The fictional municipality of "Zwirgberg" as a model for spatial planning in rural Rhineland-Palatinate

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Abstract
Rural regions in Germany face significant structural transformations due to climate change, demographic shifts, digitalization, and mobility transitions. The research project "Kommune 2050" addresses the challenge of limited strategic planning capacities in rural municipalities by developing a transferable model framework. Using the fictional collective municipality "Zwirgberg," based on existing municipalities in Rhineland-Palatinate, the project integrates GIS analyses, modular synthesis, and participatory scenario development. Zwirgberg functions as a digital experimental space that combines real data with creative projections. The result is a planning tool that allows municipalities to explore future development paths and translate abstract challenges into spatial strategies. This methodological approach offers an innovative and replicable model for strategic spatial planning in rural areas.

Keywords: Data-Driven, Model Municipality, Scenario Modeling, Rural Development

1. Introduction and theoretical background

The ramifications of the substantial challenges confronting contemporary society, encompassing the climate crisis, demographic shifts, social transformations, the digitalization of numerous domains, and the mobility transition are already exerting an influence on nearly all aspects of municipal endeavors. These repercussions are poised to persist, engendering increasingly disparate (spatial) repercussions on our lives in the forthcoming years. This phenomenon is not merely an abstract concept; it is one that is particularly pertinent to the German state of Rhineland-Palatinate. It presents challenges, opens up new perspectives, offers opportunities for control and highlights areas where action is required. But what will future change look like? Where and how strongly will changes be felt? How can we identify, formulate, visualize, and communicate changes? What conclusions must be drawn and what innovative solutions are available?

The "Kommune 2050 - Die nächste Generation" (English: "Municipality 2050 - The next Generation") research project was concerned with these issues and is developing new planning approaches. The objective of the project was to develop a set of tools with which municipalities - exemplified by the fictional model municipality of "Zwirgberg" – can concisely identify, design, test, and spatially concretize their own futures and development paths, but in particular, possible solutions. In order to develop practical and transferable solutions, it was essential to consider both general future trends and local characteristics. In consideration of the model nature of the fictional "Collective Municipality" (German: "Verbandsgemeinde") it is possible to derive and transfer corresponding conclusions to analogous structures and the entire federal state. These conclusions can then be classified in the context of future (spatial) developments and their control.

In the German administrative system, a Verbandsgemeinde (roughly translated as "collective municipality") is a specific form of local government structure, predominantly found in the federal state of Rhineland-Palatinate. It consists of a group of smaller, municipalities (Ortsgemeinden) that collaborate under a shared administrative body. While each local municipality retains its political autonomy and elected council, key public services - such as urban land-use planning, school administration, infrastructure management, and fire protection - are managed collectively by the Verbandsgemeinde. This structure is designed to improve administrative efficiency and ensure the provision of essential services in sparsely populated areas. Due to the lack of terminology for precisely this form of municipality, the German word Verbandsgemeinde is used in this paper, also the term Hauptort refers to the largest and functionally most central town within the Verbandsgemeinde and the word Nebenort denotes the smaller surrounding villages or localities.

Also used in German are the words Grundzentrum, Mittelzentrum and Oberzentrum. Germany's spatial planning system categorizes settlements into a three-tiered hierarchy of central places to structure public service provision and regional development, where a Grundzentrum (basic center) serves everyday local needs (e.g. primary schools, groceries, basic healthcare), a Mittelzentrum (intermediate center) offers a broader range of services such as secondary education, hospitals, and specialized retail, and an Oberzentrum (major center) provides high-level services and infrastructure, such as universities, major hospitals, and cultural institutions, typically serving large regions (ARL, 2010).

During a preparatory phase, the essential foundations for this were laid: future topics were identified, necessary data sets were analyzed, and methodological approaches were formulated. The development of a realistic yet abstract model that provides a framework for iterative planning processes was a primary focus. The emphasis was placed on interdisciplinary collaboration between students and teachers, who cooperated as part of a 'Masterprojekt' (English: 'master's project' - a final project at the very end of the Master's programme) or as student assistants. The objective of the research project was to employ creative and data-driven methodologies to conceptualize a fictional municipality derived from authentic structural components.

The methodological structure of the project was based on a three-phase process; however, the practical work revealed the necessity for increased iteration. In the initial phase, entitled 'Understanding the Territory' the emphasis was placed on the analysis, categorization, and design of the model community. In the subsequent phase, entitled 'Construction of the Model' the elements of the model community were specified, reconstructed, and digitized. In the third phase, entitled 'Developing Future Visions', scenarios were formulated to illustrate potential future trajectories for the developed Verbandsgemeinde.

The methodological value of fiction is the central aspect under consideration here. Zwirgberg's - the fictional Verbandsgemeinde - model does not represent an arbitrary real community; rather, it is composed of real fragments. This phenomenon gives rise to a reflexive space wherein authentic communities can discern their own identity without the sense of being addressed in a direct manner. In this context, Zwirgberg functions as a projection-open planning tool - as a digital experimental space for exploring realistic yet innovative development paths. The structural modularity enables the flexible composition of fictional community types and targeted transfer of individual components to real contexts.

The project thus demonstrates an innovative approach to planning processes in rural areas based on geodata, creativity, and strategic planning. Working with "Zwirgberg" allows concrete actions and the exploration of potential spatial configurations prior to their implementation in actual planning instruments. This lays the foundation for subsequent development of digital, modular, and participatory tools in municipal planning.

2. Methodical approach

The objective of the project was to develop a fictitious municipality based on existing Verbandsgemeinden in Rhineland-Palatinate. Subsequent to this, the future development visions of several Verbandsgemeinden were to be formulated and presented. During the initial six-month period, a collaborative effort was undertaken with a team of four students enrolled in master's programs specializing in 'Urban and Regional Development' and 'Urban Planning'. As a culminating element of their master's program, students were tasked with the development of the fundamental structures of the fictional municipality and its future vision. These were subsequently elaborated upon by a group of three students, two of whom were in the initial stages of their bachelor's degree program. It was anticipated that they would offer a novel and impartial perspective on the future of the municipalities in Rhineland-Palatinate.

The initial plan was to divide the project into three phases; however, as work progressed, it became evident that this approach was not feasible. Conversely, alternating between task areas (analysis, construction, replication, detailing of previously developed content) and levels of consideration (Verbandsgemeinde and municipalities within the Verbandsgemeinde) has been demonstrated to be a more fruitful approach. Nevertheless, the three

phases remained as a rough framework for the order of processing:

• Phase 1 - "Understanding the Territory"
Reading, analyzing, and understanding: Getting to know and developing the framework of the fictional Verbandsgemeinde
• Phase 2 - "Construction of the Model"
Recreating, assembling, and defining the model municipality; Describing its characteristics or "genetic code"
• Phase 3 - "Developing Future Visions"
Examination of developments and trends at the Verbandsgemeinde level and their manifestation in the individual municipalities

Database and selection of existing Verbandsgemeinden
The research project was commissioned by "Entwicklungsagentur Rheinland-Pfalz e.V." which had already formulated specifications the fictitious Verbandsgemeinde to be developed was to embody. These were as follows:

The Verbandsgemeinde is comparable to a modern-day municipality in Rhineland-Palatinate: The Verbandsgemeinde has approximately 20,000 inhabitants. It consists of a Hauptort (5,000 inhabitants, Grundzentrum with schools) and 15 Nebenorten (150 to 800 inhabitants). All 16 individual towns (Hauptort and Nebenorte) are run on a voluntary basis. The Verbandsgemeinde has a full-time administrative head who is responsible for all 16 municipalities. It has its own independent administration. The Verbandsgemeinde is situated in the rural area of Rhineland-Palatinate. The property is located approximately 30 kilometers from the nearest Oberzentrum.

According to these criteria, all Verbandsgemeinden in Rhineland-Palatinate with 18,000 to 22,000 inhabitants that are also more than about 30 km from the nearest Oberzentrum were selected for inclusion in the study: Aar-Einrich, Bad Marienberg (Westerwald), Birkenfeld, Brohltahl, Cochem, Kirchberg (Hunsrück), Kirchheimbolanden, Linz am Rhein, Prüm, Südeifel (northern half), and Wirges.

The Verbandsgemeinden of Annweiler am Trifels, Edenkoben, and Wonnegau are located approximately 30 kilometers from the nearest Oberzentrum (red circles). However, they are situated within the 20-kilometer catchment areas of a Mittelzentrum with partial functions of a Oberzentrum (Mittelzentren mit Teilfunktionen eines Oberzentrums) (yellow circles). It should be noted that this selection does not yet take into account the number of sub-locations, i.e., "one Hauptort and 15 Nebenorte"

The initial spatial structural studies are summarized in the map below:

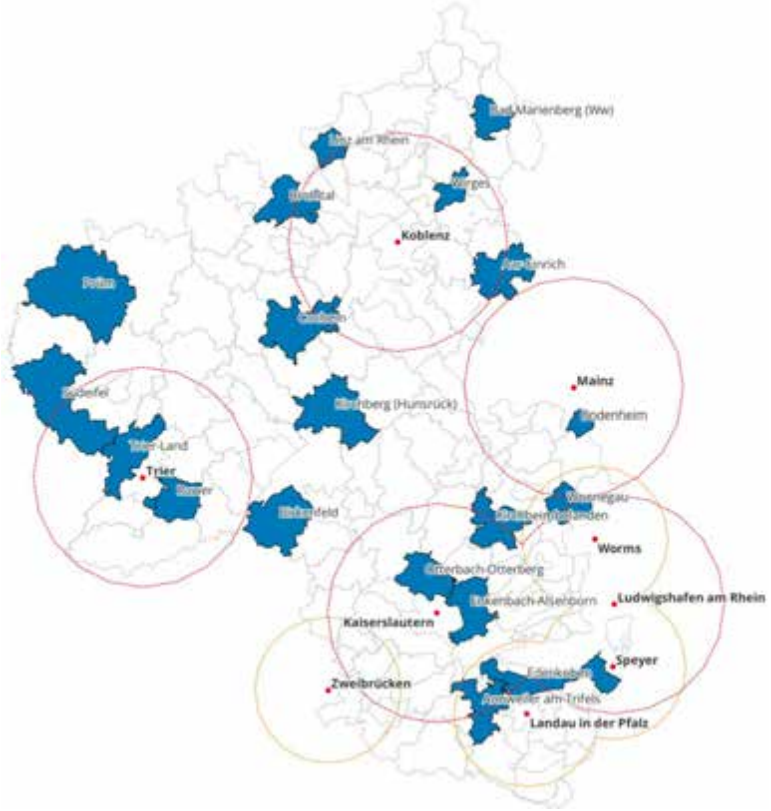


Fig. 1: The map shows the first spatial structure studies. All municipalities with a population of 18,000 to 22,000 are coloured blue, the red circles show the 30-kilometre radius around the Oberzentren, the yellow circles around the Mittelzentren with partial functions of a Oberzentrum. Source: Authors 2024.

Role of students and didactic format

A central feature of the methodological design is the involvement of students in various stages of their education: Master's students provided initial drafts and structural concepts as part of project-based work and developed the fictional Verbandsgemeinde in its entirety. Bachelor's students then took over the further elaboration, reflection, and critical development—their impartiality proved to be particularly productive. This interdisciplinary and multi-stage process enabled a deep understanding of both systemic relationships and the challenges of concrete municipal development.

3. Phase 1: Understanding the Territory

Following the methodological foundation of the project, an empirical analysis of existing Verbandsgemeinden in Rhineland-Palatinate was conducted. This analysis forms the backbone for the subsequent construction of the model Verbandsgemeinde "Zwirgberg." The analysis can be divided into three sections.

In the initial phase, profiles were created for the eleven selected Verbandsgemeinden. The objective of this stage was to acquire a comprehensive understanding of them. In the subsequent phase, the land distribution of the Verbandsgemeinden was examined and classified into categories so that comparable or similar structures could be grouped together. The third and final step of the analysis entailed the creation of a modular system that would serve as the foundation for establishing the fictional association of municipalities.

The objective was to identify the typical structural characteristics, development potential, and spatial functional patterns of the Verbandsgemeinden in Rhineland-Palatinate. These characteristics were then used as the basis for building the fictional association of municipalities.

Profiles and comparison criteria
The initial phase of the study centered on eleven selected Verbandsgemeinden of comparable size (18,000–22,000 inhabitants) and remote location (more than 30 km from the regional center). For each of these Verbandsgemeinden, structured profiles were created, reflecting the following criteria:
- Demographic structure: age distribution, population development,
- Household sizes
- Settlement structure: density, types of centers, types of urban development
- Land use: proportions of settlement, vegetation, traffic areas
- Accessibility: distance to medium-sized and larger centers, public transport connections
- Infrastructure: education, health, and administrative services

Comparability was ensured by a standardized profile template that combines both quantitative data and qualitative assessments.

Spatial analyses of similar existing Verbandsgemeinden in Rhineland-Palatinate
In order to gain a more nuanced understanding of the selected Verbandsgemeinden's spatial characteristics, a range of structural elements were subjected to analysis, including boundaries, settlement patterns, primary access routes, the location of the primary urban center, agriculture, topographical features, water bodies, green spaces and points of interest.

To this end, cartographic representations were developed through the utilization of a geographic information system (GIS) and hand sketches, which were made based on such maps. Infrastructure aspects such as interregional connections, public transportation, and bicycle paths were also considered. During this phase, statistical data was also processed and subsequently compared with the data from the other Verbandsgemeinden.

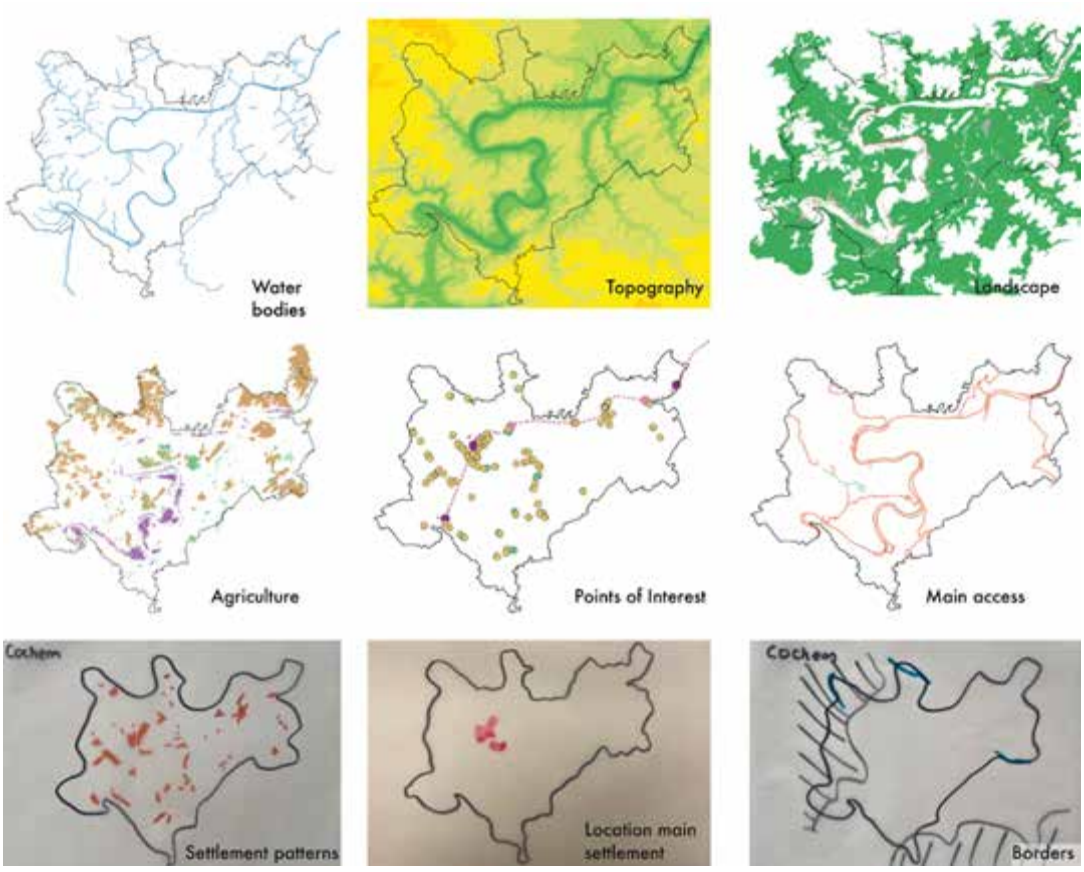


Fig. 2: The structures of the municipalities examined using the example of Cochem. Source: Authors 2024.

Following the examination of the Verbandsgemeinden individually, the results were compared with the analysis results of all the other considered Verbandsgemeinden. Based on these comparisons, categories were developed for each analysis topic into which the eleven municipalities could be classified (even though transitions can be fluid).

The following example illustrates the investigation of all subject areas, as evidenced by the presentation of the various settlement patterns. A distinction was made between:

• Cow spots:
Large-scale settlement structures are dispersed in a seemingly random manner.
• Drops:
The settlement structures under consideration are of a smaller nature, with some larger drops situated between them.
• Sprinkles:
The settlement structures are diminutive in size and dispersed in a seemingly random manner.

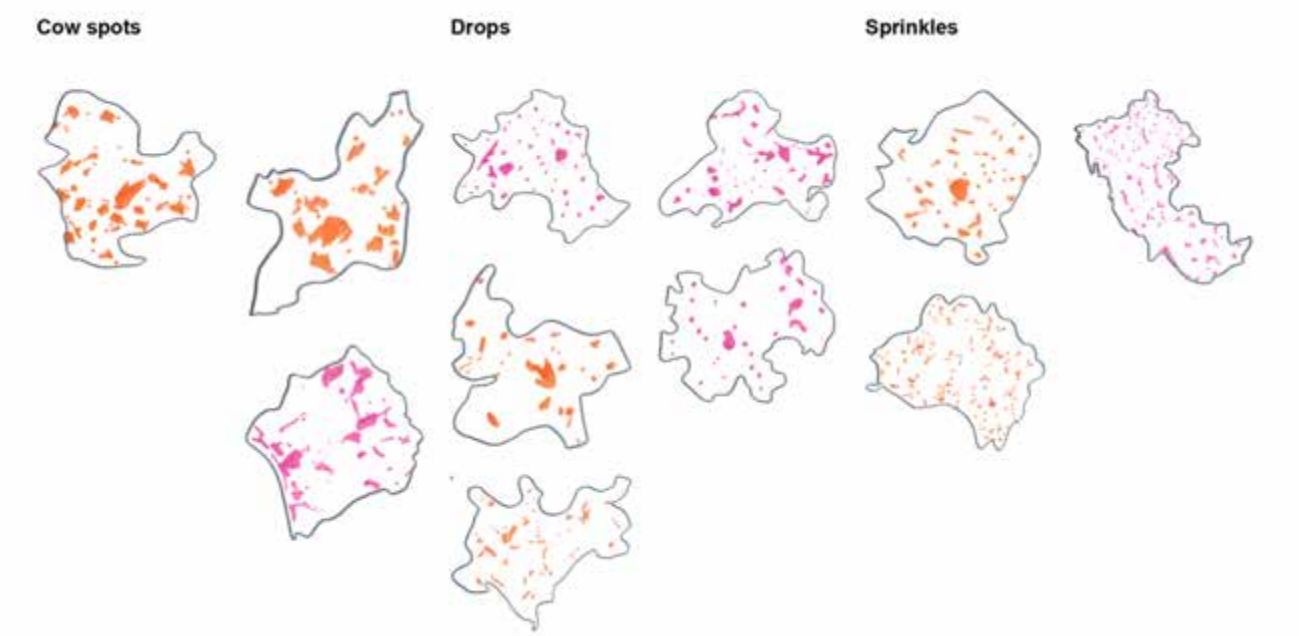


Fig. 3: The settlement structures of the eleven municipalities divided into the categories of cow spots, drops and sprinkles. Source: Authors 2024.

Derivation of a modular system of similar existing municipalities
A modular system was created by analysing and categorizing the structures. Based on this, the fictitious Verbandsgemeinde was to be designed and built in the next phase. A distinction was made between two categories:

• Fundamentals: The foundational elements of the municipal framework such as topography and settlement structure
• Infrastructure: Encompasses elements such as public transportation and bicycle pathways.

The following presents an overview of the components of the modular system. These modules can be flexibly combined in further planning to develop structurally similar municipalities in a differentiated manner. This approach facilitates the synthesis of empirical evidence and planning creativity.

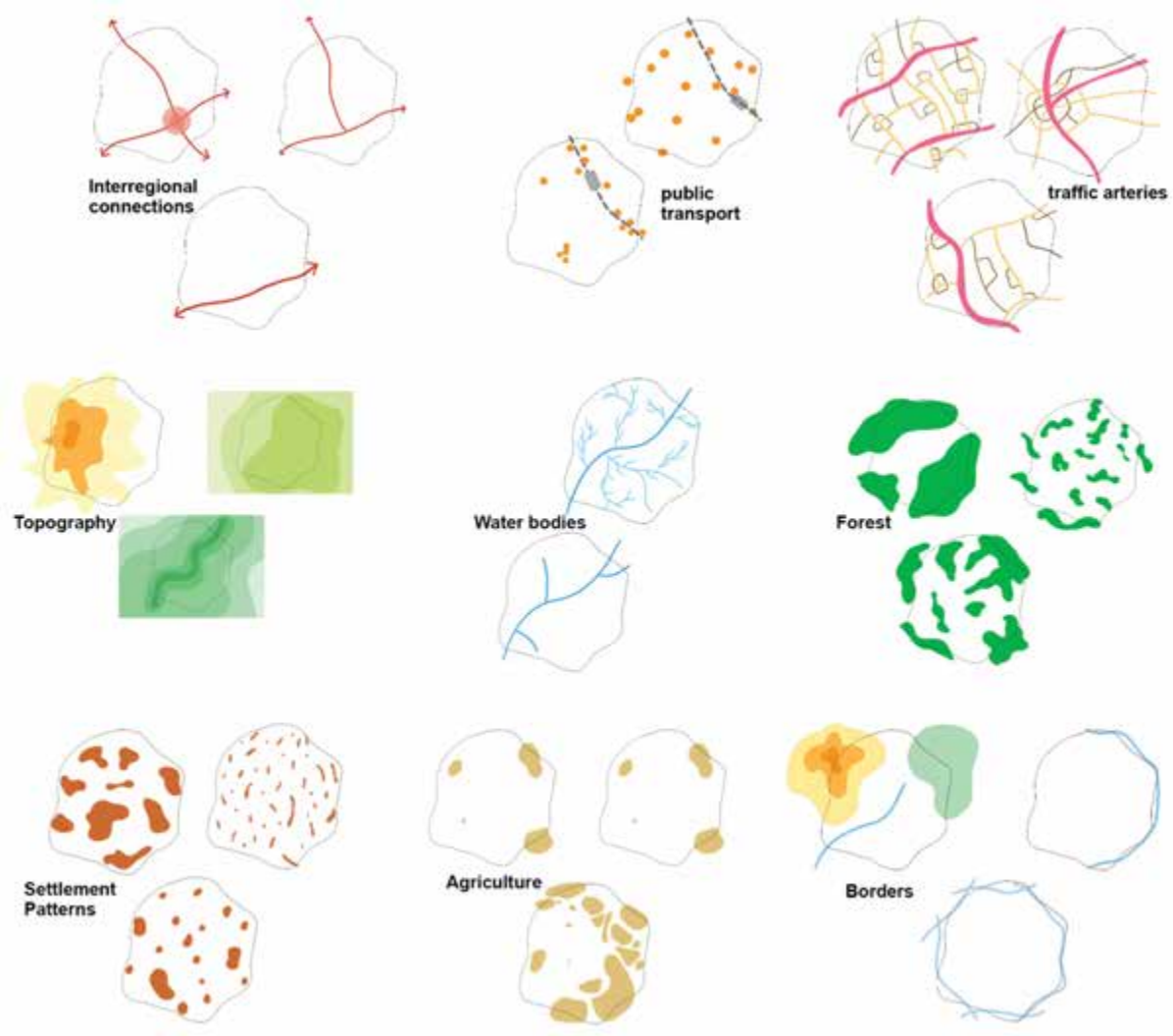
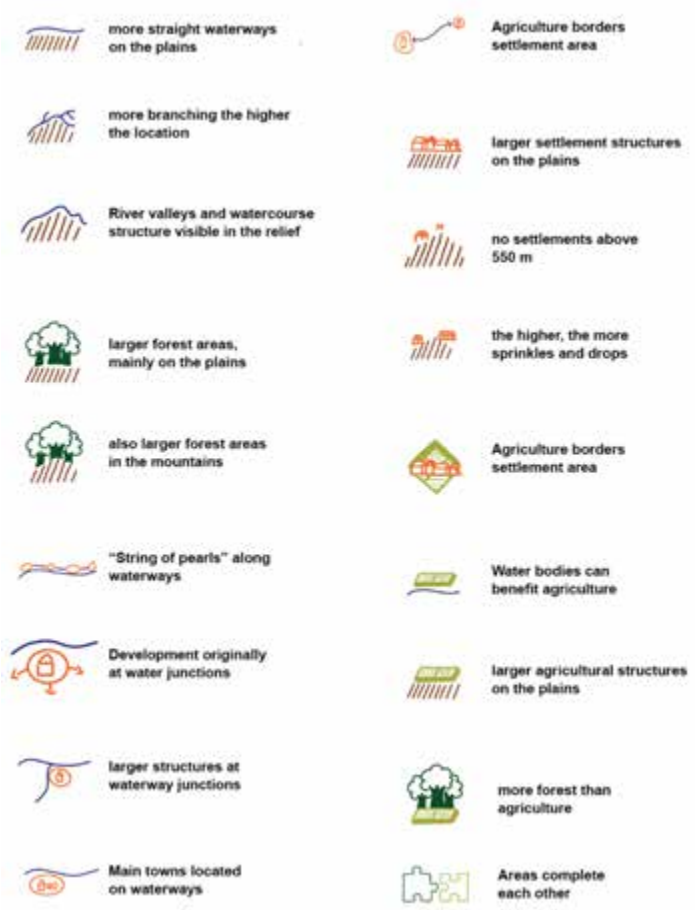


Fig. 4: Characteristics of the municipalities within the Verbandsgemeinde in accordance to the modular system. Source: Authors 2024.

Identification of correlations between the categories considered in the analysis

In order to be able to derive initial design guidelines for the fictitious Verbandsgemeinde from the results of the analysis, it was investigated whether the categories analysed were somehow mutually dependent.

Depending on the constellation, there are varying numbers of connections and mutual conditions. For example, four relationships could be identified between settlement structure and water bodies, but only one between water bodies and agriculture. No conclusions about mutual conditions could be drawn from other constellations, such as forests and settlements.



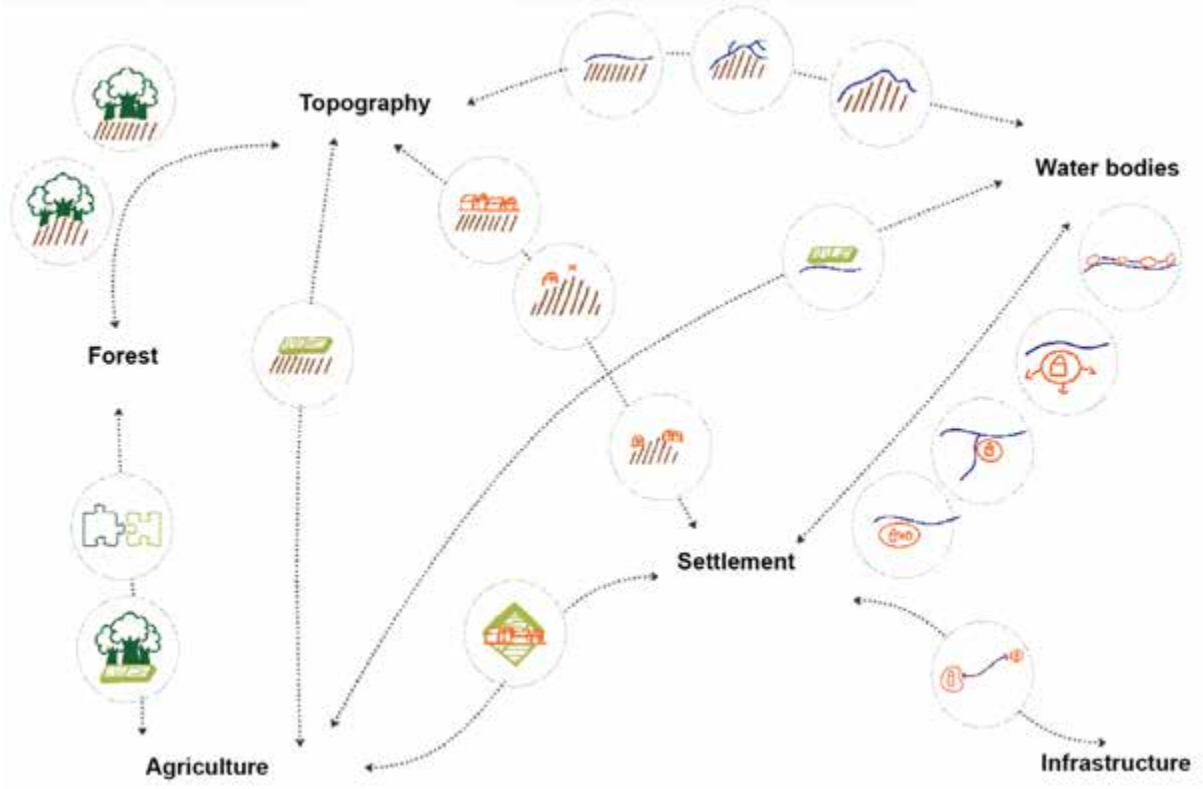


Fig. 5: The diagram shown illustrates the relationships between the categories, the legend above provides explanations of the symbols within the diagram. Source: Authors 2024.

4. Phase 2 - Construction of the Model

During the preceding analysis phase, the modular system was developed and the overarching relationships were examined. In the subsequent design phase, the current status of a fictitious Verbandsgemeinde was determined.

The fictitious Verbandsgemeinde of Zwirgberg was designed by first developing two types of Verbandsgemeinden from four basic designs. These were then combined into one type. Using hand drawn sketches, the individual layers were digitized with the help of a geographic information system (GIS), so that the basic structure of the Verbandsgemeinde became visible.

In further steps, the relationships within the settlements were analyzed. In the present study, sprinkles in higher topographical levels, pearl chains along waterways, cow spots, and even drops in the landscape were analyzed. The results were used to reconstruct fictional municipalities from fragments of real local communities before these were digitally reconstructed in the GIS using the corresponding census data.

Impromptu design

The construction of the fictitious Verbandsgemeinde began based on the analysis. As part of the project, each participating student carried out an individual “basic impromptu design”. The aim was to develop their own design for the municipality based on the knowledge gained.

Fig. 6: Basic impromptu designs for the fictional municipality. Source: Authors 2024.

On closer inspection of the drafts produced, two types of draft could be identified.
• Many smaller villages at higher altitudes and branched water structures
• Larger villages in lower, flatter locations and straighter watercourse structures
Therefore two new drafts were produced, each resembling one of the distinct types.

Fig. 7: The two types of designs for the fictional municipality. Source: Authors 2024.

The fictitious Verbandsgemeinde of Zwirgberg was ultimately developed from these variants. The derivation of the individual layers and the entire Verbandsgemeinde was based on the previously developed modular system and the identified correlations between the categories of the superordinate structures. The aim was to integrate as many special features of the previously considered existing Verbandsgemeinden in Zwirgberg as possible. This duality also allows the exemplary treatment of central areas of tension - such as between the formation of centers and peripheralization - in the model. Furthermore the choice of these types reflects the demographic, infrastructural and functional heterogeneity of many real Verbandsgemeinden.

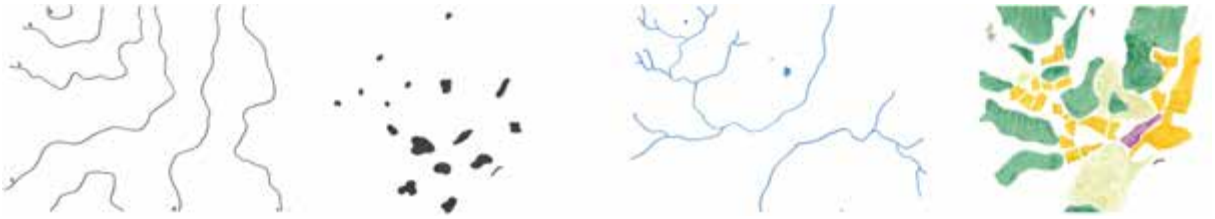


Fig. 8: The municipality of Zwirgberg and its layers: topography, settlement structure, water bodies, and land use. Source: Authors 2024.

Several points were relevant in the development process. The boundaries were to be defined as the final element of the process in order to avoid a limited and therefore incorrect alignment of the subsequent steps from the outset. In addition, it should be noted that the category of open spaces is not limited exclusively to forest and agricultural areas but also includes green spaces to which no specific function is ascribed. In view of these findings,

the corresponding work steps in the previous phases were modified and carried out again until a satisfactory result was achieved.

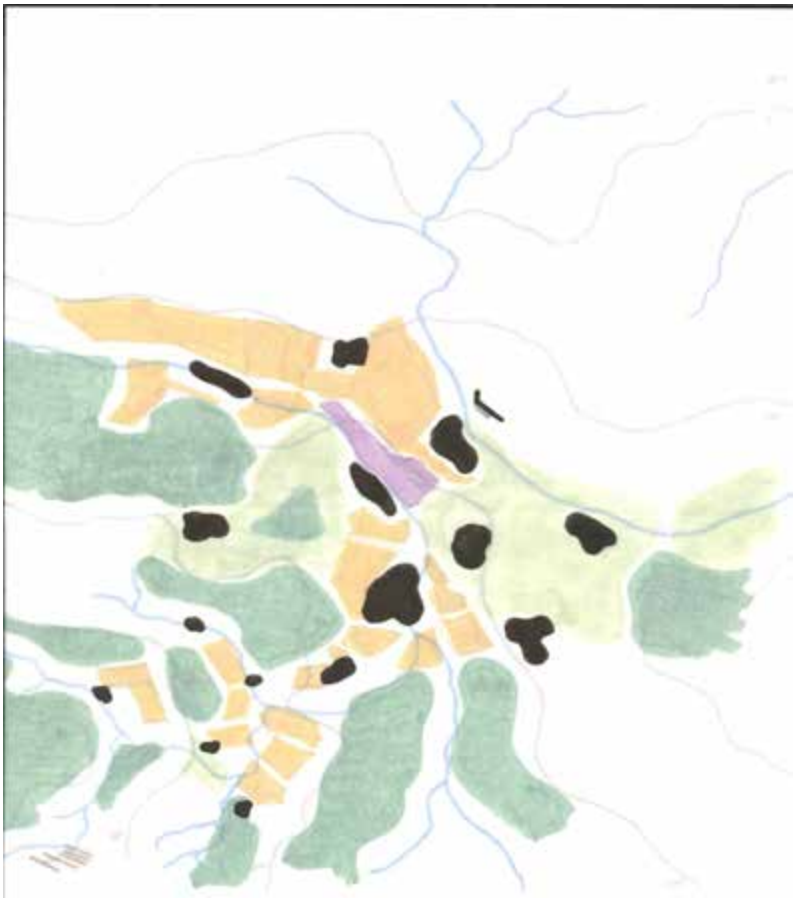


Fig. 9: Overlay of the hand drawn layers of the Verbandsgemeinde of Zwirgberg. Source: Authors 2024.

Transfer and reproduction of the fictitious municipality in a Geographic Information System (GIS)

After developing a joint design for the fictitious Verbandsgemeinde, it was transferred to a GIS. As part of the topographical incorporation, a structural simplification was carried out in which the topographical levels were numbered from one to five and assigned specific properties without a detailed GIS representation. Level 1 represents the lowest level, while level 5 indicates the highest elevation. Subsequently, the other levels of the municipality are successively transferred to the GIS. These are settlements, forest, agriculture, waterways, meadows, vineyards and a quarry.

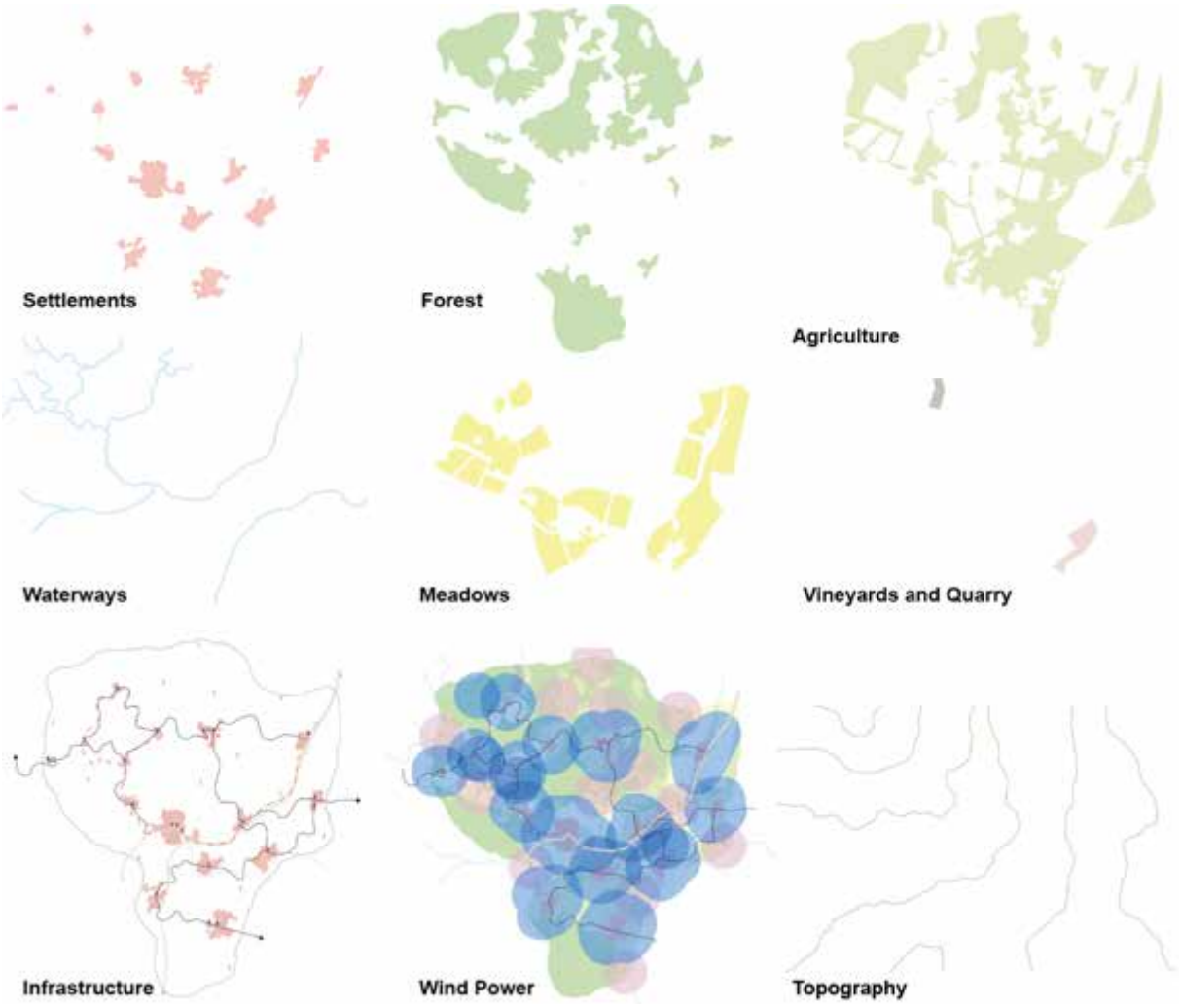


Fig. 10: The digital layers of the Verbandsgemeinde of Zwirgberg. Source: Authors 2024.

Once the relevant layers had been recorded, the infrastructure could be added. In the present context, a hierarchy with main roads, connecting roads and residential roads was selected for traffic, which was supplemented by active and disused railroad tracks and bus stops. Due to the fact that an average of eleven wind turbines are installed in the previously considered municipalities, this number of wind turbines should also be placed in Zwirgberg.

According to the applicable guidelines, wind turbines must be installed at a distance of at least 900 meters from residential areas. In addition, a minimum distance of around 1,000 meters between individual turbines must be ensured. Furthermore, positioning in bird or nature conservation areas is not permitted and they must not impair the appearance of the landscape (Vhw - Bundesverband für Wohnen und Stadtent-wicklung e.V. 2023). Following corresponding analyses, the areas marked in blue were excluded as locations so that the turbines could be positioned in the remaining areas.

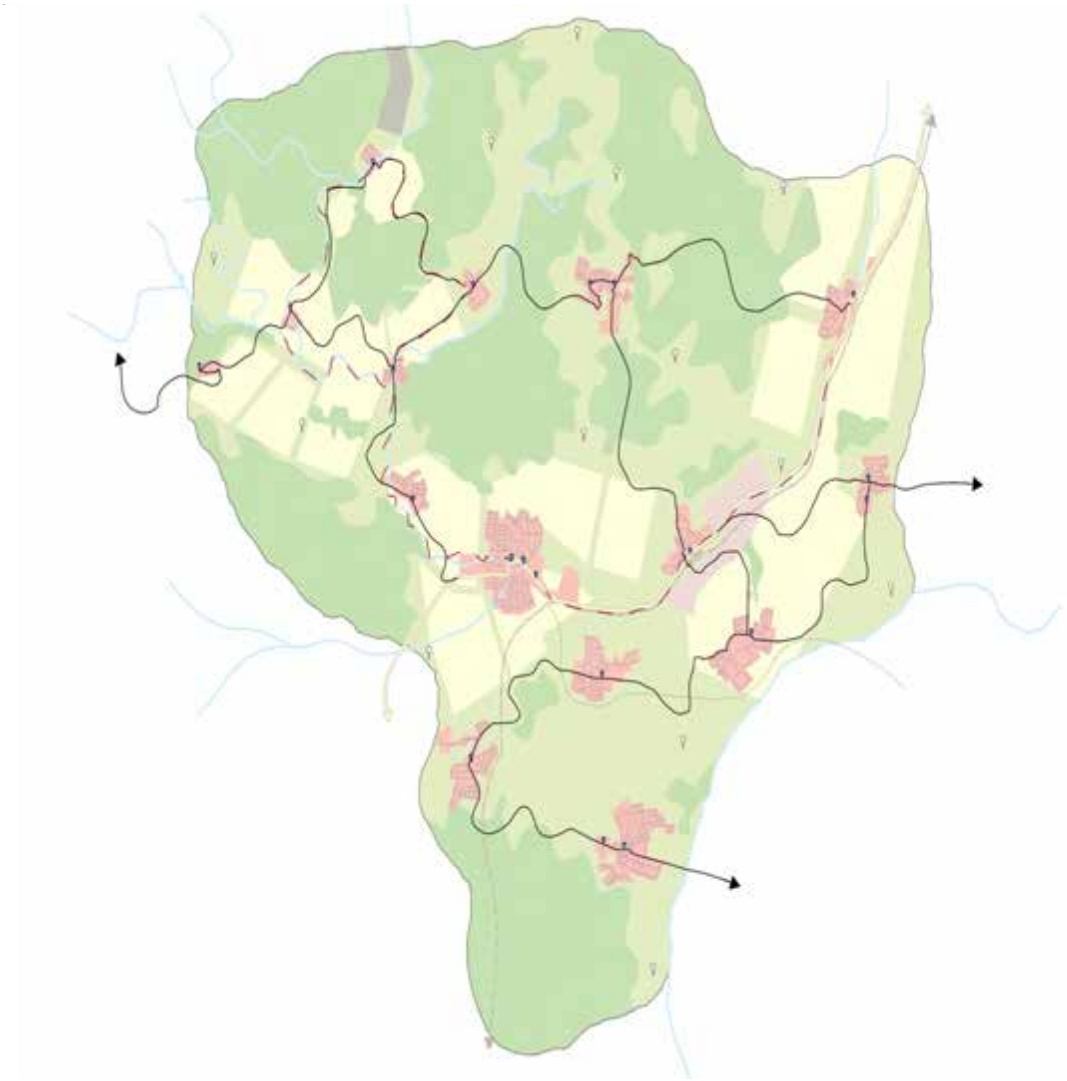


Fig. 11: Digital model of the Verbandsgemeinde of Zwirgberg without detailed settlement structures. Source: Authors 2024.

Settlement structures and their characteristics - Territory categories
In order to create realistic local structures based on settlement areas, it is first important to identify connections between settlement structures within the localities. To this end, the 15 localities are first divided into three "Territory categories":

• Territory category 1
Sprinkles to Drops in topographically higher locations
• Territory category 2
Cow spots as a string of pearls
• Territory category 3
Cow spots surrounded by agriculture or meadows

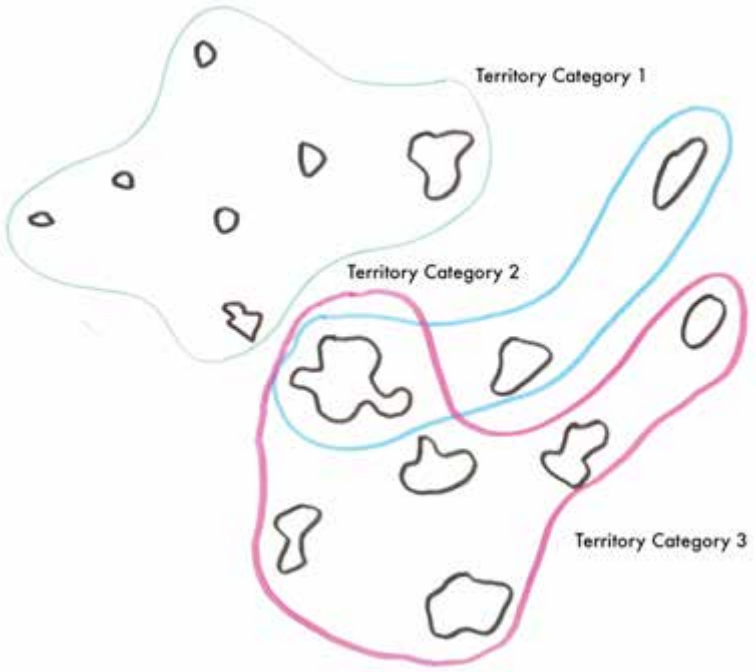
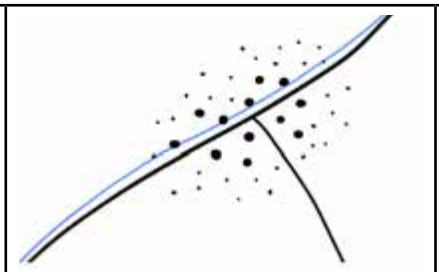
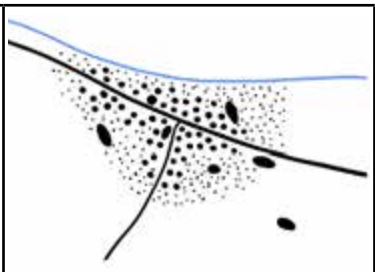
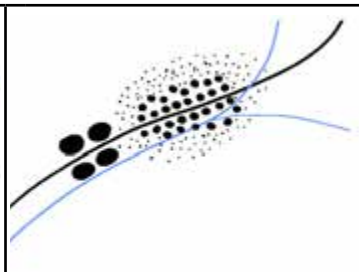


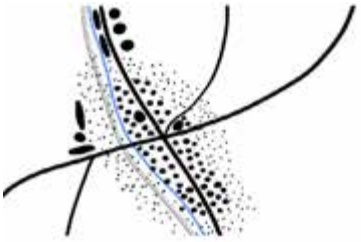
Fig. 12: Division of Territory Categories in the municipality of Zwirgberg. Source: Authors 2024.

Based on these categories, the eleven existing Verbandsgemeinden were analysed and examined for their local characteristics. Particular attention is paid to the town centre, the boundaries to the surrounding area, how the town has grown, how the single-family home areas are arranged, where waterways run, what typologies are present, how the transportation infrastructure runs and what uses are located where and how.

Furthermore, the analysis examines how local structures have grown along waterways, surrounded by vineyards or surrounded by agriculture and to what extent they differ from one another. The analysis also distinguishes between main towns and secondary towns. Since the scattered settlements in the higher-lying areas of the analysed existing Verbandsgemeinden do not contain any Hauptorte, only Nebenorte can be analysed for Territory category 1.

Tab. 1: Settlement structures and their characteristics divided into the three Territory Categories and their respective characteristics in the areas town center, typology, traffic, infrastructure and waterways. Source: Authors 2024.

			
	Territory Category 1	**Territory Category 2**	
	Nebenorte	**Hauptorte**	**Nebenorte**
Town Center	Type 1: denser town center with a street village character, directly on the main road Type 2: looser town center, characterized by several groups of farms	Town center along the intersection of a state road Retail and supply along the town center	Compare with Hauptort
Typology	Single-family houses on both sides of the main road, which runs through the center of town. Mostly, there are no large single-family house areas in the smaller drops, but several (usually two) smaller ones	Single-family home areas border directly on the town center, without transition If commercial or industrial areas are present, they are located along major roads, railway lines, or bodies of water	Commercial enterprises are often located on the outskirts. Denser local structures can be seen along the main roads. Agricultural farms are often found on the outskirts. Type 1: The town develops elongated along the water. Type 2: The town developed as a cluster across the water.
Traffic	Mostly arranged in T-junctions Main road runs through the town center or directly past it	T-junctions Roads often run parallel to the watercourse	A country road or federal highway runs through the town. District roads connect the neighboring towns. The towns are partially divided and split in two by major roads.
Infra-structure	Sports fields are mainly located on the outskirts of town	Sports fields mainly on the outskirts of town School facilities available Market square near church and water, surrounded by main road	Compare with Hauptort

Waterways	Often run parallel to the roads	Type 1: Flows through the main town Type 2: Borders one side of the development Type 3: Recognizable branch of the water in the main town	Compare with Hauptort
			
	Territory Category 3		
	Hauptorte	**Nebenorte**	
Town Center	The town center stretches along the main roads. It is partially surrounded by waterways.	Along the main road in some cases, no clearly recognizable town center, but denser structures along the larger roads and less dense structures away from the main roads	
Typology	Commercial enterprises are located along the main roads or important transport links and mostly on the outskirts. Single-family residential areas adjacent to the town center are mostly laid out in a grid pattern.	Commercial enterprises on the outskirts along transport routes Agricultural farms are located slightly outside or adjacent to the outskirts of the town	
Traffic	Star-shaped traffic axes: State, federal, or district roads often converge at a roundabout.	Compare with Hauptort	
Infra-structure	Some isolated green spaces in the town. Educational institutions are often grouped together in one location in connection with a sports field and clubhouse. Most main towns have a hospital adjacent to the single-family home areas, which is often located on the outskirts of the town.	Volunteer fire department in the town center or on the outskirts	

Development of fictional municipalities

An analysis of settlement structure interdependencies was conducted and suitable structures were first sought from the eleven existing Verbandsgemeinden with the help of a GIS. The structures were color-coded according to their use: town centers, single-family home areas, multi-family homes, educational institutions, healthcare facilities, industry, commerce and agricultural farms.

In the subsequent phase, the GIS snippets were extracted and integrated to generate new settlements. This was done by printing them out, cutting them into smaller sections and "puzzling" them into new settlements. The composition of the locations was based on the identified connections and findings from the analysis phase. Following the integration of the snippets, they were transferred back to the GIS, along with the raster-based census data (as of 2011, the newest data available to this date) corresponding to the building structures. The existing street layouts were adopted and adjusted or expanded as needed.

Fig. 13: Students during the development process of individual settlements in Zwirgberg, cutting and puzzling the snippets of the selected segments. Source: Authors 2024.

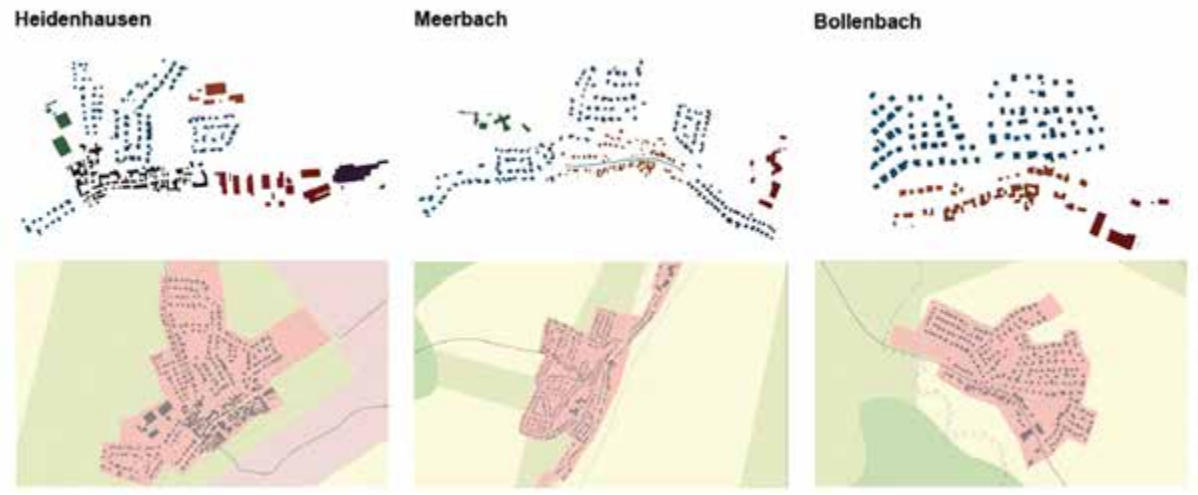


Fig. 14: Exemplary representation of three municipalities of the Verbandsgemeinde of Zwirgberg, once in their raw form consisting of snippets of different thematic categories and once integrated into the GIS. Source: Authors 2024.

Zwirgberg's Profiles

Following the completion of the digitization process for all 16 municipalities (15 Nebenorte and the Hauptort Zwirgberg), the subsequent phase involved the consolidation of the individual localities' identities. Since the local communities that had been developed only existed in their current state in the present, the first concern was to underpin them with a historic background to be able to better shape the future of the localities on this basis.

Based on the structure of the municipalities, open questions were formulated that could find their answers in the history of the places: Questions have been raised regarding the rationale behind the location of Strempelfeld, which is situated in a forested area, and the relative size of the town Zwirgberg in relation to the broader municipality.

In order to address these inquiries, a comparative analysis was conducted on the historical functions and origins of the eleven existing Verbandsgemeinden, which revealed a variety of patterns. The majority of the local communities were characterized by agricultural use, although there were also some forest clearing and craft settlements, mining and wine-growing villages, as well as industrial sites, mayoralties, trading centers, and monasteries or castles. In accordance with the categories delineated above, the fictional local communities are allocated to one of these categories, contingent on their geographical location and settlement structure.

Fig. 15: Characteristics. Source: Authors 2024.

In addition to the historical background of the fictional municipalities, further information was assigned to them (based, among other things, on the census data on file). This additional information included the following:
- Size of the settlement area and
- Population
- Local and regional connections
- Individual distribution of land use
- Distribution of open space and
- Leisure activities

This information can be found in respective profiles, such as the one shown below for the Verbandsgemeinde and the Hauptort Zwirgberg. The location of the municipality in the Verbandsgemeinde can also be seen in the illustration next to the name of the town. The illustrations appended to the profiles offer insight into the specific spatial configuration of the municipality.

Fig. 16: Profile for the entire municipality of Zwirgberg and, representing the profiles of all 16 local communities, an exemplary profile for the town of Zwirgberg. Source: Authors 2024.

5. Phase 3 - Developing Future Visions 2050

The development of scenarios is a central aspect of strategic future planning. As part of the "Kommune 2050" project, they were used to design different plausible development paths up to the year 2050 based on the fictional model community of Zwirgberg. The objective was not to provide exact forecasts, but rather to present a range of possibilities that existing Verbangsgemeinden in Rhineland-Palatinate can use as a guide. The scenarios are based on trends such as climate change, demographic change, digitalization, and the mobility transition. These developments have a profound impact on rural areas. The fictional Verbandsgemeinde of Zwirgberg is the result of a synthesis of the existing Verbandsgemeinden that were reviewed during the analysis. As a result, many of the ideas and visions realized in this fictional Verbandsgemeinde can also be transferred to the existing ones. This approach enables these Verbandsgemeinde to gather ideas or find inspiration without being subjected to specific criticism of their shortcomings.

Methodological approach to the scenario development

The scenarios were developed in close coordination with the previous phases of analysis, construction, and vision. Based on Zwirgberg's structures, three consistent futures were developed using narrative elements, trend syntheses, and graphic sketches. Using the GIS model, which contained real demographic and morphological data, iterative feedback enabled the scenarios to be precisely anchored in space. Participatory elements and critical reflections - such as those concerning the plausibility or scope of visionary proposals - complemented the methodological process.

To ease the transition into developing visions of the future, three phases were completed as part of a "Future Workshop" (Zukunftswerkstatt). During the 15-minute criticism phase, the municipality's weaknesses and risks were identified and noted. Next came a 20-minute utopia phase, during which future developments were designed without restrictions due to practical constraints to capture all wishes, dreams, and utopias. The concluding 25-minute implementation phase reviewed the utopian designs for feasibility and translated them into concrete, realizable projects.

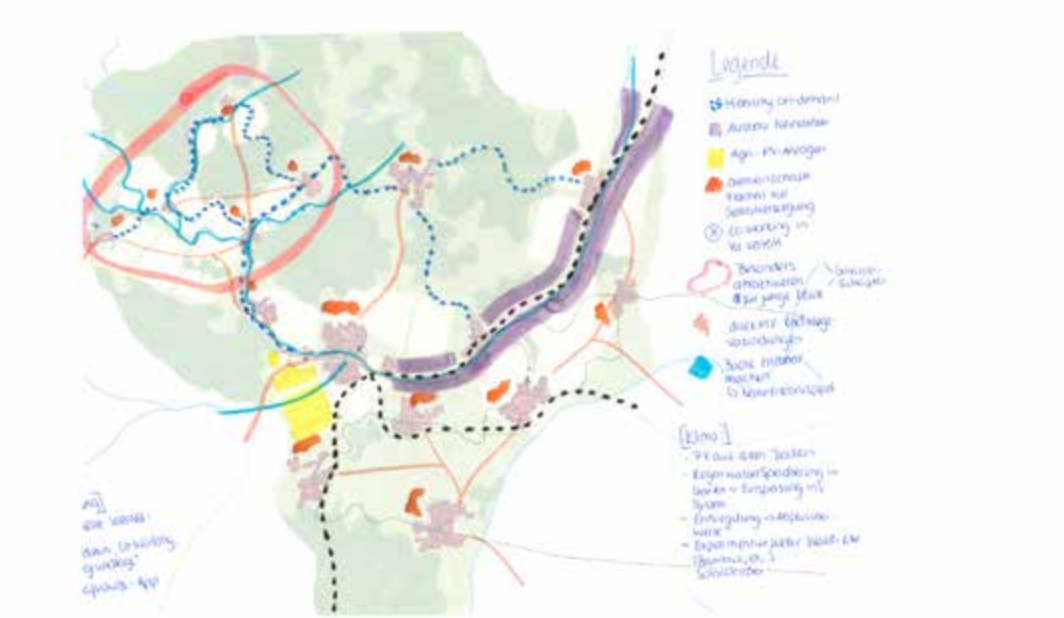


Fig. 17: Characteristics. Source: Authors 2024.

Three Scenarios for Zwirgberg in 2050

Based on current trends, the results of the 'Future Workshop', and Zwirgberg's existing potential, three visions of Zwirgberg's future were developed.

These visions are interconnected and mutually dependent. The visions 'Net Zero Tourism', 'Climate-Positive Zwirgberg', and 'Interconnected Community' contain core building blocks that can be implemented with the help of the developed tools. The cross-cutting themes of digitalization and mobility are reflected in all three.

A conceptual image was created for all three future visons, and corresponding areas of action and associated measures were developed for each. The conceptual image is provided for all visions; the detailed version, which includes the fields of action and measures, is only shown as an exemplary model in the case of vision a, but was also developed for the other visions.

The scenarios were not only designed as thought models, but systematically translated into concrete action paths. These include: the reactivation of vacant properties, the transformation of mobility infrastructure, the promotion of civic energy projects and digital inclusion. Thanks to the modular structure of Zwirgberg, these building blocks can be transferred directly to existing Verbandsgemeinden. Each Verbandsgemeinde can select the components from the Zwirgberg toolbox that suit its starting point and objectives.

A. Net-Zero Tourism

The future vision is predicated on the trends of mobility and climate change. The region's potential for hiking and cycling trails, the distinctive characteristics of the surrounding villages, and viticulture will be fully utilized. The Verbandsgemeindes distinctive selling point is its commitment to net-zero tourism. It is hypothesized that Zwirgberg will become an oasis for climate tourism. Measures such as the renaturation of the Meerbach stream, the introduction of new forms of mobility (autonomous shuttle buses, mobility stations, mobility on demand), and the expansion of the cycle path network will improve accessibility. The implementation of additional measures is expected to enhance the appeal of the towns and the broader municipality.

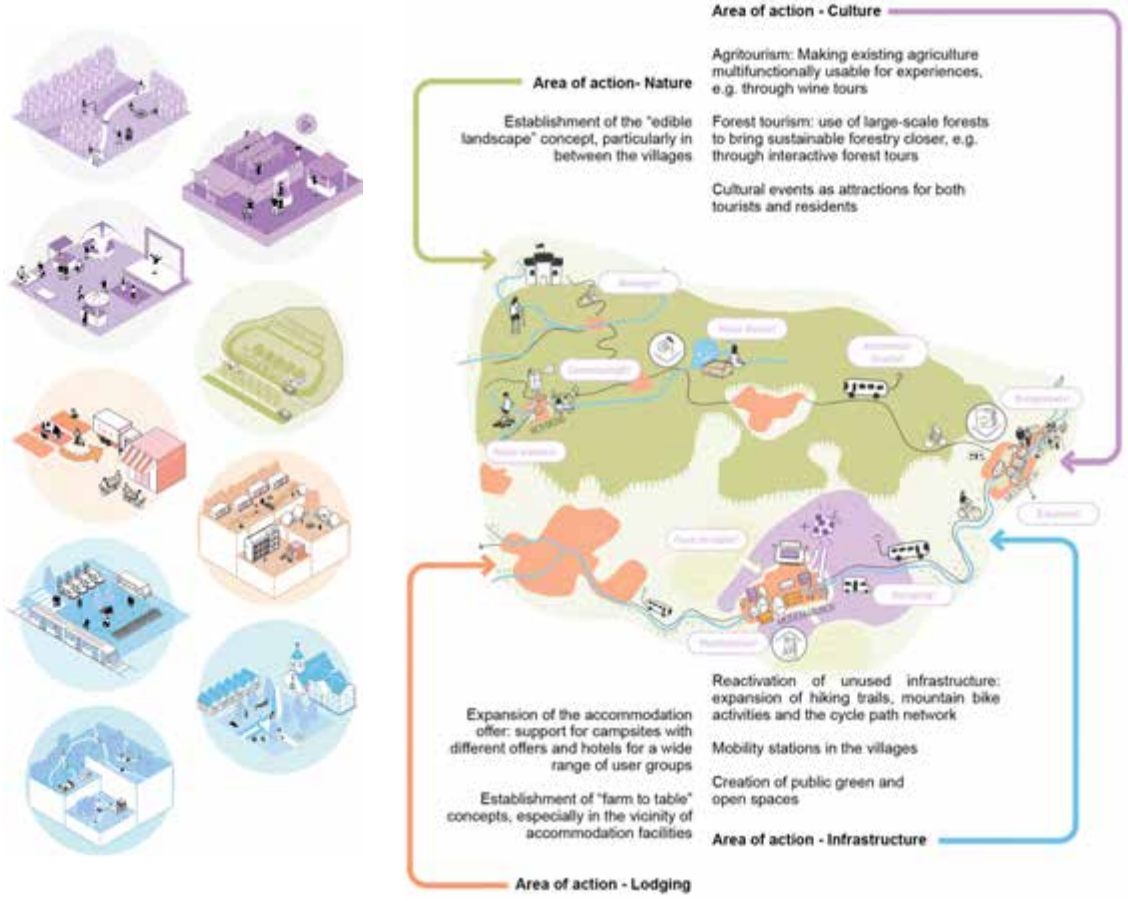


Fig. 18: Areas of action and the according catalogue of measures of the future vision 'Net-Zero Tourism'. Source: Authors 2024.

B. Climate-Positive Zwirgberg

This vision focuses on climate change, particularly extreme weather events, changes in biodiversity, the energy supply, and sustainable mobility. Forest structures, agriculture, wind turbines, and places such as Niederkalm are characterized by climate-adapted development. Zwirgberg aims to become climate-positive by 2050, surpassing the goal of merely achieving climate neutrality. This proactive approach to climate change is included in the vision for the future. The measures cover construction and housing, forestry, and agriculture.

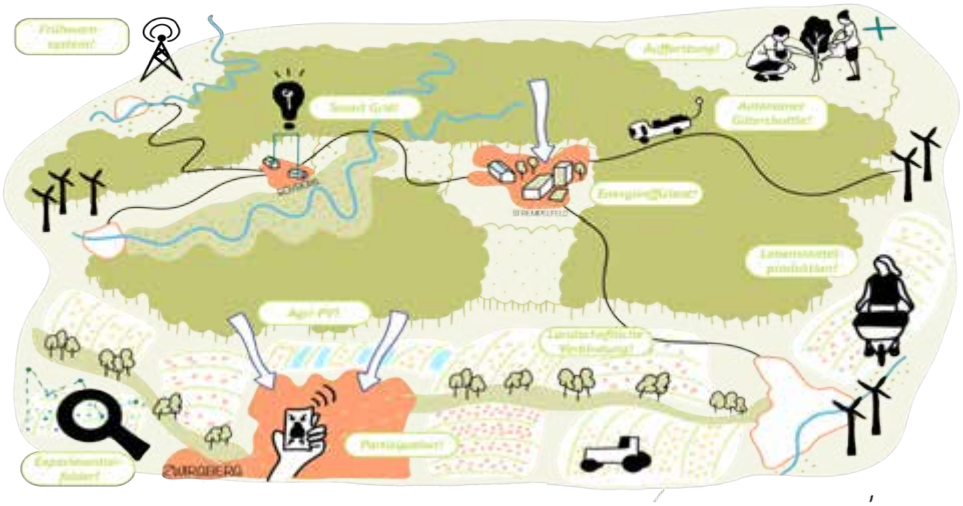


Fig. 19: The conceptual image of the future vision 'Climate-Positive Zwirgberg'. Source: Authors 2024.

C. Interconnected Community

Central to this vision is the reorganization of the administrative and supply structure. Zwirgberg becomes a federally cooperating community in which administration, social services, mobility, and education are networked via a digital platform. Shared infrastructure, shared resources, and hybrid co-working spaces form the basis of a new municipal governance model. Smaller local units retain their autonomy but benefit from the network character of the overall community.

Fig. 20: The conceptual image of the future vision 'Interconnected Community'. Source: Authors 2024.

6. Discussion and conclusion

The 'Municipality 2050 - The next Generation' research project demonstrates the potential of an experimental approach using digital, creative and analytical methods. The chosen approach of using a fictitious but realistic model municipality as a projection surface for future issues has proven to be a viable basis for reflecting on real development challenges.

The combined methods proved to be particularly effective: the combination of GIS-based analysis, modular settlement structuring, participatory scenarios and narrative elements enabled a high degree of reflection and connectivity. The creative and analytical work with real settlement fragments strengthened the transferability to real contexts. At the same time, the fictional nature of the model allowed for a certain degree of non-bindingness, which opened up scope for the municipal actors to selectively explore possible future options without political pitfalls.

Nevertheless, it is important to acknowledge the limitations of this approach: Transferability depends largely on the willingness of local authorities to embrace new ways of thinking. Methodologically, the approach also requires a certain degree of planning and data expertise in order to be able to interpret and use models, scenarios and spatial analyses. Collaboration with students proved to be a strength in this context, as their perspectives provided creative impetus, but also required a substantial degree of guidance and structuring.

The central realisation is that it is less about a 'right model' and more about a comprehensible and well-structured process of self-assurance and perspective building. Zwirgberg as a fictional but realistic model space offers a versatile framework for this. The further development now lies in transferring the reflection into real practice - with the Verbandsgemeinden, for which Zwirgberg can also be a mirror.

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