

Regulation, Monitoring, and Community Governance in the Protection of Romanian Rural Cultural Landscapes

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Abstract. This paper examines how modern investigation and modelling tools for the rural cultural landscape - discussed in a companion paper dedicated to Building Information Modelling (BIM) and Heritage BIM (HBIM) - can substantiate a sustainable intervention strategy, be monitored once implemented, and be embedded within a participatory model of community governance. The paper argues that the transition from investigation to intervention requires an explicit correlation with the three pillars of sustainable development, and that monitoring remains the least developed component of integrated rural cultural landscape management, both internationally and in Romania. Drawing on international heritage-monitoring mechanisms (UNESCO, IUCN) and on structural-monitoring case studies, the paper proposes a realistic, tiered monitoring approach for protected rural areas. The second half of the paper addresses an integrated approach to community inclusion through Public Participation GIS (PPGIS) and the institutional and legal governance of the data generated by these processes. The paper concludes with a set of methodological directions - a working hypothesis, a case-study correlation matrix, and anticipated limitations - intended to guide the empirical validation of the proposed framework, and situates its findings within the broader legislative and policy context of Romanian and European rural development.

Keywords: Rural Cultural Landscape, Heritage Monitoring, Sustainable Intervention, Public Participation GIS, Data Governance, Protected Areas, Community Participation, Romania

1. Introduction

The companion paper "Modern Tools and Methods for the Digital Investigation of Romanian Rural Cultural Landscapes: From Data Acquisition to Heritage BIM" identified and systematized the modern tools for the digital investigation of the Romanian rural cultural landscape, from the acquisition of historical and current data to Building Information Modelling (BIM) and Heritage BIM (HBIM) models, while also examining their impact on rural communities through a SWOT analysis. This paper continues that effort, shifting the emphasis from the technical instrument to the process through which it becomes a sustainable, monitored, and participatorily governed intervention strategy.

The first author's ongoing doctoral research on the Romanian rural cultural landscape identified, during its theoretical stage, the principle that the sustainability of an intervention requires an explicit balance between the three pillars of sustainable development - economic, social, and environmental (World Commission on Environment and Development [WCED], 1987) - and the preservation of the targeted community's landscape identity (Stobbelaar & Pedrolí, 2011). This paper applies this principle to three concrete components of the planning process: monitoring interventions in protected areas, the economic sustainability of digitalization strategies, and the participatory governance of collected data.

The paper follows three directions. Section 2 discusses the transition from investigation to sustainable intervention strategy, focusing on the monitoring of projects in protected areas and the economic sustainability of these strategies. Section 3 examines the integrated approach and community inclusion, through PPGIS-type digital participation instruments and data governance. Section 4 proposes the methodological directions for the empirical validation of the entire

framework, including the research hypothesis, case-study selection criteria, and anticipated limitations. The paper concludes with a glossary of terms and a summary section.

2. From Investigation to Sustainable Intervention Strategy

2.1. From Data to Strategy

The investigation instruments discussed in the companion paper - from data acquisition to BIM/HBIM models - do not constitute an end in themselves, but a means of substantiating a sustainable intervention strategy for the rural cultural landscape. The transition from investigation to strategy requires an intermediate evaluation stage, in which the collected and structured data is weighed against sustainable development objectives: the balance between the economic, social, and environmental pillars, the preservation of landscape identity, and the maintenance of the community's social functions.

A complete BIM or HBIM model, correlated with GIS data and urban planning documentation, allows for the prior testing of multiple intervention scenarios - for example, alternative restoration variants for a traditional farmstead, with differing visual and structural impact - before any of them is actually implemented. From a technical standpoint, such a model can directly support the environmental pillar, by simulating the energy impact of different intervention solutions, and the economic pillar, through more precise cost estimation. The social pillar - maintaining the community functions of the space - remains, however, harder to capture through a purely technical model, which confirms the need for the integrated approach discussed in Section 3: without an explicit community-consultation component, even the most sophisticated technical model risks optimizing an intervention strategy according to incomplete criteria.

2.2. Monitoring Intervention Projects in Protected Areas

Monitoring is the least developed component of integrated rural cultural landscape management, both at European and Romanian levels. Internationally, UNESCO's reactive monitoring mechanism requires signatory states to inform the World Heritage Committee of any restoration or construction project that could affect the outstanding universal value of a protected site, ideally before the basic project documents are drafted (UNESCO World Heritage Centre [WHC], n.d.). A complementary mechanism, managed by the International Union for Conservation of Nature (IUCN) for natural sites, produces annual reports on the conservation status of approximately 60 sites, based on information provided by states, field missions, and the international network of experts (IUCN, 2025). Although these mechanisms were designed for World Heritage sites, their basic principles - prior notification, independent technical assessment, periodic reporting - remain applicable, by analogy, to protected areas of national or local interest, even if at a much smaller institutional scale.

At the scale of an individual construction site, real-time structural monitoring techniques - deformation sensors, vibration and ground-settlement monitoring - allow for the early identification of risks to buildings adjacent to an active site. A recent case study on the protection of a protected masonry historic building located near an excavation demonstrated that a composite shoring scheme, combined with continuous monitoring, can limit the settlement of the protected structure to values on the order of 2.4-3.1 millimeters, well below the threshold considered critical for damage (Wang et al., 2025). Correlating such structural monitoring data with the HBIM model of the protected construction theoretically offers an integrated monitoring solution, in which deviations observed on site can be visualised directly within the digital model of the construction.

A concrete example of this integration is the deterioration-mapping project through HBIM applied to the façade of the Church of St. Francis of Assisi in Ouro Preto, Brazil, where the digital model of the building was used directly to support cultural heritage risk management, through a deterioration map integrated into the three-dimensional model of the façade. A complementary, less costly monitoring direction than permanent structural instrumentation involves periodic monitoring through unmanned aerial vehicle (UAV) photogrammetry, repeated at regular intervals

- for instance, annually - for extensive protected areas, where instrumenting every individual construction would be disproportionately costly. Automatically comparing successive three-dimensional models, generated from repeated flights, can reveal subtle changes - progressive roof degradation, unauthorized extensions, deforestation in the visual protection zones of rural ensembles - that would otherwise go undetected between occasional physical inspections by heritage protection authorities.

For the Romanian context, such integration remains, for now, more aspirational than current. The absence of a national methodology for the digital monitoring of interventions in protected areas is reflected, at the individual construction-site scale, in the absence of standard structural monitoring requirements associated with building permits issued for listed properties or those located in protection zones. Formulating such standard requirements, possibly correlated with the obligation of a minimum HBIM model for interventions on protected rural heritage, constitutes a recommendation direction that the doctoral research can propose.

2.3. Economic Sustainability of Intervention Strategies

The economic dimension of a sustainable intervention strategy deserves separate discussion, given the central role accorded to the balance between the economic, social, and environmental pillars of sustainable development. The cost of complete HBIM documentation for a protected rural ensemble varies significantly depending on the geometric complexity of the buildings, the area covered, and the level of detail required (Level of Development, in ISO 19650 terminology). For a single, small-scale property, the cost can remain accessible to a motivated private owner, especially if documentation is carried out as part of a university research project or a public funding scheme; for an extensive ensemble, such as a village core, the cumulative cost can become prohibitive without a dedicated funding source.

This observation suggests a rational economic prioritization strategy: allocating limited resources for the digitalization of rural heritage should follow a combined criterion of heritage value and imminent risk, rather than a simple chronological or geographical order. A property with high heritage value but exposed to imminent risk of degradation or unauthorised intervention should receive priority over a similarly valued property located in an area with reduced development pressure and, therefore, a longer time horizon for documentation. Formalizing such a prioritization criterion, as an explicit methodology, suggests a further research direction.

3. The Integrated Approach: Digital Community Participation and Data Governance

3.1. Digital Public Participation

In this paper, community inclusion in the planning process takes on a specific instrumental dimension: Public Participation Geographic Information Systems (PPGIS). The term was coined in 1996, at a meeting of the National Center for Geographic Information and Analysis in the United States, to describe how GIS technology can support public participation across a variety of applications, with the goal of broader public inclusion and empowerment in decision-making processes (Sieber, 2006).

PPGIS combines "hard" spatial data with "soft," subjective information - residents' experiences, behaviors, and local attachments to particular places (Sieber, 2006). Studies applied in Finnish urban planning show that using interactive maps in public consultation processes can improve the quality of participation, while also signalling important limitations: not all categories of residents participate equally in such digital exercises, and the results of participatory mapping require careful interpretation to avoid hasty conclusions (Kahila-Tani et al., 2019). An early application of the method, in the preparation of Helsinki's general plan, demonstrated the feasibility of integrating participatory data directly into planning decision-support tools (Kahila-Tani et al., 2016), while a synthesis of research priorities in the field confirms the need for more rigorous methodologies for analyzing collected participatory data (Brown & Kyttä, 2014). More recent PPGIS applications, developed for assessing the social impact of infrastructure projects, show the

method's potential to integrate landscape values directly into the impact-assessment process (Mapping What Matters, 2025), while studies dedicated to urban green infrastructure confirm the method's added value for green-space planning (Rall et al., 2019).

For rural local administrative units (LAUs), applying PPGIS could directly support the public consultation stages already mandatory under Law No. 350/2001, in the process of preparing urban planning documentation. Instead of simply displaying plates at the town hall - a practice still dominant in many small LAUs -, a simple PPGIS-type digital platform would allow residents to mark, directly on a map, places of identity value to them, comments on zoning proposals, or concerns related to a specific intervention project. Practical implementation of such a platform does not necessarily require a major technological investment: the technical complexity of configuring a simple digital consultation remains considerably lower than that of the instruments discussed in the companion paper, such as GeoBIM or complete HBIM models, which suggests a possible sequencing of technological investments for a resource-limited rural LAU.

3.2. Data Governance and Institutional Interoperability

Effective community inclusion requires, however, more than the availability of a technical platform. Governance of collected data - who administers it, how long it is retained, who has access to it - constitutes a precondition often neglected in technical implementations of digital participation. Information about residents' attachment to particular places, although seemingly harmless, may affect property values or the interests of local economic actors, which is why responsible management remains essential. Institutional interoperability, in turn, adds a governance dimension: for data collected through a participatory process to effectively influence planning decisions, it must be capable of being integrated directly into the local public authority's workflow, not merely archived separately, as a purely formal consultation. A final governance dimension concerns intellectual property and public access to the generated digital models. A complete HBIM model of a protected rural ensemble represents, potentially, a significant investment of public or private resources; the legal regime of public access to such a model remains, at present, insufficiently clarified in Romanian legislation. Clarifying this legal regime - possibly through a standard open-licensing requirement for digital models produced with public funding - constitutes a further recommendation, consistent with the open-data principles promoted by international standards such as ISO 19650 (International Organization for Standardization [ISO], 2018) and with practices already established in the field of public geospatial data (National Agency for Cadastre and Land Registration [ANCPI], n.d.).

This section concludes that the integrated approach is not a separate stage, appended at the end of an otherwise complete technical process, but a principle that must traverse each of the stages discussed: from the initial acquisition of data, carried out, where possible, with the involvement of local community knowledge, to the final monitoring of the intervention, transparently communicated to the residents directly affected by it.

4. Methodological Directions for Empirical Validation

4.1. Research Hypothesis

This paper proposes a specific hypothesis, derived from the SWOT analysis conducted in the companion paper: the adoption of BIM/HBIM-type instruments for rural heritage is more likely to succeed when the digitalization process is initiated with a concrete, limited scope - for example, documenting a single heritage-value ensemble for a funding application - than when it is conceived, from the outset, as an exhaustive strategy for digitalizing an entire locality's built stock.

This hypothesis has a direct methodological consequence for how the success of technology adoption will be evaluated in the empirical stage of the research: success will not be measured by the scale of the digitalization initiative - the number of buildings documented, the area covered by the model - but by the degree to which the results of digitalization were actually used in concrete planning, approval, or funding decisions. A detailed HBIM model of a single property that directly

supported an approved funding application will be considered, within this evaluative framework, a more relevant success than an extensive GIS database that was never actually used in any concrete decision-making process.

4.2. Correlation with Case Studies

The empirical component of this methodological framework will be correlated with a case-study selection matrix combining three criteria: historical exposure to systematization, recent demographic trajectory, and the legal protection status of the area, to which a fourth criterion specific to this paper is added - the current level of technology adoption. Concretely, for each rural LAU selected as a case study, the research will document not only the legal-urbanistic framework and the general level of technology adoption, but also the presence or absence, locally, of any initiative - public or private - to digitalize the built heritage stock through BIM/HBIM.

The concrete instrument proposed for this component is an in-depth case study, carried out for at least one rural ensemble of heritage value, which effectively follows the integrated workflow proposed in the companion paper: from data acquisition through UAV photogrammetry, to the construction of a simplified HBIM model and its correlation with the urban planning documentation applicable to that area. The selection criteria for the pilot ensemble will need to balance its relevance to the rural cultural landscape theme with the practical feasibility of the exercise - physical access to the ensemble, the willingness of owners or the local authority to cooperate, and the reasonable geometric complexity of the targeted constructions.

4.3. Specific Methodological Limitations

Several limitations must be anticipated for this component of the research. The technical resources required for a complete scan-to-BIM exercise - laser-scanning equipment or specialized software licences - probably exceed the budget available for individual research, which will require either limiting the case study to a single, small-scale building or collaborating with institutions or companies that already possess such equipment. In addition, obtaining the consent of owners or local authorities for a digital documentation exercise cannot be assumed implicitly, but will require an explicit consultation effort, itself aligned with the principles of community inclusion discussed in Section 3.

5. Glossary of Terms

The glossary below defines the main concepts specific to this paper, complementary to those discussed in the companion paper dedicated to BIM/HBIM instruments.

Table 1. Glossary of Key Terms

Term	Definition	Main source
Reactive monitoring	UNESCO mechanism through which states report projects that could affect the value of a protected site.	UNESCO WHC
Scan-to-BIM	Process of converting data obtained through laser scanning or photogrammetry into a parametric BIM/HBIM model.	HBIM literature
PPGIS	The use of Geographic Information Systems to support and extend public participation in planning processes.	Sieber (2006)
Data governance	The set of rules and practices concerning the administration, retention, and access to collected data.	Specialized literature
Common Data Environment (CDE)	A centralised platform through which project actors access a single version of information.	ISO 19650 (2018)
Approval (aviz)	A binding technical act through which a competent institution expresses its position on a documentation.	CertificateUrbanism.ro

6. Conclusions

The synthesis presented in this paper outlines several main conclusions. First, monitoring interventions in protected areas remains the least developed component of integrated rural cultural

landscape management, both internationally and, especially, in Romania. Integrating structural monitoring instruments with HBIM models of protected buildings offers a promising, though as yet unexploited, technical direction in Romanian practice for authorizing and monitoring interventions on rural heritage.

Second, the economic sustainability of digitalization strategies requires a rational prioritization of available resources, based on a combined criterion of heritage value and imminent risk, rather than a simple chronological or geographical order.

Third, the integrated approach discussed in Section 3 confirms a central principle: no purely technological solution, however sophisticated, can substitute for the absence of functional local governance and authentic community participation. The instruments discussed in this paper - PPGIS, in particular - can support, but cannot replace, the institutional commitment necessary for genuinely participatory rural territorial planning.

Taken together, the two papers produced during this stage of the research present a coherent, cumulative argument. Enache's doctoral research has identified the rural cultural landscape as a complex object situated at the intersection of urban planning law, ecology, and collective identity. This understanding draws on the European Landscape Convention (Council of Europe, 2000) and the concept of landscape identity (Stobbelaar & Pedrolí, 2011). However, the rural cultural landscape remains insufficiently protected under the current Romanian legislative framework, which is fragmented across Law No. 350/2001, Law No. 5/2000, Law No. 575/2001, and Law No. 451/2002. These laws are not adequately coordinated, despite the preliminary theses of the Cultural Heritage Code explicitly acknowledging this fragmentation (Government Decision No. 905/2016). Sustainability, in the sense established by the Brundtland Report (WCED, 1987), and territorial resilience, defined by Holling (1973), provide the dual conceptual framework for understanding the necessary balance between conservation and development, while the concept of territorial capital (Camagni, 2009) links this conceptual discussion to the economic dimension.

The technologies capable of supporting better management of this landscape - from Geographic Information Systems to Local Action Groups discussed through the lens of the LEADER approach (EU CAP Network, 2023) and the Common Agricultural Policy (European Commission, 2023) - exist and are mature, but their adoption in the Romanian rural space remains conditioned on local governance capacity and the persistent rural digital divide (Institutul de Cercetare Făgăraș, 2022), more than on the technical availability of instruments such as GeoBIM (Al Furjani et al., 2020; Omrany et al., 2022) or territorial digital twins (Batty, 2018; Chioni et al., 2024). The same conclusion has been confirmed, from a heritage-regeneration perspective, by the literature on RURITAGE-type European projects (Conticelli et al., 2020) and by smart-village evaluation frameworks (Maja et al., 2020; Srivastava, 2020), as well as by concrete examples of Romanian rural agritourism, which demonstrate that the successful economic valorization of the rural landscape requires, equally, local authenticity and functional governance (Ciolac et al., 2021).

Together, this paper and the companion paper bring this discussion down to the scale of the concrete instrument - BIM and HBIM. Their findings reveal a consistent pattern: real technical potential, consistently documented including from the perspective of collaborative planning (Healey, 1997) and successive rural policy paradigms (OECD, 2018), but systematically limited by institutional factors. The European Union's *Territorial Agenda 2030* provides a common strategic framework within which these convergent findings gain meaning: development based on local specificity, capable of integrating both technological instruments and participatory governance (European Commission, 2020). At the national level, Romania's *National Strategy for Sustainable Development 2030* remains the programmatic framework into which the recommendations of this research stage should ultimately be integrated (Government of Romania, 2018).

The central hypothesis that emerges at the end of this stage is that a truly effective reform of Romania's urban planning legislative system, applied specifically to the rural cultural landscape, must act simultaneously on three levels - the normative, the technological, and the institutional - since isolated intervention on a single level, however well-intentioned, risks remaining without

practical effect in the absence of the other two. The protection of the rural cultural landscape remains an ongoing effort to balance spatial memory with the demands of contemporary life. Modern digital tools undoubtedly offer increasingly clear and precise images of the territory, but the direction in which we choose to intervene continues to depend on the clarity of our methodological reasoning and on the responsibility of a decision that remains, at its core, a political and cultural one.

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