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Rural Polycentricity Through Rhizomatic Thinking

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Abstract

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This paper proposes a conceptual and methodological framework for interpreting rural polycentric development through the lens of rhizomatic thinking, explicitly grounded in the philosophy of Gilles Deleuze and Félix Guattari. Challenging conventional, hierarchical models, polycentricity is reframed as a non linear, relational, and emergent process in which spatial organization arises from interactions rather than predefined centers. Rural territories are conceptualized as adaptive networks shaped by continuous exchanges between actors, practices, flows, and meanings, often transcending administrative boundaries. Building on this theoretical foundation, the paper outlines a network-based analytical approach for identifying emergent “communities of influence” through GIS-supported spatial analysis and digital methodologies. By positioning rural planning as a knowledge

trading zone between continental philosophy, spatial analysis, and computational tools, the study contributes to more inclusive, adaptive, and context-sensitive understandings of polycentric territorial development.

Keywords: Polycentricity; Rhizomatic thinking; Relational spatiality; Rural networks; Territorial dynamics.

1. Introduction

1.1. The rhizomatic nature of territory

Rural and urban territories can no longer be understood merely as administrative or geographical spaces, but as living, rhizomatic, and hybrid structures in which residents’ experiences, collective memory, and shared emotions play an essential role. Drawing on poststructuralist thought, concepts such as rhizomatic thinking and the “fold” from Deleuze and Guattari’s philosophy offer a vision of the rural as a network of multiple meanings—one that does not follow a hierarchical order, but instead folds fluidly over natural configurations and lived contexts. This perspective suggests that the rhizomatic system is not entirely opposed to the hierarchical one; rather, they are complementary (Hillier, 2021).

Thus, the rural becomes a space of intersections, where the affective and subjective dimension (latitude—feelings, intensities) meets the material one (longitude—infrastructure, production, morphology). This supports a non-hierarchical approach to planning oriented toward parallel networks and fluid morphologies, in which territorial form “folds” around natural elements, collective memory, and socio-economic context (Grayling et al., 2022). The rural is an open space capable of adapting and transforming under the influence of the forces that traverse it. Within this framework, the rhizomatic map becomes a tool for nonlinear representation, revealing the relationships between emotions, places, and processes (Kairienė and Mažeikienė, 2024). Even cartography can be understood as a rhizome, open to creative experimentation and the transformation of its elements (Deleuze et al., 2007)

1.2. Critique of technocratic approaches

At present, territorial planning is primarily centered on technical and normative criteria, leading to an excessive formalization of public participation and a limited degree of genuine citizen involvement (Åström, 2020). This study addresses the “discursive monopoly” often held by institutional hubs and elite researchers by advocating for more inclusive, context-sensitive evidence. Current models often fail because they treat space as an “action container” rather than a manifestation of social relations in a constant state of transition. This paper proposes an applied exercise through a participatory GIS (PGIS) application to explore a new methodology for analyzing territoriality from a non-hierarchical and affective perspective. PGIS is vital for capturing location-specific human values, perceptions, and preferences regarding future developments (Fagerholm et al., 2021). Space is thus understood as a network of affective forces (Hutta, 2019). Participatory planning remains relatively new for post-socialist countries compared with Western Europe (Akmentina, 2023), largely due to administrative shortcomings (Slave et al., 2023). Even in Romania, early GIS-based systematic content analysis has only recently begun to address the needs of vulnerable groups (Grădinaru et al., 2023). This research seeks to bridge this methodological gap, moving from a “passive, geographic background” to a territory of innovation and resilience.

2. Materials and Methods

The present research adopts an interdisciplinary approach that bridges continental philosophy, qualitative citizen engagement, and advanced digital tools to enhance public participation in territorial planning. This methodology integrates a rhizomatic philosophical foundation, operationalizing Deleuzian concepts of multiplicity, "lines of flight," and assemblage into measurable spatial variables for planning. Within this framework, space is approached not as a hierarchical "tree-like" structure, but as an open field of interactions where "lines of flight" represent transversal connections that elude rigid administrative boundaries.

As a practical application of this "knowledge-trading zone," a participatory GIS (PGIS) application was developed for the initial stage of the General Urban Plan (G.U.P.) for 14 communes in Cluj County, coordinated by the Cluj County Council (HCJ 16/2022). This platform functions as a symbiosis interface, allowing users to access thematic maps and submit affective feedback, which is then stored in a centralized database for search and analysis by public employees.

The analytical core of the study relies on GIS-supported network analysis to identify emergent "communities of influence". This involves:

- Defining nodes and edges: nodes represent physical places, actors, or "points of affectivity" (place memory) identified through the entropy method, while edges represent interactions such as mobility and economic exchanges calculated via a gravity model.
- Algorithmic detection: The study utilizes modularity detection—specifically algorithms to isolate functional groups with strong internal cohesion where flow circulation is more intense than with the rest of the network.
- Statistical metrics: centrality coefficients are employed to measure the importance of specific nodes within informational or resource flows.

For digital GIS methodologies, the study employs tools like ArcGIS Network Analysis to visualize non-linear flows. This allows for the modeling of complex systems as dissipative structures that function far from equilibrium, where positive and negative feedbacks generate new emergent spatial configurations. To provide a faithful representation of morphological and functional realities, the methodology concludes by calculating accessibility isochrones and network density, identifying how socioeconomic variables degrade with distance from emergent centers.

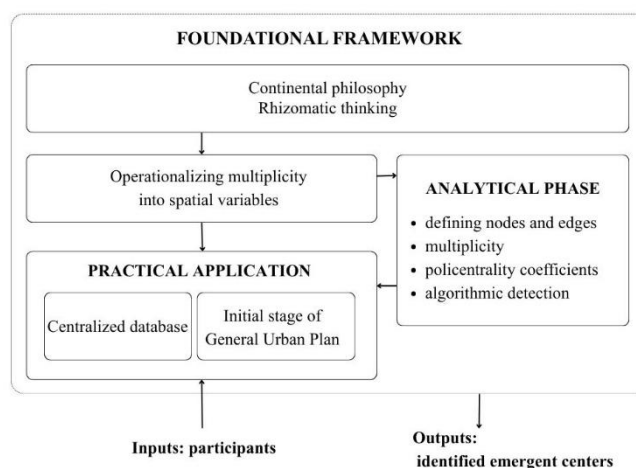


Figure 1. Rhizomatic thinking in territorial planning (Source: authors).

3. Results

Despite their lack of prior experience with digital public consultations, the local population demonstrated a remarkably rapid learning curve. This participatory process was structured in accordance with National Public Consultation Law No. 2701/2010.

3.1. Technical Infrastructure and the Base Map

To facilitate informed decision-making regarding their territory, participants were provided with a comprehensive base map. This map utilized an orthophotoplan as its foundation, offering a clear, objective, and easily recognizable spatial context.

The mapping interface integrated both static and dynamic data layers, organized into the following categories:

- Administrative Boundaries: UAT limits, cadastral boundaries, existing built-up area limits, and current General Urban Plan (PUG) zoning.
- Natural Areas: Forested lands, Natura 2000 sites, and protected areas of regional interest.
- Existing Infrastructure: Water supply, gas, electricity, and telecommunications networks.
- Environmental Constraints: Static layers indicating natural limitations, hydrography (rivers), and existing built-up surfaces.

3.2. Application design and functionality

The application's UI/UX was intentionally designed to be intuitive and engaging, adopting the logic of an interactive visual game to stimulate public engagement. To lower the barrier to entry, the platform was publicly accessible without the requirement of a user account. To ensure data integrity, submitted entries could not be deleted by users. Following the collection phase, the database underwent a rigorous cleaning process to remove errors, overlaps, and redundant records.

3.3. Dynamic Layers and Spatial Planning

The dynamic components of the map allowed users to actively contribute by plotting points, polylines, and polygons. These tools were strategically categorized to support multi-sectoral planning:

- Social & Residential Infrastructure: Assessing the equitable distribution of Education, Health, and Housing services.
- Economic Development: Identifying potential zones for Industrial and commercial activity.
- Environmental Stewardship: Planning for afforestation, erosion control, and green space expansion.
- Tourism & Leisure: Marking locations for camping, vacation homes, pontoons, viewpoints, and the expansion of tourist trails.
- Utilities Expansion: Assessing community needs for the extension of electricity, water, and gas networks.

3.4. Behavioral analysis: rhizomatic thinking in territory

A distinctive feature of the application was its transparency; while users remained anonymous, all contributions were visible in real-time, allowing participants to see live updates from others without the ability to interfere with their data. As illustrated in Figure 2 and Table 1, the results revealed a concentrated effort by the public on specific communes and dynamic layers, despite the lack of formal constraints. This behavior—where participation naturally clustered and expanded across conventional boundaries—serves as a practical demonstration of rhizomatic thinking applied to territorial analysis, showing how non-linear, self-organized networks of residents can effectively contribute to spatial planning.

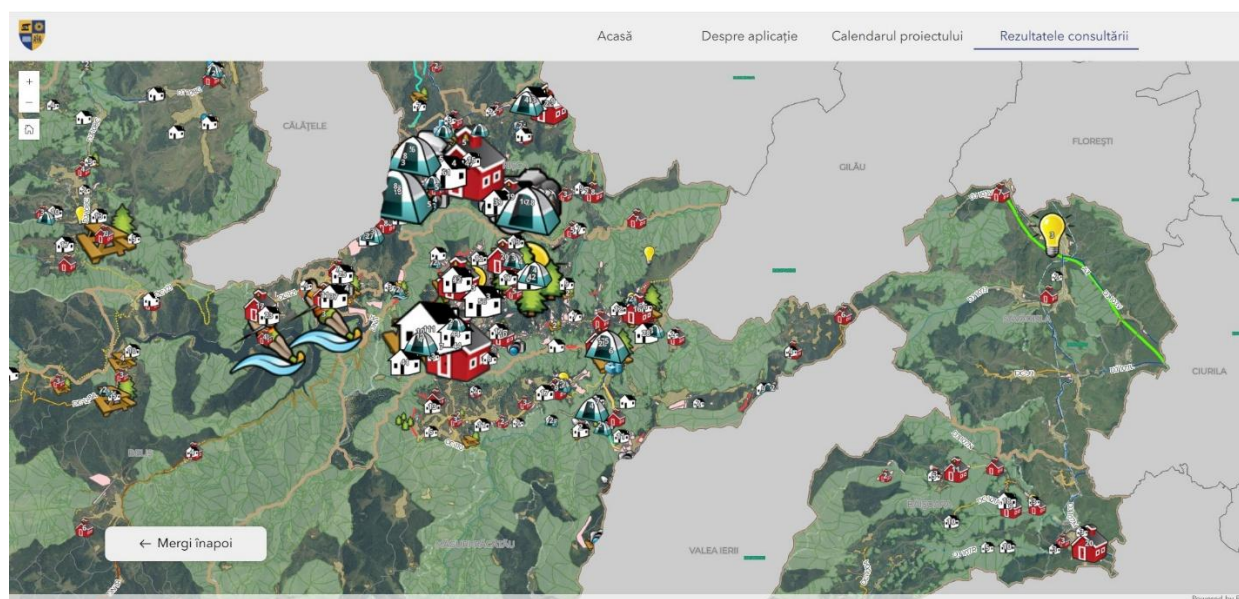


Figure 2. Results of public consultation (Source: authors).

Table 1. Quantitative results of the public consultation (Source: Authors).

Studied ATU/ Elements from the dynamic layers	Camping	Vacation housing	Education	Health	Housing	Industry	Reforestation	Dock	Viewpoints	Tourism	Others	Rural areas expansions (mp)
Băișoara	0	70	0	0	94	0	0	0	0	0	2	1,637,472.33
Beliș	2	101	0	0	47	0	0	6	0	15	0	1,739,106.71
Ciucea	4	1	0	0	1	0	0	0	0	1	0	225,453.84
Izvoru Crișului	0	0	0	0	2	0	0	0	0	0	0	0.00
Măguri-Răcățâu	9	102	0	1	31	2	3	0	7	9	1	2,981,062.97
Mănăstireni	0	9	0	0	2	0	0	0	0	1	0	91,336.40
Mărgău	3	65	2	0	16	3	1	0	3	11	3	405,993.07
Mărișel	22	490	0	0	160	0	6	0	7	52	12	11,715,879.75
Negreni	1	7	8	0	3	1	0	2	0	6	0	851,856.54
Poieni	2	7	0	1	18	1	0	0	0	3	1	693,053.06
Rîșca	33	275	0	2	156	5	0	1	39	16	5	4,976,331.70
Săcuieu	0	7	0	0	6	0	0	0	6	0	0	2,414.99
Sâncraiu	1	2	0	0	1	0	0	0	4	1	0	50,316.81
Săvâdisla	0	2	0	0	8	0	0	0	0	0	3	462,814.25
Total	77	1139	10	6	546	12	11	9	66	116	28	25,615,019.62

4. Discussion

The principal advantage of the application lies in its capacity to generate an affective and relational database structured around rhizomatic modes of spatial interpretation. Rather than relying exclusively on fixed physical points or conventional administrative boundaries, the method identifies and connects nodes of interest that extend across territorial limits and reveal broader patterns of socio-spatial interaction. In this sense, the application provides a more nuanced understanding of rural space, one that is not limited to formal jurisdictions but is instead informed by lived practices, investment intentions, mobility patterns, and emerging development pressures. In order to ensure compliance with Law no. 525/1996, Article 18, and to support the delineation of areas of significant community interest, the study aggregated all proposals associated with housing development. These included permanent residential uses, occasional or second-home housing, and tourism-related accommodation facilities. By consolidating these categories into a single analytical framework, the study was able to capture the full spectrum of residential demand, including both stable settlement intentions and more flexible, seasonal, or tourism-driven forms of occupation. This approach enables the identification of spatial concentrations of interest, which are interpreted as emergent demand hotspots. These hotspots indicate areas where development pressure is particularly intense and where future transformations of the territory are most likely to occur. As illustrated in Fig. 5, the resulting spatial distribution reveals zones in which housing-related proposals are clustered, suggesting the presence of strong market interest, increased land-use expectations, and potential pressures on local infrastructure, landscape quality, and community identity. The data are expressed as standardized units, or z-scores, calculated in relation to the mean density of housing demand points across the study area. This standardization makes it possible to compare different parts of the territory using dimensionless values that represent relative deviations from the average density. The analysis incorporates permanent, seasonal, and tourism-related residential interests, thereby offering a more comprehensive representation of housing demand. In this framework, negative values indicate “communities of influence” characterized by higher-than-average demand densities, while positive values correspond to areas with lower-than-average concentrations of development proposals. The methodological relevance of this approach lies in its ability to reframe rural spatiality as a non-linear, relational, and emergent process. Rural territory is therefore understood not as a static administrative surface, but as a dynamic field shaped by flows, interests, actor practices, and overlapping forms of territorial attachment. The identified areas of concentrated demand are not merely statistical anomalies; they represent territories subject to substantial developmental interest and should therefore be treated with particular care in future planning processes. Their capacity to sustain future development must be assessed in relation to infrastructure availability, environmental constraints, landscape sensitivity, community needs, and the long-term coherence of local spatial strategies.

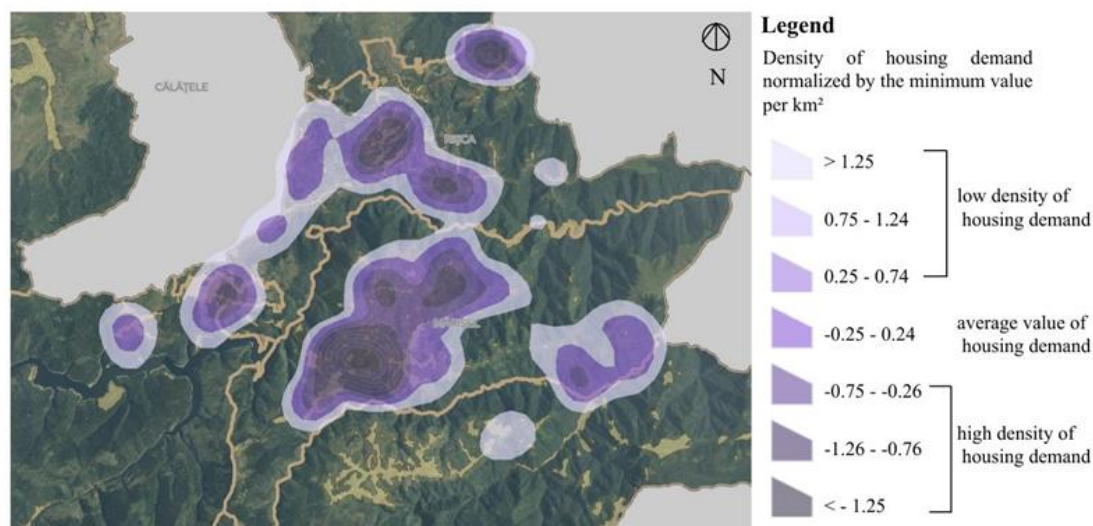


Figure 3. Density of housing demand (Source: authors)

5. Conclusions

This study demonstrates that territorial planning can be strengthened by moving beyond rigid administrative, technical, and linear interpretations of space toward a more relational and rhizomatic understanding of territory, in which rural areas are seen as dynamic systems shaped by flows, memories, emotions, development intentions, infrastructure, environmental constraints, and everyday practices. By integrating participatory GIS with concepts such as multiplicity, affective nodes, lines of flight, and communities of influence, the research proposes a methodological framework capable of transforming subjective territorial perceptions into spatially explicit and analytically useful data. The results show that public participation does not occur randomly, but tends to concentrate around specific areas of perceived value, need, opportunity, or pressure, revealing emergent demand hotspots that often transcend administrative borders. These concentrations are especially relevant in the context of housing, occasional residences, tourism accommodation, and rural expansion, where community interest and development pressure overlap. The study therefore confirms the value of GIS-based public consultation as an early diagnostic tool for identifying zones that require careful planning attention before regulatory decisions are finalized. It also shows that intuitive digital platforms can encourage meaningful participation even in communities with limited previous experience of online consultation, provided that the interface is accessible, transparent, and connected to recognizable territorial references. From a theoretical perspective, the research contributes to planning studies by operationalizing rhizomatic thinking in an applied spatial methodology. From a professional perspective, it offers public authorities a replicable tool for integrating citizen knowledge into General Urban Plan preparation and broader territorial strategies. The identified hotspots should not be interpreted simply as areas available for development, but as sensitive zones requiring integrated assessment of infrastructure capacity, accessibility, environmental vulnerability, landscape value, public services, and long-term settlement sustainability. Consequently, future planning policies should combine development opportunities with precautionary regulation, carrying-capacity evaluation, and community-based spatial design. Overall, the study reframes rural territory as an emergent field of relations rather than a passive geographic background, demonstrating that digital participatory tools can transform public consultation from a formal legal requirement into a meaningful evidence-based instrument for inclusive, adaptive, and context-sensitive territorial planning.

Acknowledgements

The public consultation application developed within the Cluj County Council and promoted by the Chief Architect, Mr. Claudiu Salanță, demonstrates the growing role of GIS-based digital tools in supporting participatory governance. By integrating spatial data with citizen input, the platform enabled a clearer understanding of territorial perceptions, local needs, and spatially differentiated feedback, offering decision-makers a valuable, evidence-based support instrument. The use of GIS not only enhanced the analytical depth of the consultation process but also improved transparency and traceability, strengthening the link between planning authorities and the public. From an ethical perspective, the application fully adhered to data protection standards. All collected data were anonymized, and user participation was conditional upon explicit consent in accordance with the GDPR Regulation requirements. This ensured that the consultation process respected privacy, minimized ethical risks, and reinforced public trust in the digital participation mechanisms. The combination of spatial intelligence, institutional backing, and ethical compliance positions this application as a replicable model for future GIS-enabled public consultation initiatives, particularly in contexts where inclusive and data-driven urban planning is a strategic priority.

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Conflicts of Interest

The author(s) report no conflicts of interest. An earlier iteration of this conceptual framework and its supporting visual data was previously disseminated at *Lucrările conferinței de cercetare în construcții, economia construcțiilor, urbanism și amenajarea teritoriului, Ediția a XXVIII-a*, pp. 5–12. ISSN 2393-3208., 2025 and at *10th Conference on Urban e-Planning*, 2026, to solicit preliminary peer feedback.

Data Availability Statement

The interactive platform used for data collection and public consultation is accessible at: <https://arcg.is/099HiW0>

Institutional Review Board Statement

This study utilized a Participatory GIS (PGIS) application designed for public consultation in the context of territorial planning. The platform was publicly accessible without the requirement of a user account. The data collection process focused on spatial proposals and affective feedback regarding territorial development rather than controlled human or animal experimentation. The public consultation process was structured based on the National Public Consultation Law No. 2701/2010 and coordinated by the Cluj County Council (HCJ 16/2022), ensuring legal and procedural compliance for urban planning activities.

CRedit Author Statement

According to the CRediT (Contributor Roles Taxonomy), the authors' individual contributions to this study are distributed as follows: First Author: Conceptualization; Methodology; Investigation; Data Curation; Software; Visualization; Writing – Original Draft. Second Author: Writing – Review & Editing; Validation; Supervision. All authors have read and approved the final manuscript.

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