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AN EVALUATION OF COMMUNITY KNOWLEDGE LEVEL ON SPATIAL UTILIZATION IN NGARGOYOSO SUB DISTRICT YEAR 2025

Sekar Ayu Sukmawati*, Gentur Adi Tjahjono, Pipit Wijayanti
Geography Education, FKIP, Universitas Sebelas Maret, Surakarta, Indonesia
* sekarayusukmawati713@gmail.com

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ABSTRACT

Land-use change in Ngargoyoso District has increased due to tourism expansion. Situated on Mount Lawu's slopes with high landslide susceptibility, improper spatial utilization and low public understanding of Spatial Planning escalate disaster risks. This study aims to analyze public knowledge levels regarding spatial utilization in landslide-prone areas and its influencing factors in 2025. The research employs a descriptive quantitative approach supported by explicit qualitative data. Primary data were obtained through semi-structured interviews with 99 heads of households selected via stratified random sampling. Qualitative data occupies an explicit position to contextualize quantitative findings, analyzed using the Miles & Huberman (1994) model. Results show public knowledge is generally low (80.8%), with Segorogunung and Jatirejo Villages in the moderate category. Factors such as education, licensing experience, and socialization access significantly influence knowledge levels. This research provides a scientific contribution by integrating spatial literacy into community-based disaster risk reduction, emphasizing that vulnerability is determined by both physical factors and legal-spatial understanding. It underscores the need for strengthened education and participatory supervision in spatial utilization.
***Keywords**: Landslide; Permit; Spatial Pattern; Spatial Plan; Spatial Utilization.*

A. INTRODUCTION

Ngargoyoso District is a prominent tourism hub in Karanganyar Regency, featuring iconic destinations such as Jumog Waterfall, Madirda Lake, and the Kemuning Tea Garden. Rapid economic growth in this region has triggered massive land-use conversion at elevations of 750–1,000 meters above sea level on the western slopes of Mount Lawu. The mountainous topography, characterized by steep slopes, renders the area highly susceptible to landslides. The urgency of this issue is evidenced by data from the Indonesian Disaster Information Database, which recorded 43 landslide incidents between 2020 and 2024, with a significant impact in 2024 that damaged 41 houses and displaced 76 residents. Despite these evident physical risks, development in hazardous zones continues to expand due to uncontrolled tourism expansion. This persistence of spatial violations suggests a lack of compliance with regional spatial planning, likely rooted in the community's limited knowledge regarding land-use zoning.

Ideally, landslide hazard assessment should serve as a fundamental instrument in disaster management and integrated spatial planning (Hadmoko et al., 2010 in Bucała-Hrabia et al., 2022). However, empirical evidence suggests that development in high-risk zones continues to expand due to inappropriate spatial planning and weak regulatory

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implementation (Glade & Crozier, 2005; Mateos et al., 2020). The discrepancy between spatial utilization and environmental carrying capacity exacerbates disaster risks, necessitating an in-depth analysis of human factors specifically public knowledge of spatial regulations as a key step toward effective disaster mitigation in Ngargoyoso District.

Satellite imagery analysis from 2010 to 2020 highlights a significant conversion of forest and plantation areas into tourism and residential zones in Ngargoyoso District, totaling dozens of hectares (Sanjaya & Kurniawan, 2021). This decline in production forests and tea plantations has been driven by the construction of restaurants, reservoirs, and natural tourism expansions that often overlook environmental carrying capacity. Such phenomena reflect complex conflicts of interest, where short-term economic objectives from the tourism sector clash directly with the protective functions of the landscape (Arisanjaya, 2021). Consequently, there is a widespread discrepancy between actual land use and the Regional Spatial Plan, characterized by the proliferation of buildings in protected and disaster-prone zones. This uncontrolled land-use conversion not only exacerbates urban sprawl but also systematically increases community vulnerability to natural disasters (Andari et al., 2022).

Discrepancies in spatial utilization within protected and buffer zones are not merely administrative violations; they represent ecological threats that increase land pressure and trigger ground movement. Suwanda (2018) identifies that such inconsistencies are often driven by socio-cultural factors, such as emotional attachment to ancestral land (*place attachment*), traditions, and economic constraints, all of which are exacerbated by low spatial literacy (Bucała-Hrabia et al., 2022; Akola et al., 2023). In Ngargoyoso District, this phenomenon is evident through recurring spatial violations in landslide-prone zones, indicating a significant gap between regulatory policies and community behavior on the ground.

This study examines these behaviors through the lens of the Theory of Planned Behavior (TPB) (Ajzen, 1991). Within this framework, knowledge serves as the informational foundation that shapes an individual's perception and intention to comply with spatial regulations. Public knowledge of regional zoning encompasses more than just technical understanding; it reflects educational background, access to information, and administrative experience in licensing. By operationalizing TPB, this research does not only measure the level of public understanding but also analyzes how these factors serve as predictors for community actions in selecting residential locations and constructing physical structures in high-risk areas.

Despite the extensive mapping of biophysical landslide risks in Ngargoyoso, a critical research gap persists regarding the extent to which public legal-spatial knowledge contributes to disaster vulnerability. Most mitigation studies focus on structural aspects, while community understanding of legal instruments such as the Spatial Plan as a form of non-structural mitigation remains largely overlooked. Consequently, this research is vital to evaluate public spatial literacy as a basis for formulating more representative and community-based disaster mitigation policies.

B. MATERIALS AND METHODS

This study was conducted in Ngargoyoso District, Karanganyar Regency (21.46 km northeast of the capital), employing a mixed-methods approach that combines descriptive-quantitative analysis with explicit qualitative support. The quantitative component evaluated public knowledge of spatial utilization through an 18-item questionnaire. Knowledge levels were categorized into low, medium, and high levels, adopting a 3-point Likert scale to align with the technical standards of PUPR Regulation No. 22/PRT/M/2007. This three-tier classification was purposefully selected to ensure the results are directly applicable to national spatial planning benchmarks and to minimize response style bias among rural respondents, as supported by Jacoby & Matell (1971) and Dolnicar et al. (2011).

Respondent selection utilized a stratified random sampling technique based on landslide susceptibility zones (low, medium, and high), totaling 99 heads of households. To address the reviewer's concern regarding spatial variations, the quantitative data were analyzed using descriptive-comparative analysis. This approach compares knowledge levels across different hazard strata to identify how geographical risk correlates with public awareness. Due to the proportional allocation of samples per village based on the Slovin formula, the classification ranges for knowledge levels were customized for each village. This adjustment ensures that the 'Low', 'Medium', and 'High' categories are statistically comparable across administrative boundaries, despite the varying number of respondents in each village.

Qualitative data were integrated as explicit support to explore the socio-economic and cultural drivers of knowledge levels, such as education, experience, and access to information, referring to indicators by Notoatmodjo (2003) and Suwanda (2018). These data were obtained through semi-structured interviews and analyzed using the Miles & Huberman (1994) model, which includes data reduction, data display, and conclusion drawing. Spatial validation was ensured through Google Earth imagery interpretation and a confusion matrix to verify the consistency between actual land use and spatial regulations

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with a minimum accuracy threshold of 80%. Secondary data were sourced from the Karanganyar Regency Spatial Plan, household statistics, and BPBD landslide hazard maps.

C. RESULTS AND DISCUSSION

Land use manifests human activities in utilizing the Earth's surface to fulfill livelihood needs, a concept intrinsically linked to land-use planning. This process involves organizing land utilization to align with spatial designations, environmental conditions, and community interests. Humans actively modify their environment converting land functions for residential, agricultural, infrastructural, and tourism purposes which, while generating socio-economic benefits, poses ecological challenges that require sustainable management.

a. Land Use Dynamics and Spatial Transformation

Analysis of multi-temporal Google Earth imagery from 2010 to 2025 reveals significant fluctuations in land cover across Ngargoyoso District, particularly within forest areas, tea plantations, and rubber plantations. Forest cover experienced a notable decline from 2,344.31 ha in 2010 to 2,155.09 ha in 2020 due to conversion pressures into residential and tourism zones. Although a recovery to 2,370.735 ha was recorded in 2025 through intensive rehabilitation programs, the prior decade of deforestation has left a legacy of slope instability in this landslide-prone topography. Similarly, tea plantations showed a consistent decline until 2020 as land shifted toward more profitable agro-tourism and residential activities. While the 2025 data (384.429 ha) suggests revitalization, field observations confirm that much of this "green" expansion is now integrated with tourism infrastructure, indicating that land-use dynamics are heavily driven by economic intensification which often conflicts with the protective functions designated in the Regional Spatial Plan. The dynamic changes is presented in **Table 1**.

Table 1 Changes in Plantation and Forest Areas in Ngargoyoso District.

No	Year	Tea Plantation (Ha)	Rubber Plantation (Ha)	Forest (Ha)
1	2010	341,097	417,696	2344,31
2	2015	317,321	404,727	2261,15
3	2020	299,165	318,992	2155,09
4	2025	384,429	511,943	2370,735

Source: Sanjaya & Kurniawan (2021) and Data Analysis (2025)

The most significant surge was observed in rubber plantation areas, which reached 511.943 ha in 2025. This increase was verified through high-resolution imagery interpretation and confirmed by field observations. Methodologically, the classification utilized key interpretation elements such as texture, hue, and association to distinguish rubber plantations from other vegetation types. To ensure data reliability and address potential anomalies, the classification underwent a spatial accuracy assessment using a Confusion Matrix. The results yielded an accuracy rate above the 80% threshold, consistent with established remote sensing standards. Field checks identified that this expansion is attributed to large-scale replanting programs and land intensification policies implemented since 2021, where young rubber trees (1–2 meters in height) have significantly expanded the measurable plantation canopy. These trends underscore a complex spatial transformation where economic-driven land expansion must be balanced with strict spatial regulation to mitigate landslide risks.

b. Landslide Hazard in Ngargoyoso District

Based on the 2025 Landslide Hazard Map of Ngargoyoso District issued by the Karanganyar Regency Disaster Management Agency **(Figure 1**), there are two categories of landslide susceptibility: moderate and high.

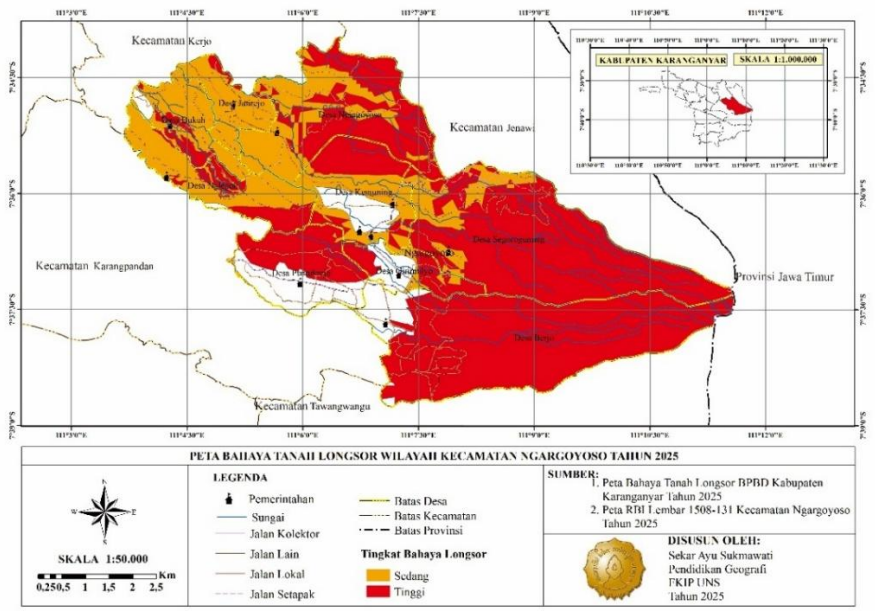


Figure 1. Landslide Hazard Map of Ngargoyoso District, 2025

The 2025 Landslide Hazard Map indicates that most of Ngargoyoso District is dominated by high-susceptibility zones, particularly in elevated eastern and southern areas adjacent to the slopes of Mount Lawu. This spatial pattern implies that a large proportion of existing settlements and agricultural activities are located within

environmentally vulnerable zones. The overlap between high hazard levels and intensive land utilization reflects a structural tension between environmental constraints and socio-economic needs, where communities continue to occupy risk-prone areas due to livelihood dependence, land inheritance, and limited alternative spaces.

From a spatial planning perspective, this condition reveals a gap between regulatory frameworks and actual land-use practices. Although the Karanganyar Regency Spatial Plan designates hazard-prone areas for controlled utilization, the persistence of development in high-risk zones suggests that spatial policies have not been fully internalized at the community level. Hazard zoning therefore functions more as a formal planning reference than as an effective instrument guiding land-use decisions.

Moreover, the uneven distribution of hazard zones indicates that safer areas for development do exist within moderate-susceptibility zones in the western part of the district. However, spatial utilization patterns show limited relocation or development shifts toward these relatively safer areas. This suggests that spatial decision-making is influenced not only by technical hazard considerations but also by socio-cultural attachment to land and economic practicality. Consequently, landslide hazard mapping in Ngargoyoso should be understood not only as a representation of physical risk but also as an indicator of the limited integration between disaster risk reduction and spatial planning implementation.

c. Level of Community Knowledge on Spatial Utilization in Ngargoyoso District in 2025

Sustainable spatial utilization depends not only on formal spatial planning documents such as the Regional Spatial Plan, but also on the level of public understanding as the primary actors in the field. Low community knowledge regarding spatial functions, zoning, and spatial-use regulations often contributes to spatial planning violations (Yulia et al., 2014), which may accelerate environmental degradation and disaster risk in landslide-prone areas such as Ngargoyoso District. The community knowledge level is detailed in **Table 2**.

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Table 2. Community Knowledge Level on Spatial Utilization in Landslide-Prone Areas in Ngargoyoso District, 2025

Knowledge Level	Number of Respondents	Percentage
High	9	9,1%
Medium	10	10,1%
Low	80	80,8%
Total	**99**	**100%**

Source: Data Analysis, 2025

Based on data from 99 respondents across nine villages, community spatial literacy remains predominantly low, with 80.8% categorized as low knowledge. Only 10.1% and 9.1% fall within medium and high categories respectively, indicating limited public understanding of spatial allocation and disaster-prone zoning. This pattern reflects uneven dissemination of spatial planning information and weak internalization of regulatory frameworks at the community level.

The scoring system applied in this study is not uniform across villages because classification ranges were normalized according to the number of respondents in each village using the Slovin-based proportional approach. This methodological adjustment ensures comparability within each village but also carries important analytical implications. The non-uniform scoring reveals that differences in total scores between villages should not be interpreted as absolute knowledge gaps, but rather as relative literacy conditions within each village context. Consequently, even villages with larger respondent numbers and higher development intensity such as Kemuning and Berjo remain categorized as low knowledge, indicating that spatial literacy deficiencies are structurally widespread rather than concentrated in specific demographic clusters.

The assessment of public awareness begins with establishing the classification ranges used to categorize community knowledge levels, as detailed in **Table 3**. Based on these parameters, the specific distribution of knowledge levels across villages in Ngargoyoso District is presented in **Table 3**, which reveals the varying degrees of understanding among local residents. To provide a clearer geographical perspective on these findings, the spatial distribution of these knowledge levels is further visualized in the map provided in **Figure 2**.

Table 3. Classification Ranges of Community Knowledge Levels on Spatial Utilization in Landslide-Prone Areas, 2025

Village	Classification		
	Low	Medium	High
Girimulyo	216-360	361-504	505-648
Berjo	270-450	451-630	631-810
Nglegok	216-360	361-504	505-648
Ngargoyoso	216-360	361-504	505-648
Kemuning	288-480	481-672	673-864
Puntukrejo	198-330	331-462	463-594
Dukuh	144-240	241-336	337-432
Segorogunung	90-150	151-210	211-270
Jatirejo	144-240	241-336	337-432

Source: Data Analysis, 2025

Table 4. Community Knowledge Levels on Spatial Utilization in Landslide-Prone Areas by Village in Ngargoyoso District, 2025

Village	Total Score	Respondents	Classification
Girimulyo	315	12	Low
Berjo	442	15	Low
Nglegok	349	12	Low
Ngargoyoso	337	12	Low
Kemuning	427	16	Low
Puntukrejo	296	11	Low
Dukuh	202	8	Low
Segorogunung	169	5	Medium
Jatirejo	254	8	Medium

Source: Data Analysis, 2025

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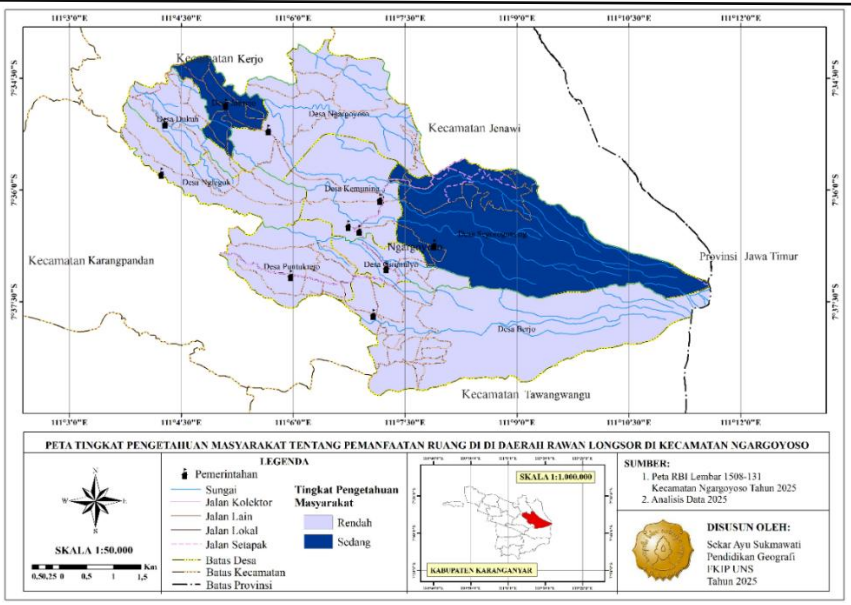


Figure 2. Map of Community Knowledge Levels on Spatial Utilization in Ngargoyoso District

This finding has direct implications for spatial governance. The persistence of low knowledge across villages with varying population sizes, economic functions, and hazard exposure suggests that spatial literacy is not determined by settlement scale or development intensity. Instead, it reflects systemic limitations in information dissemination, regulatory socialization, and community engagement. In practical terms, the non-uniform scoring highlights that spatial planning challenges in Ngargoyoso are spatially pervasive rather than localized, requiring district-wide rather than village-specific interventions.

Of the nine villages assessed, only Segorogunung and Jatirejo fall into the medium knowledge category, while the remaining seven exhibit low literacy despite being located within high landslide-susceptibility zones. This indicates that residing in hazard-prone areas does not automatically generate spatial literacy or regulatory awareness. Overall, these findings suggest that community understanding of spatial utilization develops more reactively than proactively, shaped primarily by practical needs rather than risk-based planning considerations. Therefore, strengthening spatial literacy should be positioned as a core component of community-based disaster risk reduction to ensure alignment between development practices and environmental carrying capacity.

These findings can also be further understood through the Theory of Planned Behavior (TPB), which posits that behaviour is shaped by attitudes, subjective norms,

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and perceived behavioural control. The widespread low spatial literacy across villages indicates that many residents lack the cognitive foundation necessary to form risk-aware attitudes toward spatial compliance. Limited understanding of zoning systems, licensing procedures, and hazard-based regulations weakens positive attitudes toward regulated land use and reduces normative pressure to follow spatial plans, particularly in villages where formal socialization is minimal. Furthermore, insufficient knowledge of administrative procedures lowers perceived behavioural control, as communities may perceive compliance with spatial regulations as complex and difficult to implement.

Within this framework, the persistence of low knowledge across villages with different demographic and spatial characteristics suggests that weak behavioural intention toward spatially compliant practices is structurally embedded rather than confined to specific localities. Strengthening spatial literacy therefore becomes essential not only for improving knowledge but also for shaping pro-compliance attitudes, reinforcing collective norms, and enhancing community capacity to implement spatial planning provisions in everyday land-use decisions.

d. Factors Influencing Community Knowledge Level

Community participation in spatial and environmental management cannot be separated from the level of understanding they possess. The community is no longer positioned merely as the object of development but as active subjects who have both the right and the responsibility to engage in every stage of planning and implementation. Knowledge is closely linked to the information that individuals acquire, whether through formal education or personal experience. The following section outlines the factors that influence the level of community knowledge are comprehensively identified and analyzed in **Table 5**.

Table 5. Factors Influencing Community Knowledge Levels on Spatial Utilization in Landslide-Prone Areas in Ngargoyoso District, 2025

Parameter	Category	Frequency	Total	Knowledge Level		
				Low	Medium	High
Age	<30	1	99	0%	100%	0%
	31-45	26		61,5%	26,9%	11,5%
	46-60	43		79,1%	9,3%	11,6%
	61-79	29		89,7%	10,3%	0%
Education	No School	8	99	100%	0%	0%
	Primary School	39		92,3%	7,7%	0%
	Junior High	23		95,7%	4,3%	0%

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Parameter	Category	Frequency	Total	Knowledge Level		
				Low	Medium	High
Information Source	Senior School	22	99	45,5%	40,9%	13,6%
	Higher Education	7		0%	28,6%	71,4%
	Never Received	73		94,5%	5,5%	0%
	Mass Media	11		54,5%	36,4%	9,1%
	Village Government	9		11,1%	55,6%	33,3%
	Village Government & Mass Media	4		0%	25%	75%
	DPUPR Karanganyar	1		0%	0%	100%
	Independent Consultation	1		0%	100%	0%
Ease of Access to Information	Easy	17	99	29,4%	29,4%	41,2%
	Never Accessed	82		86,6%	12,2%	1,2%
Socialization	None	92	99	81,5%	14,1%	4,3%
	During Certain Events	7		14,3%	28,6%	57,1%
Participation	Ever	5	99	20%	20%	60%
	Never	94		79,8%	14,9%	5,3%
Licensing Experience	Ever	9	99	0%	33,3%	66,7%
	Never	90		85,6%	12,2%	2,2%
Socioeconomic Status	Lower-Middle	88	99	80,7%	14,8%	4,5%
	Middle	11		45,5%	18,2%	36,4%
	Upper-Middle	0		0%	0%	0%

Source: Data Analysis, 2025

The findings can be further interpreted through the lens of the Theory of Planned Behavior (TPB), which posits that individual behaviour is shaped by intention, and intention is influenced by three key components: attitudes toward behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). In the context of spatial utilization in landslide-prone areas, community knowledge serves as a foundational element that shapes these three components simultaneously.

Education and socioeconomic status play a central role in forming attitudes toward spatial planning compliance. Individuals with higher educational attainment demonstrate better understanding of spatial regulations, licensing mechanisms, and disaster risk implications. This cognitive understanding fosters more rational and risk-aware evaluations of land-use decisions, resulting in more positive attitudes toward compliant spatial behaviour. Conversely, lower educational attainment tends to limit comprehension of regulatory frameworks, leading to the perception that spatial planning regulations are complex, distant, or irrelevant to daily needs. Within the TPB framework, this condition weakens the formation of positive behavioural attitudes toward spatial conformity.

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Socioeconomic status further influences perceived behavioural control, which refers to the perceived ease or difficulty of performing a behaviour. Communities with middle socioeconomic status possess greater financial and informational resources to comply with spatial regulations, such as processing permits or adjusting land use according to zoning provisions. As a result, they perceive spatial compliance as achievable and beneficial. In contrast, lower-middle socioeconomic groups often perceive spatial compliance as costly, administratively complicated, and less urgent than fulfilling immediate economic needs. This perception reduces their perceived control over spatially compliant behaviour, ultimately lowering their intention to adhere to spatial planning provisions. Thus, socioeconomic constraints do not merely limit knowledge but also shape the perceived feasibility realization of compliant spatial behaviour.

Access to information and socialization processes influence subjective norms within the TPB framework. Communities that receive regular socialization from village governments or access information through mass media are more likely to perceive spatial planning compliance as a socially endorsed and institutionally expected behaviour. This creates normative pressure that encourages conformity to spatial regulations. However, the limited frequency of socialization activities in Ngargoyoso weakens these subjective norms, resulting in spatial planning being perceived as an administrative requirement rather than a collective responsibility. Consequently, even individuals with moderate knowledge may lack strong normative motivation to apply that knowledge in practice.

Age and experience further interact with these TPB components. Productive-age individuals demonstrate higher digital literacy and broader exposure to spatial information, strengthening both attitudes and perceived behavioural control. Meanwhile, direct experience in managing land-use permits enhances perceived behavioural control by providing practical familiarity with regulatory procedures. Interestingly, disaster experience alone does not automatically strengthen behavioural intention toward spatial compliance. Although landslide events increase risk awareness, they do not necessarily translate into stronger intention to follow spatial regulations unless accompanied by adequate regulatory knowledge and institutional guidance. This indicates that experiential awareness of hazards is insufficient to shape behavioural intention without the support of cognitive and normative components.

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Overall, the results suggest that community knowledge of spatial utilization functions as a pre-behavioural determinant that shapes attitudes, subjective norms, and perceived behavioural control simultaneously. Education and socioeconomic status form the structural basis of knowledge acquisition, while access to information and socialization processes operationalize knowledge into behavioural intention. Within the TPB framework, improving community compliance with spatial planning in landslide-prone areas therefore requires strengthening not only knowledge dissemination but also normative reinforcement and perceived feasibility of compliant behaviour. Without addressing these interconnected components, increased knowledge alone may not translate into spatially responsible land-use behaviour.

D. CONCLUSIONS

Community knowledge of spatial utilization in Ngargoyoso District remains generally low, with only Segorogunung and Jatirejo reaching the medium category. Although most residents are aware of landslide risks and the consequences of improper land use, only a small proportion understand the Regional Spatial Plan, licensing procedures, and incentive–disincentive mechanisms. This condition indicates that spatial literacy is shaped by the interaction of education, socioeconomic status, administrative experience, and access to information.

Despite the contribution of direct experience and limited socialization, disaster-risk awareness does not automatically translate into regulatory and planning literacy. As a result, community understanding of spatial utilization remains reactive and fragmented, relying more on empirical experience than on formal spatial frameworks. This gap highlights the need to reposition spatial literacy as a central component of disaster risk reduction and spatial governance in hazard-prone areas.

From a policy perspective, local governments should prioritize decentralized and village-based spatial planning socialization, particularly in low-knowledge villages located within high-risk zones. Integrating hazard information, zoning regulations, and licensing guidance into routine village governance forums and community development programs would strengthen public comprehension and compliance. In addition, spatial planning policies should move beyond administrative regulation toward participatory and risk-sensitive approaches that actively involve communities in decision-making processes. Strengthening institutional coordination between spatial planning agencies, disaster management authorities, and village administrations is essential to ensure that spatial

utilization aligns with environmental carrying capacity and long-term risk reduction objectives.

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