, I24) as well as the interlink with heating and energy supply (I18) is also represented. Another topic raised is the role of agriculture close to the village (I8). Finally, a general trend towards more acknowledgement of the importance of inner development becomes apparent (I14, I17).

4.1.3 General views on inner development

While the interview participants proposed a variety of solutions and frequently recognized the value of inner development, there was also a noticeable reluctance to set overly high expectations. This ambivalence shows in the following quote:

“It [inner development] does have a certain significance. [...] we do pay attention to it in the end. I also believe that the municipalities want to and still have to do more in the area of inner development compared to outer development. The problem with inner development is that you don't always necessarily have access to the land.”

While inner development is regarded a positive tool by many, some also share a dismissal to reduce land consumption by the local municipalities:

“On the one hand, there is an understanding that everything has its limits, and how important that is in relation to the ground, the available space. [...] But if this [inner development] is supposed to be a tool to once again slow down the development of the communities, then I have to say that's what the spatial development programme is for [...]”

Although some mayors are open to advance inner development by constructing taller buildings or adding additional floors, most emphasize the importance of preserving the original aesthetics of the townscape:

“We want to preserve certain settlement structures. If we allow a six-family house to be built among 20 townhouses, then the townscape will be completely destroyed at some point [...]”

Finally, in some interviews inner development is rated as an important guideline for municipal planning. There, the aspect of village degradation by mainly building outwards is seen as highly problematic:

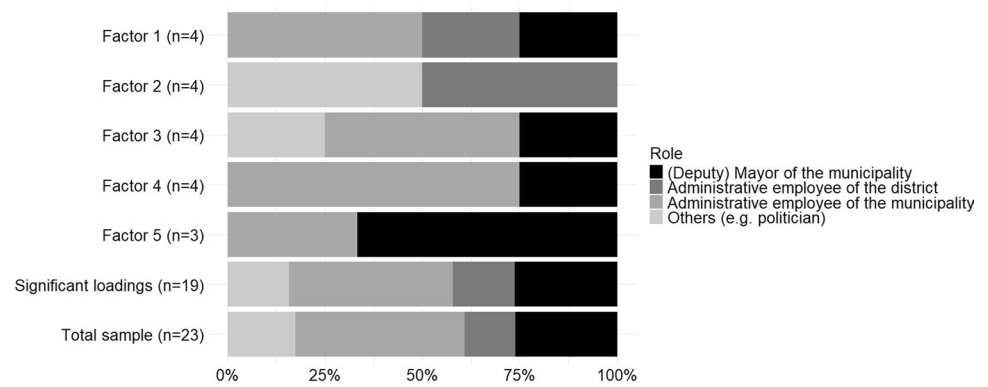
“[Inner development plays] A very important role. So inner development is the most crucial thing. You have to be extremely careful, I think many other communities do this wrong: That you pack your 'centre-relevant' things on the outside [...] This naturally leads to long, drawn-out villages and loses the character – the way a place should actually develop, in a ring shape, getting bigger and bigger. And the centre is where, so to speak, social encounters take place.”

The qualitative interview analysis shows that the concept of inner development is almost universally recognised. However, it is weighed against many other institutional objectives and sometimes seen as a concept that limits the freedom to grow outwards. Some interviewees perceive inner development as an additional pressure from higher political levels, which is challenging to adhere to beside other municipal duties. Nevertheless, some mayors view inner development as an important guideline for the preservation and development of their municipality.

4.2 Q-methodology results

In the following the results of the Q-methodology analysis are presented. The 25 items we extracted from the interviews as potential measures to promote inner development were used as the Q-Set for evaluation by the participants, the P-Set, which consisted of 23 administrative and political actors. First five factors with Eigenvalues greater 1 were extracted with a cumulative variance of 65% (22%, 15%, 11%, 9%, and 8%), indicating that not all participant sortings are fully represented by these factors. The distribution of roles (Fig. 4) shows that most participants are administrative employees, who are present in each factor ($n = 13$). The mayors ($n = 5$) occur in all but factor 2 and even are in the majority in factor 5. Since the factors are based on patterns of correlation, an individual participant's perspective may align with multiple factors rather than being tied to just one. The results revealed distinct opinion clusters, each representing a shared pattern in how participants within a cluster sorted the items, reflecting their collective perspectives [55].

Fig. 4 Role distribution of participants based on loadings for each factor



An initial assessment of general Q-sorts (Fig. 5) reveals that items benefitting planning and construction initiatives, such as I1, I2, I7 and I19, received the most frequently ranked as high (+2, +3, +4). Although I22 seemingly received positive rankings in sum, those were mostly in the range between 0 and +2. In contrast, items tackling administrative structures and citizen participation (I9, I11, I12) were most commonly ranked at the lower end (-2, -3, -4). I23 stands out for receiving a high total of negative rankings, while primarily rated within the -2 and 0 range. However, items 1, 9 and 19 show a relatively high standard deviation (2.1 – 2.3), indicating low agreement among participants. The same is true for items 3, 4, 10 and 15. On the other side, items that were ranked particularly often as neutral, such as I14 (“Political steering to promote measures to further inner development”) or I17 (“Raising awareness for the advantages and benefits of inner development”), accompanied by a comparatively low standard deviation (1.1–1.5), may display points of compromise due to the lack of strongly polarized opinions regarding the potential for inner development.

4.2.1 Q-method factor interpretation

Participants associated with factor 1, “Pragmatic Inner Development” (Fig. 6), prioritize “Setting up or redrafting of land-use & town plans in the centre to promote inner development” (I2) and emphasize streamlining bureaucracy (I1). They also rank “Strengthening central infrastructure and avoiding outsourcing” (I20) highly (+3), more than in other factors, focusing on revitalizing centres through planning. Lower-ranked items include “Hiring additional municipal staff” (I9) and “Expanding floors of existing buildings” (I4), indicating reluctance toward administrative expansion and structural alterations.

Unlike other factors, participants associated with factor 2, “Fostering the Housing Market” (Fig. 7), highly emphasize items that benefit structures and housing initiatives (I4, I7, I3). All items between above 0 are related to buildings within the village or town. In contrast, “Raising awareness for local demography, especially of housing needs for the elderly” (I16) and “Stronger alignment of regional spatial planning programs to municipal needs” (I19) are ranked lowest among all factors, indicating a focus on economic housing measures over social considerations.

Factor 3, “Preservation and Supply” (Fig. 8), highlights preservation and sustainable energy while resisting market-driven or outer-area developments. Similar to factor 1, participants associated with factor 3, “Preservation and Supply,” prioritize “Set-up or redrafting of land-use & town plans in the centre” (I2) and “Reduction of bureaucratic barriers” (I1). Their focus, however, extends to preserving the townscape and structures (I5, I7) and increasing subsidies (I22) and they rate “Securing energy and heat supply” (I18) higher than in other factors, emphasizing long-term, preservation-oriented planning. Conversely, items related steering the housing market are ranked lower (I10, I11, I15).

Participants associated with Factor 4, “Townscape and Public Services” (Fig. 9), prioritize preserving the original town’s character above all (I5, I7, I22) and oppose items related to construction or buildings within the town or village (I4, I13, I15, I20). However, improving public transportation in the town centre (I24) on the other end is rated relatively high. Unlike other factors, this group strongly supports “Additional staff in municipal administrations” (I9), suggesting a need for more administrative resources rather than reduced bureaucratic barriers, as seen in the low ranking of “Reduction of bureaucratic barriers” (I1).

Participants associated with Factor 5, “Management and Social” (Fig. 10), aim to connect regional and municipal planning (I14, I19) to support local needs with preservation or renovation of buildings (I7) and promoting social

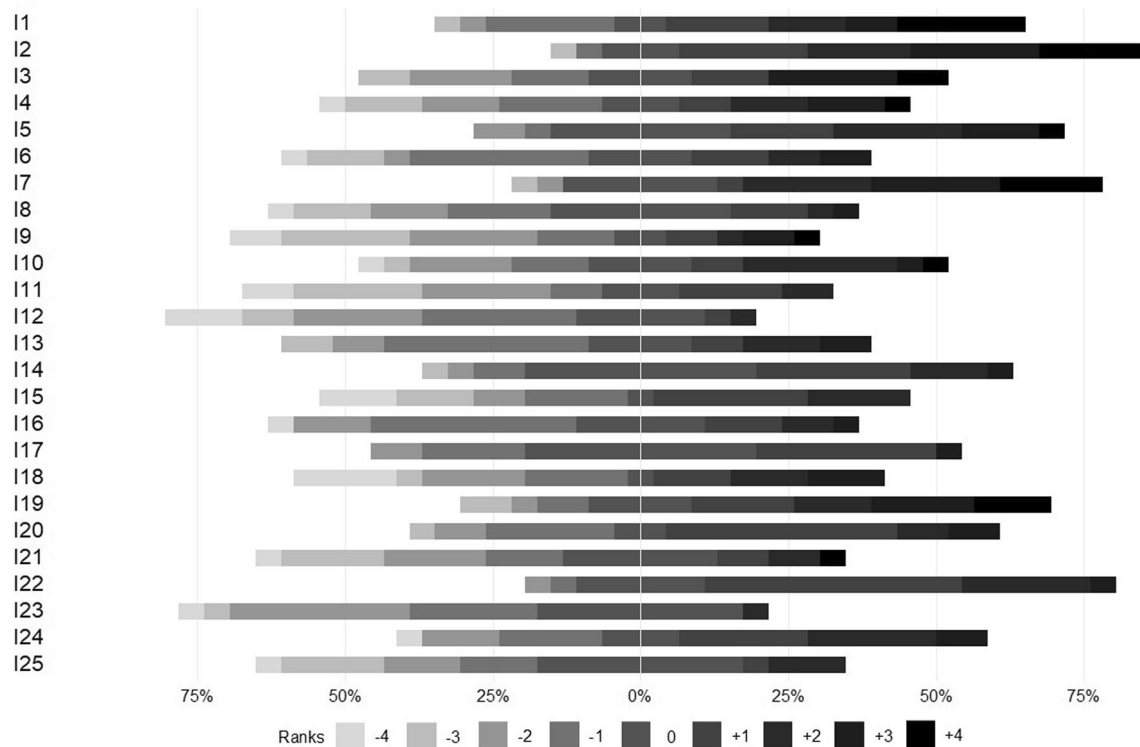


Fig. 5 Distribution of item sortings by participants (n=23)

housing (I10). They also emphasize raising awareness about the benefits of inner development (I17) more than other factors. Conversely, there is a reluctance against inter-municipal communication (I23), expanding traffic routes (I6) and citizen engagement initiatives (I12), focusing instead on policies that address immediate, practical needs while maintaining local control.

4.2.2 Overview of overall rankings

The correlations suggest low connectedness between the factors, which is, given the low sample size, not unexpected (Table 3). This shows on the one hand the absence of a unified perspective on individual items across all factors and on the other hand underlines the diversity of perspectives regarding inner development. Only between factors 1 and 3 as well as between factors 3 and 5 moderate correlation coefficients are observed. Nevertheless, certain overlaps are evident, which can be assessed by comparing item ranks across factors. Most of these cross-factors observations relate to moderately ranked items, corresponding to levels -1, 0 and +1, equivalent to item ranks 7 to 19 (see Table “Factor score ranks” in the appendix).⁵ The items “Foundation or expansion of a municipal housing association” (I11), “Political steering to promote measures to further inner development” (I14) and “Raising awareness for the advantages and benefits of inner development (for politics, society, and administration)” (I17) were ranked by four factors as moderate. These results suggest that such items generate less polarization and may be considered as solid, generally accepted measures for inner development. Although not universally agreed upon across all factors equally, these items may still reflect a broader consensus among participants and represent areas of moderate importance or relevance to inner development.

Addressing items considered as ranked highly, item 7 (“Preservation or renovation of existing buildings (including conversion or reutilisation)”) stands out as the single item that is highly ranked by four of the five factors, representing a rare point of consensus. This suggests that, despite the overall diversity in perspectives, the importance of preserving and repurposing existing structures is widely recognized as a key measure for inner development. Another item highly valued by factors 1, 3 and 4 is I22 (“Increase in subsidies to strengthen town centres and inner development”). While

⁵ Following this evaluation approach, levels +4, +3 and +2 (item ranks 1 to 6) can be considered as high ranked and levels -4, -3 and -2 (item ranks 20 to 25) as low ranked items.

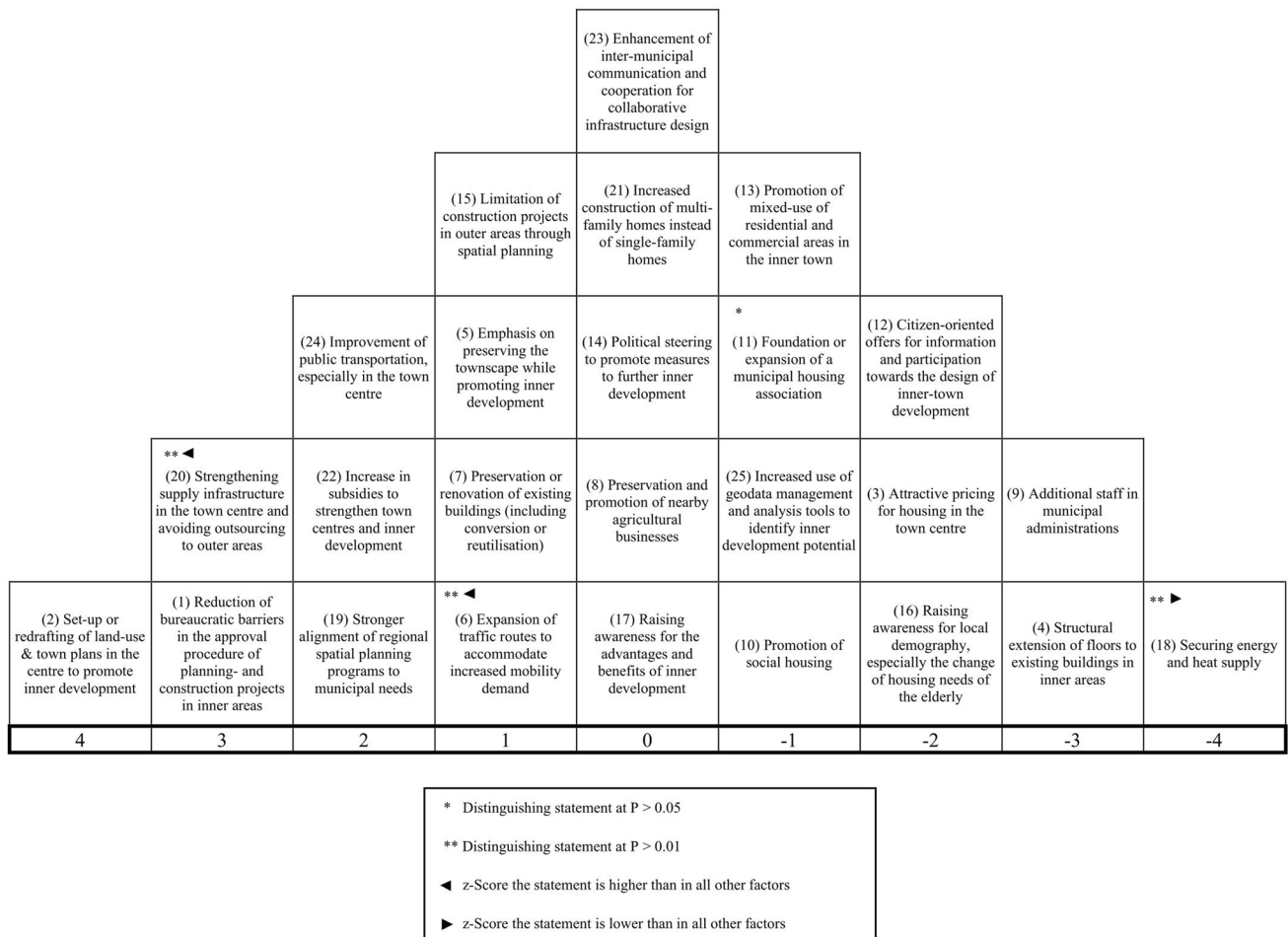


Fig. 6 Composite Q-sort for Factor 1: “Pragmatic Inner Development”

factor 5 ranked this item as moderate, bordering high value (level 1, rank 7), it was rated at the lower end of moderate ranks by factor 2 (level -1, rank 17).

Regarding measures that in the eyes of shared perspectives have little potential for fostering inner development, a convergence was observed for I12 and I15 (“Citizen-oriented offers for information and participation towards the design of inner-town development” and “Limitation of construction projects in outer areas through spatial planning”). Even though I15 was valued high (rank 6) by factor 2, three factors ranked it as very low (rank 25, 23, 21) while I12 as well received very low ranks by four factors (rank 21, 22, 23, 25). This further emphasizes the diversity of opinions within the sample. The divergent views on items such as citizen participation and spatial planning highlight the complexity of achieving consensus on inner development strategies. While some items, such as the preservation of existing structures and the expansion of municipal housing associations, garnered moderate agreement, other critical areas reveal substantial differences in priorities and approaches.

4.3 Synthesis

While there are some shared beliefs by local administrative and political personal in the district of Lüneburg, there is a wide range of differing perspectives and attitudes regarding the significance and potentials of inner development in rural areas, reaching from quite negative views (“But if this is a tool to once again slow down the development of the communities [...]”) to the acknowledgement of inner development as important approach (“So inner development is the most crucial thing”). However, in the interviews, most mayors took a centre position, that recognizes value of inner development, but also emphasise many barriers and limitations. As the results clearly show there is a wide range of perspectives among the participants. Considering both, the barriers and potentials as well as their respective ranges, we can derive the full

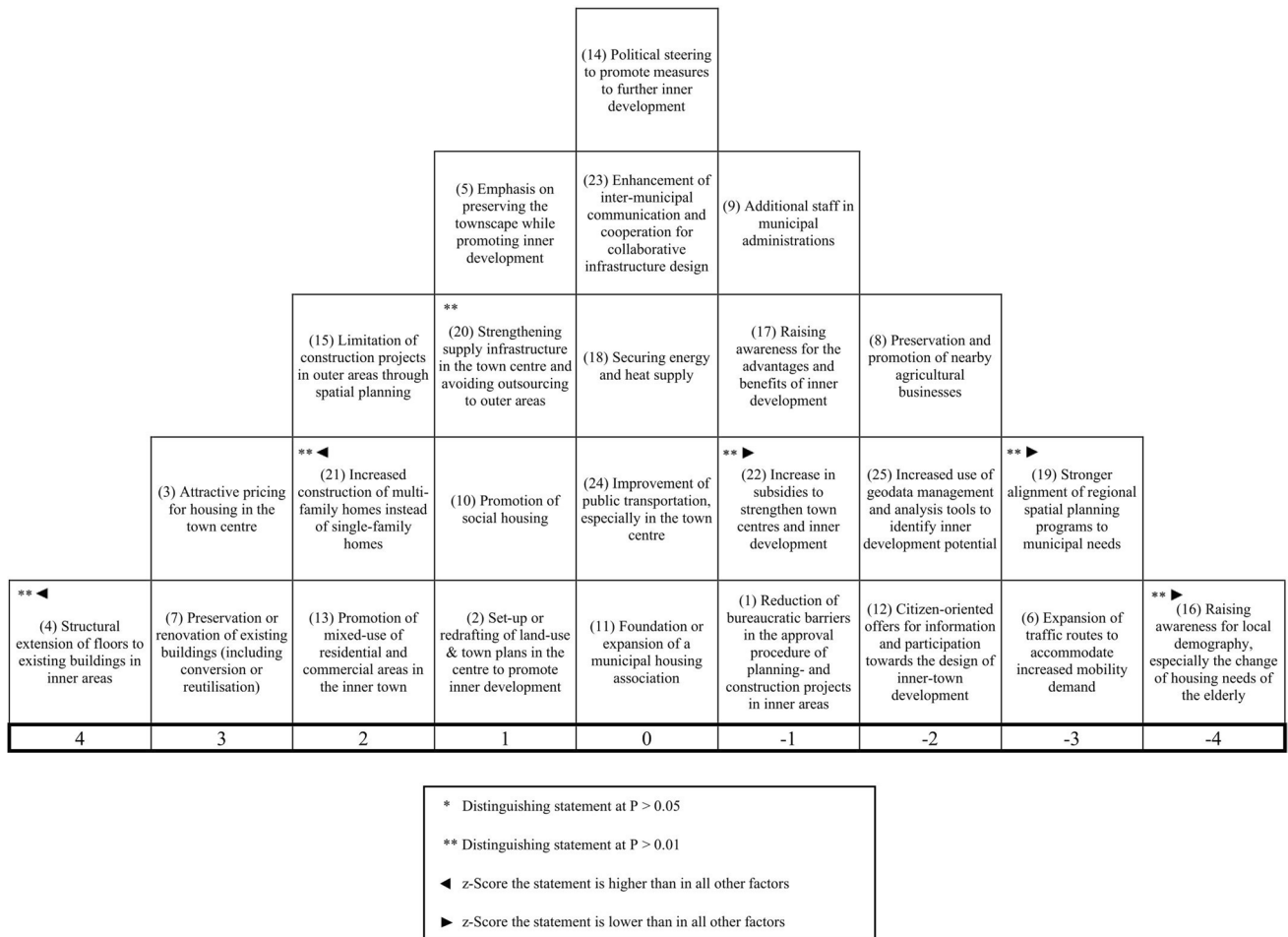


Fig. 7 Composite Q-sort for Factor 2: “Fostering the housing market”

scope of the empirical reality for inner development. Hence, we were able to grasp inner development as well as village renewal as multi-level challenges. While some barriers and potential solutions are to be found on the local level, more systemic settings are predefined, that limit the possibilities of local actors.

The factor analysis highlights how dissimilar opinions towards the feasibility of measures of inner development in rural areas are valued at this point. Certain items like I1, relating to bureaucratic barriers, divide the participants strongly. Furthermore, it becomes clear, that some potentials are rated moderately by all or most factor groups (I11, I14, I17). These potentials do not polarize and might therefore be valid first steps into the topic of inner development. In contrast, there are also items, notably I7 (“Preservation or renovation of existing buildings (including conversion or reutilisation)”) and I2 (“Set-up or redrafting of land-use and town plans in the centre to promote inner development”), that were rated quite similarly and where a general consensual opinion can be identified. On the other hand, the factors depict clusters of opinions with a thematic focus. As a result, by aggregating the potentials they hint to different pathways towards inner development.

5 Discussion and conclusion

5.1 Shared and divided perspectives

Our diverse sample provides comprehensive insights into the perspectives of local politics and administrations, focusing on the importance of inner development as a strategy towards sustainability transformations. As the municipal level actively shapes the future of spatial planning, land consumption and inner development, the importance of understanding the municipal perspective to achieve sustainable transformations becomes more apparent. Land conversion is a

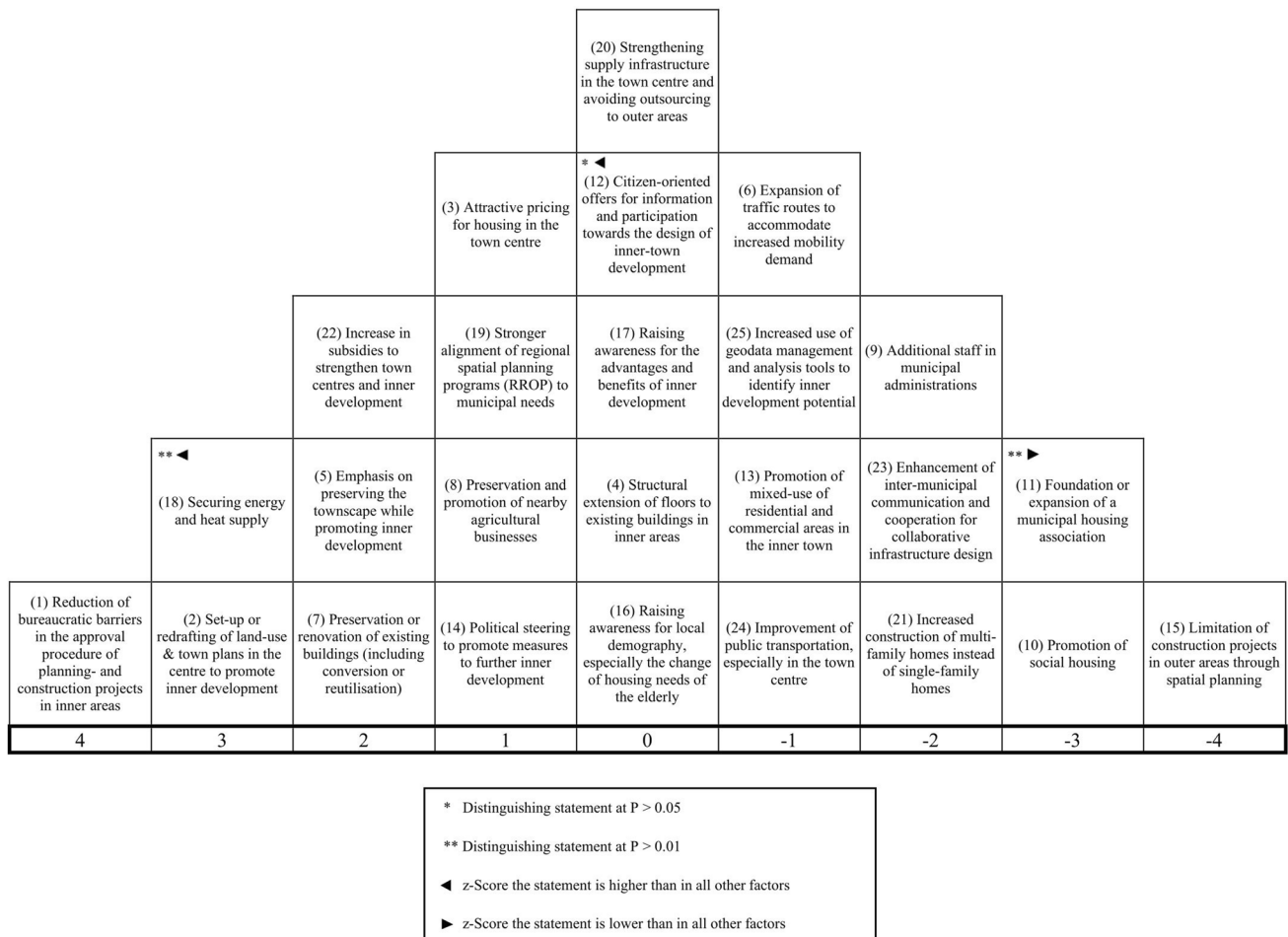


Fig. 8 Composite Q-sort for Factor 3: "Preservation and Supply"

global trend far from being halted [56]. The problem applies in Germany as well, even though the 30-hectare goal was already declared in 2002 [5, 6]. While predicament is well known across people who deal with the subject, issues like lacking political support, municipal competition or the demand for new single-family homes decelerates progress [5, 6, 57]. Regarding sustainable land use in Germany, there is no knowledge gap, but a discrepancy to the necessary actions, that are carried out on the local level [6]. Our results largely underline the ambivalence that mayors and administration face: For the most part, they are aware of the problematic development of land use and the positive role of inner development but must systematically reconcile this with many other influencing factors. While German municipalities are largely sovereign in matters of planning, though state and regional rules are also applying [58], they strive for local prosperity. Here, attracting new companies and high-income residents are among the typical aims to support the municipal finances. However, being able to achieve both aims is heavily dependent on designating suitable land [5]. From the sustainability view, this is a fundamental design flaw, which could only be changed by different state and federal government regulations and incentives [5, 59]. Even economic institutes demand change and warn that such urban sprawl may lead to a financial race-to-the-bottom for real estate in some regions [60].

Even though our data is confined to a spatial and political unit, the systemic and cross-regional barriers named are quite consistent with the literature. On the other side, issues were identified, which are highly dependent on local decisions. The local political culture, including public participation culture, plays a significant role in shaping land use and sustainability [61, 62]. The results show that offers for participation and awareness are evaluated very contradictory by the participants. While some complaint how slow planning processes have become due to active involvement of citizens, others see these as a chance for active shaping of the community. This dual role of public participation highlights a key tension: while it serves as an empowering mechanism for communities, it can also slow down decision-making and implementation of sustainability goals. Inter- and transdisciplinary exchange offers solutions to connect the scientific

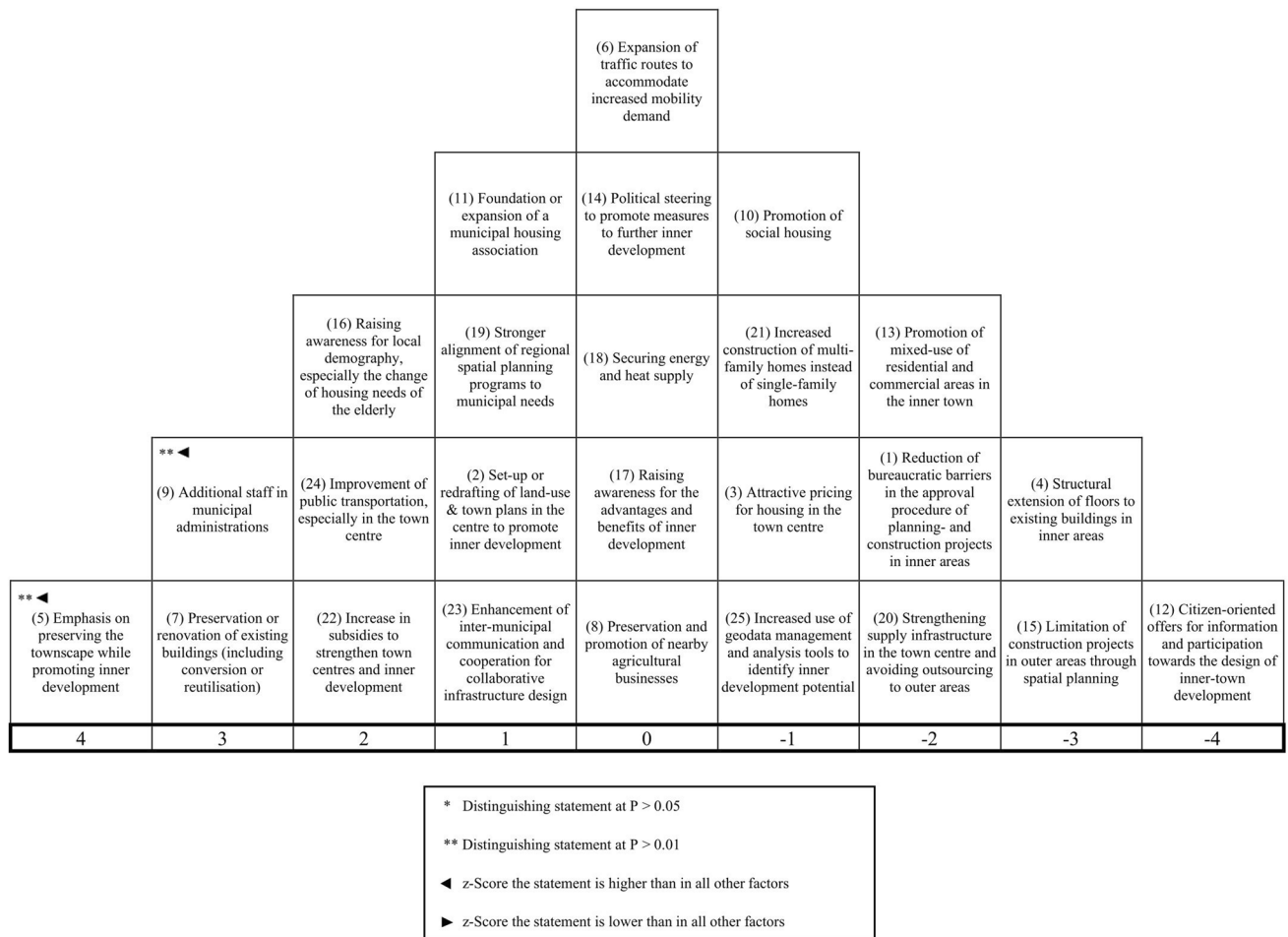


Fig. 9 Composite Q-sort for Factor 4: "Townscape and Public Services"

debate with local politics, while simultaneously opening a window for exchange and mutual learning as well as to create more robust knowledge [25, 27, 63]. Such processes should not be unidirectional, but instead, all sides ought to remain open to a continuous learning process [26].

Our factor analysis complemented by the qualitative findings provides insights into diverse perspectives of specific subgroups, both to single issues as well as in comparison to one another. The findings improve the understanding of local administrative knowledge, which has thus far not received the needed attention [64]. Among the huge landscape of municipal actors in Germany, we can expect to find a wide variety of perspectives and attitudes towards issues of municipal planning, just as revealed in our case study. By gaining information from such a wide group of actors, we are able to grasp the different facets of barriers and potentials of inner development within a land-use system. Such diverse insights not only identify impeding rationalities for spatial sustainability but also illuminate levers for change, thereby supporting the creation of actionable pathways [64, 65].

The knowledge of political and administrative actors supports the creation of a robust knowledge, which helps designing transformatory change for addressing complex land use problems [27]. Such findings are of interest to anyone seeking to enhance the implementation of inner development in rural areas, including politicians, ministries, planning offices or informed citizens. However, the results clearly indicate finding unanimous local knowledge is unlikely. While municipal actors do have shared experiences, a wide variety of perspectives exists. Building on this understanding, advancing knowledge on collaborative change within administrations and exploring ways to empower employees to develop transformative literacy would be highly valuable [66, 67]. While local transformation can support certain steps towards sustainable inner development, sustainability reforms to reduce land take are urgently needed at the state and federal level [59].

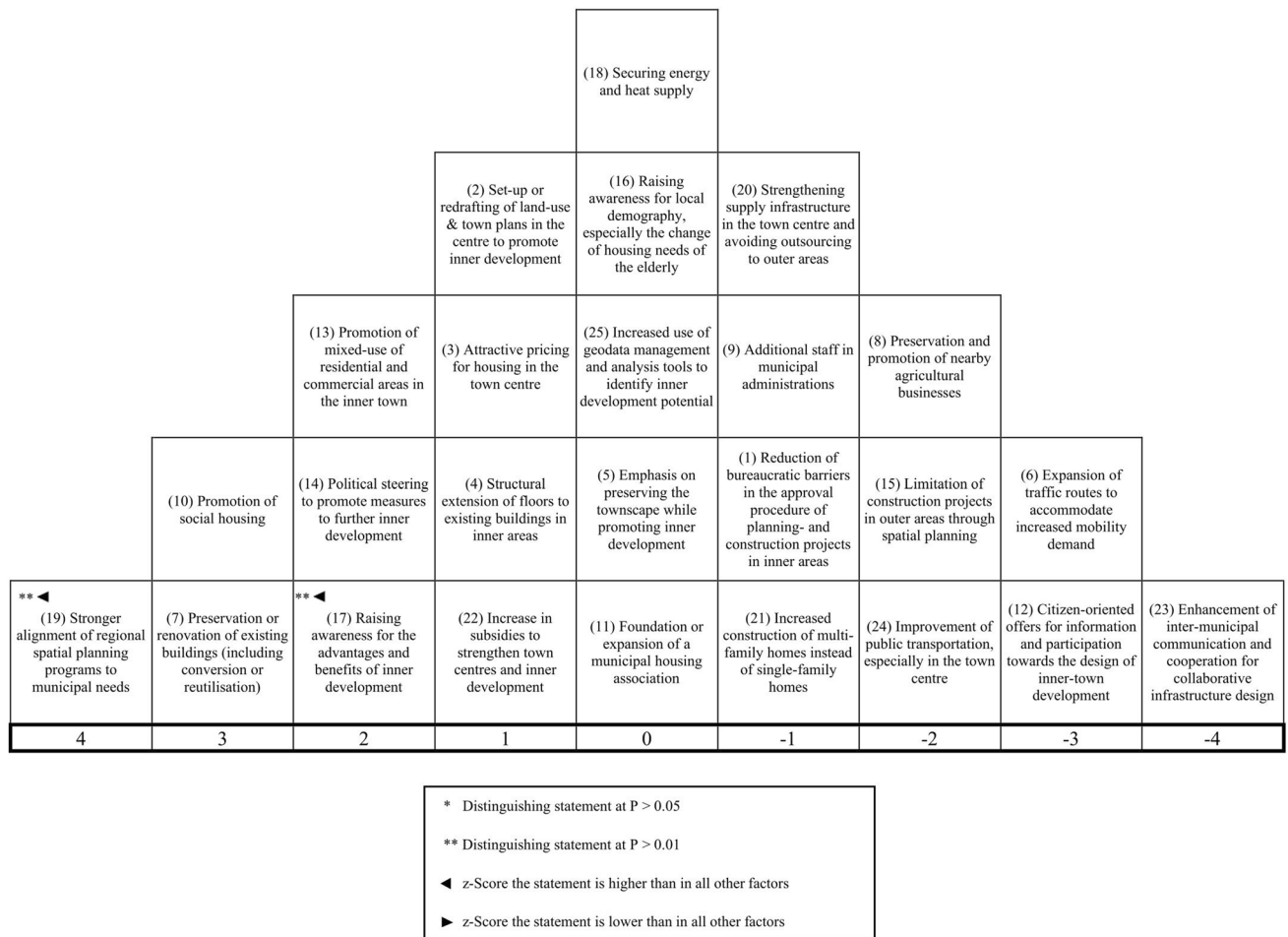


Fig. 10 Composite Q-sort for Factor 5: "Management and Social"

Table 3 Factor correlations

Factor	1	2	3	4	5
1	1	-0.0025	0.3105	0.2073	0.0571
2	-0.0025	1	-0.0359	-0.1527	0.2226
3	0.3105	-0.0359	1	0.211	0.3294
4	0.2073	-0.1527	0.211	1	0.1802
5	0.0571	0.2226	0.3294	0.1802	1

5.2 Case study: transferring findings and methods

We gathered our data from the district of Lüneburg as a local case study, offering a focused lens on rural municipalities within a dynamic metropolitan context. Thus, investigating similarities with other comparable German rural regions would be of interest, e.g. other districts in metropolitan areas. Here, we can estimate that rural areas which are experiencing centralization dynamics with growing population and economy, which is predominantly the case for the district of Lüneburg, are more inclined to show similar results [68, 69]. Since we focus on the district, we have the challenge of a range of municipalities with different legal status and different economic, socio-demographic and spatial differences, i.e. among others depending on the proximity to the city of Lüneburg and to the Metropolitan Region of Hamburg [70]. While some municipalities share urban features, others are particularly rural. Even though these discrepancies are part of the study design and support our goal of comparing different socio-economic realities

within the case study region, we find a limitation here. Exploring a similar sequential design with municipalities from different districts or states, that share even more socio-economic and demographic resemblances, would be promising for expanding and testing of our findings.

Interviewing all the mayors of the district was a unique opportunity enabled by the transdisciplinary collaboration in Lüneburg. Despite Q-methodology factor analysis with smaller sample sizes is common practice in current studies and supports our exploratory study approach [42, 47], due to a low response rate for our P-set, we can't say if the sample may be biased by similar characteristics of non-responders [71]. For future research, it would be helpful to reduce the bias due to voluntary (non-)participation, if possible, e.g. by an even more purposive sampling strategy, which is non-random [72]. The use of the online Q-Methodology significantly expanded our reach, enabling us to connect with pre-selected participants—something that would have been difficult to achieve through traditional methods. As we succeeded in reaching the majority of relevant stakeholders, this approach allowed us to gather input from a broader sample while keeping qualitative depth, ensuring a more comprehensive, yet diverse set of perspectives [53]. As a result, the extraction of five distinct factors with Eigenvalues greater 1 and a cumulative variance of 65% was made possible, underlining the robustness of the methodological approach [35, 53].

Building on the sequential exploratory design [31], the extracted items are solely originating from the subjective points mentioned by the mayors. As the items serve as basis for the Q-survey, the participants had to accept the pre-given responses. This could be seen as a very subjective knowledge creation [55]. Nevertheless, the methodological design has been created on purpose in that way, so that the topics and responses are chosen by local actors. The design could therefore be criticized for lacking expert feedback loops. However, we chose this method design intentionally as we explicitly aimed for local knowledge creation [46, 73].

Finally, despite deriving and discussing barriers the study focusses more on the potentials. While both aspects are closely intertwined, the initial analysis reveals that the distinct frames behind the two terms “potential” and “barrier” reflect both connected and different aspects. By referring to potentials, we hoped to maintain a positive narrative, that aligns with the question of how sustainability transformations can create opportunities for rural areas.

5.3 Inner development, sustainability transformations and New European Bauhaus

Inner development is a promising approach for the further development of sustainable transformations and reducing land consumption in rural areas. Leveraging local and tacit knowledge supports robust, context-sensitive solutions that are well suited to fulfil the unique needs of divergent rural communities. This study's exploratory sequential design provides rich insights how local actors evaluate inner development. With 25 identified items of possible solutions for improving the feasibility of inner development and five factors distinguishing how these are prioritised, a broad spectrum of local perspectives emerges, highlighting both consensual and polarizing measures. The qualitative analysis of extracted barriers further emphasizes the need for multi-level approaches that promote change at the local level, while also addressing systemic and cross-regional hurdles. The integration of local knowledge to effectively strengthen place-based approaches of inner development shows potential. By leveraging local and tacit knowledge the diverse perspectives of actors and complex system interrelationships become comprehensible. Locally specific needs and characteristics in rural areas, often overlooked or even restricted by top-down policy frameworks [74], can be integrated into a broader contextual picture to advance inner development [6]. Based on the co-production of knowledge, the gap between academic as well as political frameworks and the real-world complexities of rural communities can be bridged [63] and, as a result, support sustainability transformations [67, 75]. While gaining a better understanding of the small-scale differences of past and present socio-material transformations in this study, it became clear that the material dimension—infrastructure, architecture, everyday place-making practices like shopping, commuting or cultural events—play an important role in the spatial transformation of the rural areas. We argue that the material basis of villages, including its architectural heritage, and its implications to the everyday life of residents must be acknowledged and hence needs to be studied more deeply. Without understanding the local self-conceptualisations of rural everyday life and its material basis, a bottom-up transformation that incorporates local-knowledge and participation is not feasible [16]. The transformation of villages clearly has a material dimension that provides helpful tools to understand material practices. An ongoing implementation of material approaches to urban, rural and transformation studies could be promising [14, 16].

Our findings revealed diverse perspectives on inner development, including a wide array of viewpoints and approaches. Therefore, a systematic local transformation will need to include the locally prevailing material understandings and

practices. Bottom-up approaches that recognise local knowledge ensure that proposed solutions are not only practical but also foster community ownership, a key factor in long-term success [76]. Nevertheless, considering the wider context of land use systems is essential. Sustainable transformation requires both top-down policies and bottom-up actions, with local knowledge acting as a central link between these two levels to ensure the transformation reflects the community's needs and capacities [77]. Such balanced approaches help to ensure that rural communities are not sidelined by one-size-fits-all policies or urban centred-approaches [68]. On the contrary, communities and local decision-makers can actively contribute to shaping solutions that resonate with their unique context. However, while application focused approaches are desired by local actors, the will for innovative action also needs to arise from themselves [20]. Ultimately, local knowledge becomes a driving force in creating sustainable, resilient transformations that incorporate community-driven ecological and socio-economic components [75, 78, 79]. Hence, we want to highlight the importance to move administratively beyond insular thinking and to advocate the importance of mutual respect, cooperation and learning.

Our results demonstrate the need for inclusive and integrated approaches to address challenges related to land consumption, while also highlighting the significant opportunities inner development presents for communities. From the perspective of the interviewed local actors, the preservation and enhancement of a town's or village's identity and character are essential to building a sustainable future. However, despite the political and societal recognition of inner development as a sustainable approach not only to reduce land consumption but also for the preservation of a village's character and a lively village centre, a perspective change is still needed. Ritzinger [6] concludes that saving land is often times just supported when personal, political and planning targets are not in contradiction.

We argue that inner development, as a holistic approach, not only targets sustainable transformation but inherently includes key aspects and values aligned with the core principles of the New European Bauhaus [80]. As a supporting framework the initiative offers a valuable, complementary lens by promoting a positive narrative and highlighting the many benefits innovative approaches of inner development can offer for local and sustainable development. When viewed and valued as a holistic approach and supported by the Bauhaus initiative inner development becomes a centre piece. A multipurpose holistic inner development accommodates diverse perspectives and serves as a joint movement towards achieving sustainability transformations.

The integration of local knowledge to foster rural development and highlight each community's unique beauty is a shared objective. Building on these, shared values can stimulate constructive dialogue among stakeholders across society, academia, and politics. Moreover, we contend that inner development encapsulates all three leverage points of the Bauhaus initiative: (1) encouragement of place-specific change by focusing on localized improvements that respect existing townscapes, drives, (2) change of how things are done by turning conceptual transformation into practical, feasible action, as well as demands and (3) adapting intentions and mindsets [22]. In this way, inner development and the initiative mutually reinforce each other, promoting both aesthetic and sustainable development in rural areas. The New European Bauhaus can therefore act as a mediator by enabling rural actors to raise sensitivity regarding the benefits of inner development in synergy with sustainable development practices. It emphasizes fostering original beauty while advancing sustainable objectives. Moreover, transdisciplinary co-production of knowledge interplays with the SDGs for place-based sustainability change [81]. Such localized and integrated policy approaches may contribute to bridging the gap between local needs and goals as well as the broader vision of the European Green Deal [82].

While the initiative intends to become a movement of people and organizations [22], criticism emerges for not sufficiently connecting with material realities and vernacular knowledge of local actors [83]. This criticism exists even though the programme itself aims to create tangible experiences at the local level and improve the daily life, e.g. by supporting small-scale initiatives [22]. Those were integrated into the general concept, by highlighting multi-level, interdisciplinary and participatory approaches [20]. To connect such a high-level concept with local practices of spatial development, big scale programs as well as local actors need to be open to mutual learning and acknowledging the situated knowledge of each other [25, 84].

Our findings suggest that, for rural communities, "local character" and "sense of belonging" are essential values, which is fitting well to the goals beauty and together. The program's success hinges on the ability to embrace these aspects and move beyond abstract goals, connecting to grassroots engagement. In order to truly serve as a supporting initiative for rural inner development, like other national and regional frameworks, it's Europe-wide ambitions need to resonate with national state regulations and subsidies as well as local realities. Here, more sensitivity towards the material practices of the rural area is needed. When successful, the New European Bauhaus provides the opportunity to inspire and empower rural communities for sustainability transformations, that will shape a place-sensitive inner development, preserve and beautify the townscape, revitalize village centres and reduce the land consumption in outer areas.

Acknowledgements We would like to express our gratitude to all our SUSTIL project partners and colleagues. Furthermore, we would like to thank especially Anja Krebs and Mia Kopetzky for their invaluable support during the study process. We extend our sincere appreciation to the German Federal Ministry of Education and Research (BMBF) as well as the Stadt-Land-Plus initiative for their financial support, inspiration and network.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Christoph Schwenck and Jannis Pfendtner-Heise. The first draft of the manuscript was written by Christoph Schwenck and Jannis Pfendtner-Heise. The manuscript was edited and reviewed by Henrik von Wehrden. The study was supervised by Henrik von Wehrden. All authors read and approved the final manuscript. Christoph Schwenck and Jannis Pfendtner-Heise declare shared first authorship.

Funding Open Access funding enabled and organized by Projekt DEAL. This research was funded by the German Federal Ministry of Education and Research (BMBF), grant number 033L222A, funding activity urban–rural (Stadt-Land-Plus), project name: “SUSTIL: Szenarien zur Umsetzung der UN-Nachhaltigkeitsziele in Stadt und Landkreis Lüneburg: Implikationen für die Steuerung von Landnutzung”. This publication was funded by the German Research Foundation (DFG).

Data availability Anonymised Q-methodology data and analysis output are available in the supplementary material. The interview data is confidential.

Declarations

Ethics approval and consent to participate This study aligns with the values of Leuphana University Lüneburg Ethics Boards (Beirat für Ethikfragen in der Forschung (Ethikbeirat)), in which co-author Prof. Dr. Henrik von Wehrden is chair member and was conducted in full accordance with the Guidelines for Safeguarding Good Scientific Practice (Die Leitlinien zur Sicherung guter wissenschaftlicher Praxis) established by the German Research Foundation (Deutsche Forschungsgemeinschaft).

Informed consent All data obtained from participants were anonymized, and informed consent was obtained from all individuals involved.

Competing interests The authors declare no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Newbold T, Hudson LN, Arnell AP, Contu S, De Palma A, Ferrier S, Hill SL, Hoskins AJ, Lysenko I, Phillips HR. Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. *Science*. 2016;353:288–91. <https://doi.org/10.1126/science.aaf2201>.
2. Colsaet A, Laurans Y, Levrel H. what drives land take and urban land expansion? A systematic review. *Land Use Policy*. 2018;79:339–49. <https://doi.org/10.1016/j.landusepol.2018.08.017>.
3. Deutsche Nachhaltigkeitsstrategie: Weiterentwicklung 2021 2021.
4. DESTATIS Erläuterungen Zum Indikator “Anstieg Der Siedlungs- Und Verkehrsfläche”: Nachhaltigkeitsindikator Über Die Inanspruchnahme Zusätzlicher Flächen Für Siedlungs- Und Verkehrszwecke 2024.
5. Fischer B, Klauer B, Schiller J. Prospects for sustainable land-use policy in Germany: experimenting with a sustainability heuristic. *Ecol Econ*. 2013;95:213–20. <https://doi.org/10.1016/j.ecolecon.2013.09.006>.
6. Ritzinger A. Flächensparen zwischen Anspruch und Wirklichkeit. Zur Rolle von Akteuren und Steuerungsinstrumenten in Dorferneuerungsprozessen. *Raumforsch Raumordn Spat Res Plan*. 2018;76(395):406. <https://doi.org/10.1007/s13147-018-0539-y>.
7. Schiller G, Blum A, Oertel H. Die Relevanz kleiner Gemeinden und kleinteiliger Flächen für die Innenentwicklung. Ein quantitatives Monitoring am Beispiel Deutschlands. *Raumforschung und Raumordnung Spat Res Plann*. 2018;76:461–71. <https://doi.org/10.1007/s13147-018-0534-3>.
8. Reiß-Schmidt, S. Innenentwicklung. In *Handwörterbuch der Stadt- und Raumentwicklung*; ARL, Ed.; ARL, 2018; pp. 995–1000.

9. Eichhorn S, Siedentop S. Innen vor Außen? Eine Schätzung der Innenentwicklung in nordrhein-westfälischen Gemeinden. *Raumforschung und Raumordnung Spatial Res Plann.* 2022;80:640–58. <https://doi.org/10.14512/rur.178>.
10. Brandt HS, Schmitt G. Dorferneuerung. In: Brandt HS, Schmitt G, editors. *Stadterneuerung*. Springer Fachmedien: Wiesbaden; 2016. p. 300–37.
11. Ritzinger, A. Village Development (Dorfentwicklung). In *Handwörterbuch der Stadt- und Raumentwicklung*; ARL, Ed.; ARL: Hannover, 2018; pp. 447–453.
12. ARL Stärkung Der Innenstädte Und Ortskerne: Initiativen Und Instrumente Aus Der Praxis Für Die Praxis 2014.
13. Whatmore S. Materialist returns: practising cultural geography in and for a more-than-human world. *Cultural Geogr.* 2006;13:600–9. <https://doi.org/10.1191/1474474006cgj3770a>.
14. Paniagua A. Conceptualizing new materialism in geographical studies of the rural Realm. *Land.* 2023;12:225.
15. Higgins V, Bryant M, Howell A, Battersby J. Ordering adoption: materiality, knowledge and farmer engagement with precision agriculture technologies. *J Rural Stud.* 2017;55:193–202. <https://doi.org/10.1016/j.jrurstud.2017.08.011>.
16. Lu Y, Qian J. Towards a material approach in rural geography: architectural experiments in China's rural renaissance and reconstruction movements. *Geoforum.* 2020;116:119–29.
17. Trisia MA, Prats L, Guia J. Rethinking rurality in rural tourism: a new materialist approach. *Tour Geogr.* 2024;26:1223–43. <https://doi.org/10.1080/14616688.2024.2360632>.
18. Phillips M, Smith D, Brooking H, Duer M. The agencies of landscape in rural gentrification: impressions from the wood, the village and the moortop. *Sociol Rural.* 2021;61:778–807. <https://doi.org/10.1111/soru.12339>.
19. Kraftl P. Geographies of architecture: the multiple lives of buildings. *Geogr Compass.* 2010;4:402–15. <https://doi.org/10.1111/j.1749-8198.2010.00332.x>.
20. Rosado-García MJ, Kubus R, Argüelles-Bustillo R, García-García MJ. A New European Bauhaus for a culture of transversality and sustainability. *Sustainability.* 2021;13:11844. <https://doi.org/10.3390/su132111844>.
21. Bilić B, Šmit K. Evaluation of the New European Bauhaus in urban plans by land use occurrence indicators: a case study in Rijeka, Croatia. *Buildings.* 2024;14:1058. <https://doi.org/10.3390/buildings14041058>.
22. European Commission Communication from the Commission of the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: New European Bauhaus: Beautiful, Sustainable, Together 2021.
23. Conrad A, DeTroy SE, Dross M, Eckert K, Meilinger V, Schröder A. Advancing the New European Bauhaus: sustainable mobility and resilient urban spaces for a better quality of life—the AdNEB Project. *Elni Rev.* 2022. <https://doi.org/10.46850/elni.2022.004>.
24. United Nations The Sustainable Development Goals Report 2024 2024.
25. Pfendtner-Heise J, Ackerschott A, Schwenck C, Lang DJ, von Wehrden H. Making mutual learning tangible: mixed-method delphi as a tool for measuring the convergence of participants' reciprocal understanding in transdisciplinary processes. *Futures.* 2024;159: 103365. <https://doi.org/10.1016/j.futures.2024.103365>.
26. Lang DJ, Wiek A, Bergmann M, Stauffacher M, Martens P, Moll P, Swilling M, Thomas CJ. Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustain Sci.* 2012;7:25–43. <https://doi.org/10.1007/s11625-011-0149-x>.
27. Zscheischler J, Rogga S, Busse M. The adoption and implementation of transdisciplinary research in the field of land-use science—a comparative case study. *Sustainability.* 1926;2017:9. <https://doi.org/10.3390/su9111926>.
28. *Raumordnungsbericht 2017: Daseinsvorsorge sichern*; BBSR, Ed.; Bundesamt für Bauwesen und Raumordnung: Bonn, 2018; ISBN 978-3-87994-216-9.
29. BBSR BBSR Raumordnungsprognose 2045: Ergebnisse Für Die Landkreis Und Kreisfreien Städte: Bevölkerung Für Lüneburg/Niedersachsen 2024.
30. Zensus 2022 - Bevölkerungszahlen Des Zensus 2022 Zur Festsetzung Der Amtlichen Einwohnerzahlen 2024.
31. Creswell JW. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*; SAGE, 2014; ISBN 978-1-4522-2610-1.
32. Torre A, Melot R, Magsi H, Bossuet L, Cadoret A, Caron A, Darly S, Jeanneaux P, Kirat T, Pham HV, et al. Identifying and measuring land-use and proximity conflicts: methods and identification. Springerplus. 2014;3:85. <https://doi.org/10.1186/2193-1801-3-85>.
33. Sharp CA. Qualitative research and evaluation methods. *Eval J Aust.* 2003;3:60–1. <https://doi.org/10.1177/1035719X0300300213>.
34. Gläser, J.; Laudel, G. *Experteninterviews und qualitative Inhaltsanalyse als Instrumente rekonstruierender Untersuchungen*; 4. Auflage.; VS Verlag: Wiesbaden, 2010.
35. Brown SR. Q methodology and qualitative research. *Qual Health Res.* 1996;6:561–7. <https://doi.org/10.1177/104973239600600408>.
36. Stephenson W. Technique of factor analysis. *Nature.* 1935;136:297–297. <https://doi.org/10.1038/136297b0>.
37. Mayring P. Qualitative inhaltsanalyse. In: Mey G, Mruck K, editors. *Handbuch qualitative forschung in der psychologie*. VS Verlag für Sozialwissenschaften: Wiesbaden; 2010. p. 601–13.
38. VERBI Software MAXQDA Plus 2022 [Computer Software] 2021.
39. Brown SR. Political subjectivity: applications of Q methodology in political science. New Haven and London: Yale University Press; 1980.
40. Milcu AI, Sherren K, Hanspach J, Abson D, Fischer J. Navigating conflicting landscape aspirations: application of a photo-based Q-method in Transylvania (Central Romania). *Land Use Policy.* 2014;41:408–22. <https://doi.org/10.1016/j.landusepol.2014.06.019>.
41. Holmes G, Clemoes J, Marriot K, Wynne-Jones S. The politics of the rural and relational values: contested discourses of rural change and landscape futures in West Wales. *Geoforum.* 2022;133:153–64. <https://doi.org/10.1016/j.geoforum.2022.05.014>.
42. Schulze C, Matzdorf B. The institutional design of agri-environmental contracts—how stakeholder attitudes can inform policy making. *Q Open.* 2023;3:001. <https://doi.org/10.1093/qopen/qoad001>.
43. Jaligot R, Chenal J. Stakeholders' perspectives to support the integration of ecosystem services in spatial planning in Switzerland. *Environments.* 2019;6:88. <https://doi.org/10.3390/environments6080088>.
44. Levesque A, Fouqueray T, Dupras J. Beyond setting conservation targets: Q-method as a powerful tool to collectively set an action plan agenda. *Front Conserv Sci.* 2023;4:1097360. <https://doi.org/10.3389/fcosc.2023.1097360>.
45. Bredin YK, Lindhjem H, van Dijk J, Linnell JDC. Mapping value plurality towards ecosystem services in the case of Norwegian wildlife management: a Q analysis. *Ecol Econ.* 2015;118:198–206. <https://doi.org/10.1016/j.ecolecon.2015.07.005>.

46. Živojinović I, Wolfslehner B. Perceptions of urban forestry stakeholders about climate change adaptation – A Q-Method Application in Serbia. *Urban For Urban Green*. 2015;14:1079–87. <https://doi.org/10.1016/j.ufug.2015.10.007>.
47. Andreotti F, Neher CM, Speelman EN, Bazile D. Exploring farmers' perspectives on agrobiodiversity management: future options for quinoa smallholder organizations in the Peruvian high Andes. *Agron Sustain Dev*. 2023;43:42. <https://doi.org/10.1007/s13593-023-00891-y>.
48. Walder P, Kantelhardt J. The environmental behaviour of farmers – capturing the diversity of perspectives with a Q methodological approach. *Ecol Econ*. 2018;143:55–63. <https://doi.org/10.1016/j.ecolecon.2017.06.018>.
49. Watts S, Stenner P. *Doing Q methodological research: theory, method and interpretation*. SAGE Publications Ltd.; 2012.
50. Sandbrook CG, Fisher JA, Vira B. What do conservationists think about markets? *Geoforum*. 2013;50:232–40. <https://doi.org/10.1016/j.geoforum.2013.09.009>.
51. Pruneddu, A.; Zentner, M. Q-Software 2011.
52. Banasick S. KADE: a desktop application for Q methodology. *J Open Sour Softw*. 2019;4:1360. <https://doi.org/10.21105/joss.01360>.
53. Watts S, Stenner P. *Doing Q methodology: theory, method and interpretation*. *Qual Res Psychol*. 2005;2:67–91. <https://doi.org/10.1191/1478088705qp022oa>.
54. Kaiser HF. The varimax criterion for analytic rotation in factor analysis. *Psychometrika*. 1958;23:187–200. <https://doi.org/10.1007/BF02289233>.
55. Dziopa F, Ahern K. A systematic literature review of the applications of Q-technique and its methodology. *Methodology*. 2011;7:39–55. <https://doi.org/10.1027/1614-2241/a000021>.
56. Gerten C, Fina S, Rusche K. The sprawling planet: simplifying the measurement of global urbanization trends. *Front Environ Sci*. 2019;7:140. <https://doi.org/10.3389/fenvs.2019.00140>.
57. Schiller, G.; Gutschke, J.-M.; Siedentop, S.; Deilmann, C. *Von der Außen- zur Innenentwicklung in Städten und Gemeinden; Texte; Umweltbundesamt*, 2009;
58. Schmidt S, Siedentop S, Fina S. How Effective Are Regions in Determining Urban Spatial Patterns? Evidence from Germany. *J Urban Aff*. 2018;40:639–56. <https://doi.org/10.1080/07352166.2017.1360741>.
59. Ursachen Der Flächeninanspruchnahme in Deutschland - Eine Zwischenbilanz. In *Flächeninanspruchnahme in Deutschland: Auf dem Wege zu einem besseren Verständnis der Siedlungs- und Verkehrsflächenentwicklung*; Behnisch, M., Kretschmer, O., Meinel, G., Siedentop, S., Eds.; 2018; pp. 45–56 ISBN 978-3-662-50304-1.
60. Henger R, Schier M, Voigtländer M. Der Künftige Bedarf an Wohnungen: Eine Analyse Für Deutschland Und Alle 402 Kreise. *IW Policy Paper Nr. 24*. 2015.
61. Weck S, Ritzinger A. Co-producing just and sustainable localities: emphasising the role of local authorities in current practices in Germany. *DIE ERDE J Geogr Soc Berlin*. 2021;152:232–43. <https://doi.org/10.12854/erde-2021-583>.
62. Gerend J. Lessons in rural persuasion: village infill development in Bavaria, Germany. *Sustainability*. 2020;12:8678. <https://doi.org/10.3390/su12208678>.
63. Bodorkós B, Pataki G. Linking academic and local knowledge: community-based research and service learning for sustainable rural development in Hungary. *J Clean Prod*. 2009;17:1123–31. <https://doi.org/10.1016/j.jclepro.2009.02.023>.
64. Amundsen H, Hovelsrud GK, Aall C, Karlsson M, Westskog H. Local governments as drivers for societal transformation: towards the 1.5 °C ambition. *Curr Opin Environ Sustain*. 2018;31:23–9. <https://doi.org/10.1016/J.COSUST.2017.12.004>.
65. Wamsler C, Luederitz C, Brink E. Local levers for change: mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Glob Environ Chang*. 2014;29:189–201. <https://doi.org/10.1016/j.gloenvcha.2014.09.008>.
66. Jacob K, Paulick-Thiel C, Teebken J, Veit S, Singer-Brodowski M. Change from within: exploring transformative literacy in public administrations to foster sustainability transitions. *Sustainability*. 2021;13:4698. <https://doi.org/10.3390/su13094698>.
67. Schneidewind U. Transformative Literacy: Gesellschaftliche Veränderungsprozesse Verstehen Und Gestalten. *GAIA Ecol Perspec Sci Soc*. 2013;22:82–6. <https://doi.org/10.14512/gaia.22.2.5>.
68. Kühn M. Peripheralization: theoretical concepts explaining socio-spatial inequalities. *Eur Plan Stud*. 2015;23:367–78. <https://doi.org/10.1080/09654313.2013.862518>.
69. Volgmann K, Münter A. Understanding metropolitan growth in german polycentric urban regions. *Reg Stud*. 2022;56:99–112. <https://doi.org/10.1080/00343404.2020.1807491>.
70. Jacuniak-Suda M, Walsh C, Knieling J. Governance arrangements in the Hamburg metropolitan region: between hard and soft institutional spaces. In: Allmendinger P, Haughton G, Knieling J, Othengrafen F, editors. *Soft spaces in europe: re-negotiating governance, boundaries and borders*. Routledge; 2015. p. 45–76.
71. Manzo AN, Burke JM. Increasing response rate in web-based/internet surveys. In: Gideon L, editor. *Handbook of survey methodology for the social sciences*. New York: Springer; 2012. p. 327–43.
72. Zabala A, Sandbrook C, Mukherjee N. When and how to use Q methodology to understand perspectives in conservation research. *Conserv Biol*. 2018;32:1185–94. <https://doi.org/10.1111/cobi.13123>.
73. López-i-Gelats F, Tàbara JD, Bartolomé J. The rural in dispute: discourses of rurality in the Pyrenees. *Geoforum*. 2009;40:602–12. <https://doi.org/10.1016/j.geoforum.2009.04.008>.
74. Bosworth G, Annibal I, Carroll T, Price L, Sellick J, Shepherd J. Empowering local action through neo-endogenous development; the case of LEADER in England. *Sociol Rural*. 2016;56:427–49. <https://doi.org/10.1111/soru.12089>.
75. Schneider F, Figer M, Harari N, Moser S, Oberlack C, Providoli I, Schmid L, Tribaldos T, Zimmermann A. Transdisciplinary co-production of knowledge and sustainability transformations: three generic mechanisms of impact generation. *Environ Sci Policy*. 2019;102:26–35. <https://doi.org/10.1016/j.envsci.2019.08.017>.
76. Derak M, Cortina J, Taiqui L. Integration of stakeholder choices and multi-criteria analysis to support land use planning in semi-arid areas. *Land Use Policy*. 2017;64:414–28. <https://doi.org/10.1016/j.landusepol.2017.03.006>.
77. Semeraro T, Nicola Z, Lara A, Sergi Cucinelli F, Aretano R. A bottom-up and top-down participatory approach to planning and designing local urban development: evidence from an urban university center. *Land*. 2020;9:98. <https://doi.org/10.3390/land9040098>.
78. Gauthier M, Simard L, Waub J-P. Public participation in strategic environmental assessment (SEA): Critical Review and the Quebec (Canada) Approach. *Environ Impact Assess Rev*. 2011;31:48–60. <https://doi.org/10.1016/j.eiar.2010.01.006>.

79. Martín-López B, Felipe-Lucia MR, Bennett EM, Norström A, Peterson G, Plieninger T, Hicks CC, Turkelboom F, García-Llorente M, Jacobs S, et al. A novel telecoupling framework to assess social relations across spatial scales for ecosystem services research. *J Environ Manag.* 2019;241:251–63. <https://doi.org/10.1016/j.jenvman.2019.04.029>.
80. Di Bucchianico, G. Design for inclusion. Different Approaches for a Shared Goal. *Lecture Notes in Networks and Systems* **2021**, 260, 225–232, https://doi.org/10.1007/978-3-030-80829-7_28.
81. Félix MJ. Transdisciplinary innovation in design: pathways to a sustainable and inclusive future. In: Machado J, Soares F, Trojanowska J, Ivanov V, Antosz K, Cagáňová D, Manupati VK, Pereira A, editors. *Proceedings of the innovations in Industrial Engineering III*. Cham: Springer Nature Switzerland; 2024. p. 253–64.
82. Gisotti MR, Tarsi E. Regional spatial planning for implementing the European green deal: a new method of assessment applied to the metropolitan area of florence. *Plan Pract Res.* 2023;38:581–611. <https://doi.org/10.1080/02697459.2023.2230014>.
83. Hu M, Świerzawski J, Kleszcz J, Kmieciak P. What are the concerns with New European Bauhaus initiative? Vernacular knowledge as the primary driver toward a sustainable future. *Next Sustain.* 2023;1: 100004. <https://doi.org/10.1016/j.nxsust.2023.100004>.
84. Vilsmaier U, Engbers M, Luthardt P, Maas-Deipenbrock RM, Wunderlich S, Scholz RW. Case-based mutual learning sessions: knowledge integration and transfer in transdisciplinary processes. *Sustain Sci.* 2015;10:563–80. <https://doi.org/10.1007/s11625-015-0335-3>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.