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Research Article

Landscape Architecture as a Catalyst for Sustainable Rural Development: a Multi-Case Analysis of German Municipalities

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This research examines how landscape architecture can effectively support sustainable development in rural municipalities through integrated design approaches. Drawing on six case studies from German rural communities, this study investigates the complex interactions between built and natural environments, focusing on how thoughtful planning interventions can simultaneously preserve cultural heritage and foster community vitality. The analysis reveals successful strategies for enhancing ecological resilience while strengthening social cohesion and economic viability, particularly in small and medium-sized municipalities where resource optimization is crucial. Results demonstrate that landscape architectural interventions focusing on water management, biodiversity enhancement, and public space development can successfully address environmental challenges while improving quality of life for residents. The findings highlight the importance of combining traditional knowledge with innovative design approaches, emphasizing community engagement, and ensuring architectural quality in rural development projects. This research contributes to understanding how landscape architecture can help rural communities navigate contemporary challenges while preserving their cultural heritage and natural resources.

Keywords: rural sustainability, landscape architecture, ecological enhancement, participatory planning, cultural heritage preservation

1 Introduction

Rural municipalities face numerous challenges in the 21st century, including demographic change, economic pressures, and environmental degradation. These challenges require innovative solutions that can balance ecological sustainability with social and economic development needs. Landscape architecture plays a crucial role in addressing these challenges by providing integrated approaches to spatial planning and design that can enhance both environmental quality and community wellbeing.

The transformation of rural landscapes through thoughtful planning intervention repretsents a critical approach to sustainable development. These interventions must navigate complex interactions between built and natural environments while preserving cultural heritage and supporting community vitality. Small and medium-sized municipalities particularly benefit from integrated landscape architectural approaches that can maximize limited resources while addressing multiple development objectives simultaneously.

This research examines how landscape architectural strategies can effectively support sustainable rural development through qualitative analysis of six exemplary case studies from German municipalities conducted in 2023/2024. The study draws upon extensive document analysis, stakeholder interviews, and site observations spanning interventions implemented from the early post-reunification period to recent developments. By examining projects across this extended timeframe, the research provides insights into both immediate and long-term impacts of landscape architectural approaches. The study focuses particularly on the integration of ecosystem services, human-nature interactions, and socio-cultural

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regeneration strategies within rural contexts, examining these elements through the lens of multi-functional design approaches that simultaneously address environmental challenges while enhancing community life and economic viability.

1.1 German Municipal Structure and Rural Development Context

The structures of European Community member states have evolved differently through historical development. To provide better context for the presented case studies, it is important to understand Germany's state and municipal structures.

Germany's federal governance structure represents a sophisticated intergovernmental framework comprising 16 constituent states (Länder) and the federal government (Bund). While the federal government maintains primary legislative jurisdiction, both national and state levels possess autonomous legislative authority within constitutionally defined parameters. Each state operates through its constitution, parliament, and administrative bodies, with the Federal Council (Bundesrat) enabling state participation in federal legislation (Deutscher Bundestag, 2013).

This constitutional arrangement ensures balanced power distribution between centralized coordination and regional autonomy, reflecting Germany's commitment to effective multilevel governance and democratic representation.

The territory of individual constituent states comprises municipal areas. These possess a constitutionally guaranteed right to self-governance [Article 28, Paragraph 2 of the Basic Law (GG)]. All matters concerning the municipality and local community are regulated at the municipal level. This includes mandatory tasks like

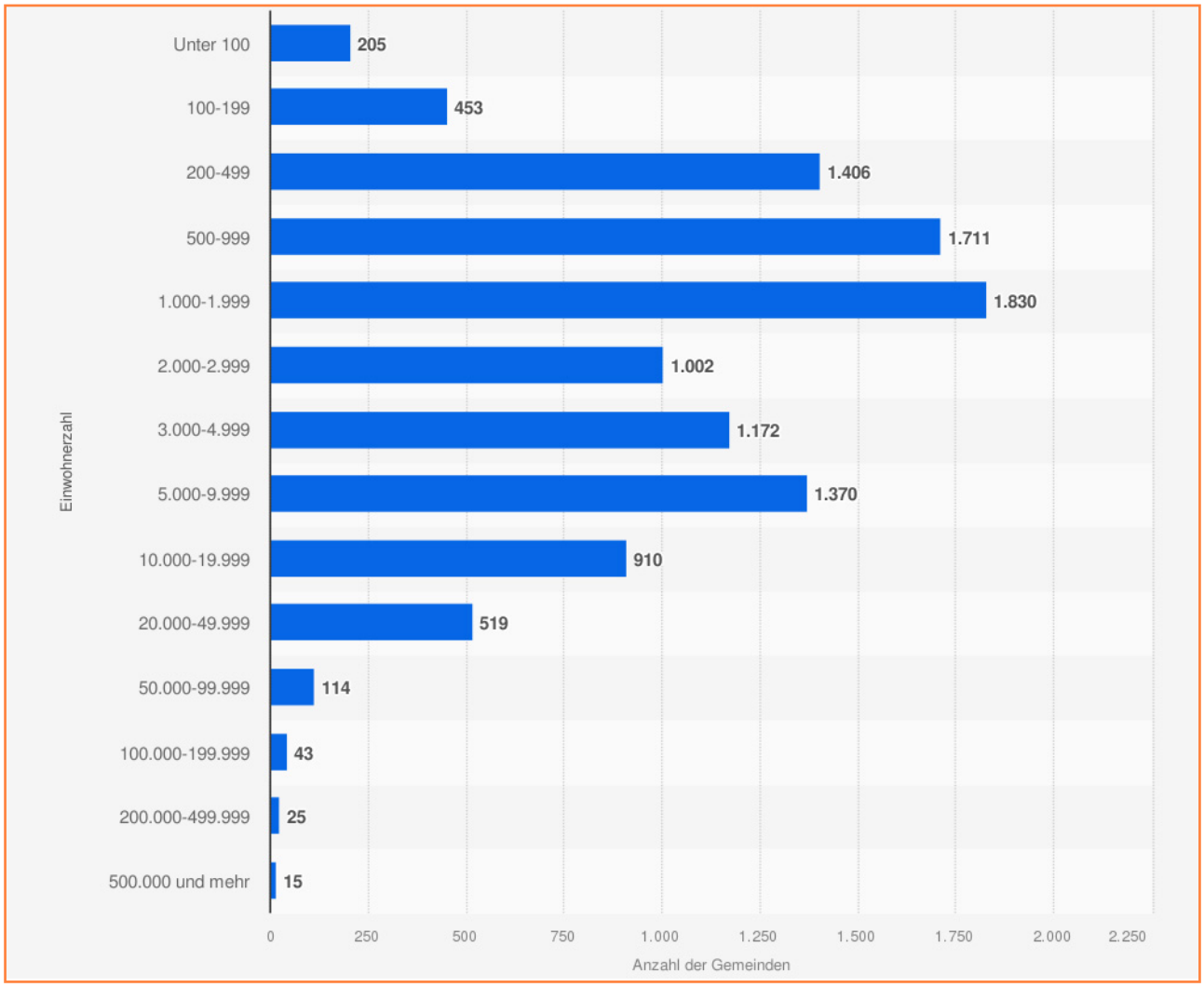

Figure 1 Size of the municipalities in Germany based on the number of inhabitants
Source: Statistisches Bundesamt (2024)

operating schools and kindergartens or maintaining roads, voluntary tasks (e.g., maintaining cultural institutions, supporting associations and sociocultural facilities), and directed tasks (Bundeszentrale für politische Bildung, 2013; Kommunalforum Sachsen, 2015).

Since the establishment of the Federal Republic of Germany and following reunification, municipal reforms were implemented across individual states. These reforms aimed to make administrations more efficient and competent. This resulted in generally larger municipalities, though population sizes vary significantly depending on reform approaches in individual states. In Germany, the terms "Gemeinde" and "Kommune" are used synonymously. In fact, "Gemeinde" is the term used in official documents, such as the aforementioned Article 28 of the Basic Law. The municipality is the smallest political administrative unit.

Figure 1 shows that more than half of the municipalities in Germany have fewer than 2,000 inhabitants. According to a source from mid-2024, these municipalities account for over 50% of the total of around 11,000 municipalities in Germany (Statistisches Bundesamt, 2024). However, the municipal reforms had significant impacts on municipality sizes across different federal states. In the eastern German states, territorial reforms led to a substantial reduction in the number of municipalities and an increase in their average population. For example, in Saxony, a reduction of municipalities through mergers and incorporations of 74% occurred, with the current average municipality size being 9,519 inhabitants. Additionally, new forms of municipal cooperation were developed, such as administrative communities or municipal and city associations (Statistisches Bundesamt, 2024).

Rural areas encompass all spaces outside officially defined agglomeration areas and their peripheral zones. These are defined in the respective state development plans. A distinction is made between very peripheral, peripheral, central, and very central spaces. Municipalities located in the agglomeration areas of prosperous urban centres typically benefit from these through immigration and subsequent investments in infrastructure, culture, and mobility. However, this often comes with a loss of identity or overprinting of the municipality. Villages and entire regions outside these areas often struggle with outmigration and aging populations (Henkel, 2004).

2 Materials and Methods

This research, conducted in 2023/2024, employed a qualitative case study methodology to examine landscape architectural interventions in six German municipalities, analyzing projects implemented across the post-reunification period (1990–2024). The selected cases represent various implementation timeframes, from early post-reunification initiatives in Kirchbach focusing on ecological enhancement and settlement pattern preservation, through transitional projects such as the Mosel manor house renovation (2014), to more recent interventions like the Radefeld village green development (2020). This temporal range enabled examination of both established and emerging outcomes of landscape architectural interventions. The methodological framework emphasized comprehensive interpretive analysis through three interconnected dimensions: ecological sustainability, social cohesion, and economic viability. Primary data collection incorporated document analysis of municipal planning materials and implementation reports, supplemented by semi-structured interviews with key stakeholders including municipal officials, project managers, and community representatives. Site observations documented physical transformations, usage patterns, and ecological developments. The analysis investigated how interventions enhanced biodiversity, water management, and habitat creation while addressing social and economic development needs. Projects with longer post-implementation periods, particularly Kirchbach's initiatives from the 1990s, provided valuable insights into the long-term effects of integrated landscape architectural approaches. While quantitative metrics supplemented the analysis where available, the primary emphasis remained on understanding the nuanced ways these interventions transformed rural landscapes and communities, incorporating local knowledge systems and community perspectives through stakeholder interviews and feedback analysis.

2.1 Case Study Overview

The research examines six German municipalities that have implemented distinctive approaches to sustainable development through landscape architectural interventions, each demonstrating unique strategies for integrating ecological enhancement with socio-cultural regeneration:

Erlbach-Kirchberg (1,600 inhabitants) exemplifies the transformation of cultural heritage sites into multifunctional community spaces through integrated design approaches (Figs 2–4). The project centred on the redevelopment of the historic "Zur Linde" inn site, implementing innovative water management solutions through permeable surfaces and sustainable drainage systems. The intervention successfully integrated social infrastructure with ecological enhancement,

Figure 2 Multifunctional village square Erlbach-Kirchberg with lime tree
Source: Schüppel (2024)

Figure 3 Water feature with lime tree leaves, reminiscent of the old 'Zur Linde' inn, Erlbach-Kirchberg
Source: Schüppel (2024)

featuring native plantings, children's play areas, and eco-friendly parking solutions. The project demonstrates how thoughtful material selection and design can address historical flooding issues while creating vibrant community spaces. The use of natural stone pathways, specialized synthetic safety surfacing for play areas, and permeable gravel parking surfaces exemplifies the integration of practical needs with environmental consciousness. The project's success in addressing recurring flooding issues (2010–2013) through water-permeable surfaces demonstrates the effective integration of climate resilience strategies with public space design. (Rehwaldt Landschaftsarchitekten, 2018a).

Heinsdorfergrund (1,945 inhabitants) showcases an innovative educational approach to sustainable village development, centred around their primary school as a catalyst for community engagement and ecological awareness. The project established a democratically elected children's parliament and developed initiatives such as the 'Naschwiesen' (snack meadows) and 'Dorfgarten' (village garden) along the Raumbach stream. The school grounds serve as a living laboratory for ecological education, featuring habitats for reptiles and insects, flower meadows, wild rose hedges, and heritage apple varieties (Figs 5 and 6). The integration of green roofs and water-permeable surfaces demonstrates practical applications of sustainable infrastructure, while the stream renaturalisation project combines flood protection with ecological enhancement. The project's emphasis on youth engagement through initiatives like annual forest cleanup campaigns (rewarded with ice cream sponsored by local councillors) demonstrates innovative approaches to fostering environmental stewardship among younger generations.

Figure 4 Permeable surfaces in the new village square Erlbach-Kirchberg
Source: Schüppel (2024)

Figure 5 Heinsdorfergrund, school grounds with village stream and play facilities
Source: Staudte (2021)

Figure 6 Heinsdorfergrund, school garden
Source: Staudte (2021)

Figure 7 Village creek of Kirchbach
Source: Schüppel (2024)

Figure 8 Restored pond as part of a system of twelve ponds in the municipality of Kirchbach
Source: Schüppel (2024)

Kirchbach (216 inhabitants) demonstrates successful preservation of historical settlement patterns while enhancing ecological value through comprehensive landscape intervention strategies (Figs 7–10). The project focused on maintaining the traditional Waldhufendorf (linear forest village) structure while implementing comprehensive ecological improvements. The initiative restored an interconnected system of twelve ponds, significantly enhancing biodiversity through the strategic planting of over 500 woody plants, establishment of traditional orchards, and installation of wild bee habitats. The "WeiRoHa Project," featuring willows, wild roses, and hazel bushes along the village road, exemplifies how historical precedents can inform contemporary ecological enhancement strategies. The project's conscious decision against further settlement expansion underscores its

Figure 9 Information plate on biodiversity enhancement measures, Kirchbach
Source: Schüppel (2024)

Figure 10 Nesting aids for insects on the back side of information plates, Kirchbach
Source: Schüppel (2024)

Figure 11 Historic manor house after renovation, Mosel
Source: Staudte (2024)

Figure 12 Restored Service Building in the manor house ensemble
Source: Staudte (2024)

Figure 13 New permeable square as part of the village green, Peritz
Source: Eberts (2018)

commitment to sustainable development principles, while the establishment of a fruit collection point demonstrates successful integration of economic viability with ecological preservation (Rehwaldt Landschaftsarchitekten, 2018b).

Mosel (2,200 inhabitants) illustrates the successful integration of industrial development with cultural heritage preservation in a complex peri-urban context. The project centred on the exemplary renovation of the baroque Niedermosel manor house, transforming it into a multifunctional community asset featuring a guesthouse, café, stables, and craft workshops (Figs 11 and 12). The demolition of deteriorated agricultural structures and subsequent ecological enhancement through Bennjes hedges and meadow orchards demonstrates effective strategies for balancing development with environmental restoration. The project's success in creating a tourist destination while maintaining ecological integrity showcases the potential for harmonizing economic development with cultural heritage preservation. The integration of compensatory ecological measures funded through industrial development (VW plant expansion) demonstrates innovative approaches to leveraging private sector resources for community benefit.

Peritz (210 inhabitants) implemented an innovative land consolidation strategy that successfully balanced agricultural efficiency with ecological restoration through integrated landscape planning. The project's centrepiece, a 400 m multifunctional village green (Fig. 13), serves as both an ecological corridor and community space, demonstrating the sophisticated integration of agricultural modernization with environmental enhancement. The intervention features permeable natural stone paving, water-bound surface treatments, and targeted ecological restoration along the Rietzschke Creek, reestablishing natural bank formations and creating a continuous biotope network within the settlement. The project exemplifies how limited resources (€ 6,500 from municipal funds) can achieve significant transformation through careful planning and stakeholder engagement, particularly through the legally mandated participant community (Teilnehmergemeinschaft) comprising all property owners (Rehwaldt Landschaftsarchitekten, 2018c).

Radefeld (1,200 inhabitants) focused on the sustainable development of its historic 800-meter village green (Anger), preserving and enhancing traditional orchards, ponds, and historic buildings through community-driven design processes (Figs 14 and 15). The project demonstrates successful integration of heritage preservation with contemporary needs

Figure 14 Historic village green with traditional orchards, Radefeld
Source: Schüppel (2024)

Figure 15 New extensive maintenance regime for the meadows in the village green, Radefeld
Source: Schüppel (2024)

through innovative solutions such as converting a historic building for a new use and implementing natural pond restoration. The intervention showcases how community-driven planning can effectively balance preservation requirements with modern usage demands while enhancing both ecological function and social infrastructure. The project's approach to aging fruit tree populations through strategic replanting programs ensures long-term ecological succession while maintaining cultural landscape elements. The restoration of concrete-lined ponds to natural aquatic ecosystems demonstrates successful integration of grey infrastructure transformation with biodiversity enhancement (Rehwaldt Landschaftsarchitekten, 2020).

These case studies collectively demonstrate the diverse approaches to sustainable rural development through landscape architectural interventions, highlighting the importance of integrated design strategies that address ecological enhancement, social cohesion, and economic viability simultaneously. The projects showcase varying scales of intervention, from village-wide ecological networks to focused public space transformations, all contributing to the broader goals of sustainable rural development.

3 Results and Discussion

3.1 Ecological Integration and Water Management

The case studies demonstrate sophisticated approaches to ecological enhancement, with water management emerging as a central theme across all projects. The interventions reveal evolving understanding of water systems as integral elements of landscape design rather than merely technical infrastructure.

Kirchbach's comprehensive water management strategy represents the most ambitious approach, creating an interconnected system of twelve ponds that functions as both ecological infrastructure and public amenity. This system demonstrates how traditional water management practices can be reimagined through contemporary landscape architectural approaches. The project's success in enhancing biodiversity while addressing flood protection illustrates the potential of integrated blue-green infrastructure in rural contexts.

This approach finds parallel expression in Erlbach-Kirchberg's village square transformation, where permeable surfaces and sustainable drainage systems address historical flooding issues while creating attractive public spaces. The project demonstrates how small-scale interventions can contribute to larger ecological objectives while maintaining functionality for daily community use.

The relationship between water management and public space design achieves perhaps its most sophisticated expression in Peritz, where the village green serves multiple functions as ecological corridor, green infrastructure for water management, and community space. This project particularly demonstrates how landscape architecture can bridge traditionally separated domains of infrastructure and public space design.

3.2 Community Engagement and Social Sustainability

The case studies reveal diverse approaches to community participation in rural development. Heinersdorfergrund's

children's parliament represents an innovative model for youth engagement, demonstrating how educational institutions can serve as catalysts for broader community development. This approach contrasts with but complements Radefeld's traditional community consultation process, showing how different engagement strategies can achieve similar goals of community ownership and sustainable social outcomes.

The transformation projects in Erlbach-Kirchberg and Mosel demonstrate how thoughtful design can create new social focal points while honouring historical context. Both projects successfully repurposed historic structures (inn and manor house respectively) into contemporary community assets through the cooperation between different stakeholders, though at different scales and with different functional emphases. These examples highlight the importance of preserving cultural heritage while adapting spaces to meet contemporary community needs.

3.3 Economic Viability and Heritage Integration

Economic sustainability approaches varied based on local context and opportunities. Mosel's manor house renovation created direct economic benefits through tourism and small business development, while Radefeld's orchard preservation project generates indirect economic value through ecosystem services and local produce. Peritz demonstrates how agricultural efficiency can be balanced with ecological enhancement, providing economic benefits through improved land management.

The case studies show that successful economic strategies often depend on identifying and leveraging local assets and opportunities. This is particularly evident in comparing Mosel's tourism-focused approach with Peritz's agricultural emphasis, demonstrating how different economic strategies can support sustainable development while respecting local context.

3.4 Design Methodology and Implementation

Analysis of the case studies reveals evolving approaches to landscape architectural intervention in rural contexts. The projects demonstrate increasing sophistication in integrating multiple functions within single design elements, moving beyond traditional segregation of ecological, social, and economic objectives.

Particularly noteworthy is the evolution from single-purpose to multi-functional design approaches. This is evident in comparing earlier interventions focused primarily on ecological restoration with more recent projects that integrate multiple objectives within single design elements. The success of these integrated approaches suggests a growing understanding of landscape architecture's potential to address complex rural development challenges.

3.5 Long-term Sustainability and Maintenance

The case studies demonstrate various approaches to ensuring long-term project viability. Successful strategies include involving community members in maintenance activities, developing phased implementation plans, and creating flexible designs that can adapt to changing needs over time. The contrast between Heinersdorfergrund's community-based maintenance approach and Mosel's more formalized management structure illustrates how maintenance strategies can be adapted to local capacity and resources.

3.6 Further Research Needed

This research, conducted as part of the LANDSCAPE IN FOCUS project under the Erasmus+ program, provides valuable insights into sustainable landscape development in rural municipalities. However, several areas warrant deeper investigation to strengthen the empirical foundation of these findings.

Long-term impact assessment remains a critical research priority. While the current study examined interventions spanning from early post-reunification initiatives to recent developments, systematic monitoring programs would enhance understanding of ecological outcomes, water quality improvements, and community engagement patterns over extended periods. Such longitudinal research could provide valuable metrics for assessing the effectiveness of different intervention approaches.

The integration of diverse knowledge systems presents another important research direction. This includes examining how traditional ecological knowledge can complement contemporary landscape practices, particularly in rural settings where historical land management approaches may offer valuable insights for current challenges. Research exploring the intersection of local knowledge with scientific frameworks could enhance our understanding of resilient landscape practices.

This research also highlights the need for comparative analysis across different cultural and administrative contexts. As evidenced by the case studies from Germany and documented in similar initiatives across Europe, successful approaches to landscape protection and development often reflect specific cultural and institutional frameworks. Future research examining how these approaches translate across different governance

structures and cultural contexts would enhance understanding of transferable principles and context-specific adaptations.

4 Conclusions

The analysis reveals that successful landscape architectural interventions in rural contexts require sophisticated integration of ecological, social, and economic considerations. Through detailed qualitative investigation of six diverse case studies, this research demonstrates various strategies for achieving this integration, from innovative youth engagement models to adaptive reuse of heritage structures.

Key success factors include meaningful community engagement throughout the design and implementation process, multi-functional design solutions that maximize ecological and social benefits, careful integration of heritage elements with contemporary needs, and sustainable maintenance strategies that ensure long-term project viability. The documented outcomes include enhanced biodiversity, improved water management systems, strengthened community cohesion, and viable economic models for rural development.

The experiences of these municipalities provide valuable lessons for other rural communities seeking to enhance their sustainability through landscape architectural interventions. Particularly noteworthy are the innovative approaches to water management, public space development, and heritage preservation demonstrated across the cases. While the research focused primarily on qualitative analysis, available quantitative indicators such as flood reduction metrics, biodiversity enhancement measures, and economic viability data support the effectiveness of these approaches.

This research contributes to the broader LANDSCAPE IN FOCUS project under the Erasmus+ program, which aims to develop tools and methodologies for sustainable landscape development in rural communities. The findings suggest that landscape architecture can play a crucial role in supporting sustainable rural development when it successfully integrates ecological enhancement with social and economic considerations. The success of these projects lies in their ability to create solutions that are both innovative and grounded in local context, as demonstrated by the varied approaches to water management, public space development that fosters social interaction, and heritage preservation across the case studies.

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