A Structural Equation Modeling Approach to the Post-Slum Upgrading Policy Design: Empirical Evidence from Banjarbaru City, Indonesia

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ABSTRACT

Slum settlements remain a persistent challenge in the urban areas of Banjarbaru City despite various upgrading programs implemented over the past decade. This study aims to evaluate the key variables influencing post-upgrading outcomes and develop a policy framework for sustainable slum improvement, focusing on the Kemuning area as a representative case. Using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach, the analysis identified three significant variables affecting post-upgrading environmental and social conditions: infrastructure quality ($\beta = 0.408$, $p < 0.001$), green open space management ($\beta = 0.313$, $p < 0.001$), and water, wastewater, and solid waste management ($\beta = 0.321$, $p = 0.002$). The findings demonstrate that adequate infrastructure, well-managed urban green spaces, and effective resource management systems significantly enhance both environmental quality and community well-being after the upgrading phase. This study contributes to the development of an evidence-based policy design for sustainable slum transformation in mid-sized tropical cities, emphasizing the integration of environmental, infrastructural, and social dimensions in post-slum governance.

Keywords-slum settlements; post-upgrading policy; sustainable housing; SEM-PLS; Banjarbaru City

I. INTRODUCTION

Slum settlements, characterized by irregular building structures and substandard housing, remain one of the most persistent and complex global urban challenges. More than one billion people currently reside in slum areas worldwide, and this figure is projected to have risen to three billion by 2050 as unplanned urbanization accelerates [1]. Similar dynamics have been observed in rapidly growing cities such as Bandung in Indonesia [2], and Lahore in Pakistan [3], where informal settlements expand amid weak land governance and socio-spatial inequality. Beyond issues of inadequate housing and governance, research highlights that insufficient spatial planning and poor integration of environmental considerations exacerbate the vulnerabilities of informal urban development. Authors in [4] found that the absence of coherent spatial planning contributes to environmental injustice and unequal exposure to ecological risks, particularly among marginalized urban communities. Similarly, in [5], it was demonstrated how weak coordination between housing, spatial planning, and environmental management accelerates ecological degradation in informal settlements. These findings underscore that persistent slum conditions stem not only from economic poverty but also from systemic failures in spatial and environmental governance, requiring deeper theoretical attention to governance fragmentation, institutional capacity, and land-use regulation.

In Indonesia, urbanization has intensified land scarcity and driven the proliferation of informal housing along riverbanks, floodplains, and environmentally sensitive areas [2]. Consequently, slum formation reflects deeper structural weaknesses in spatial planning, land management, and environmental policy frameworks [3, 5, 6]. This challenge aligns with Sustainable Development Goal (SDG) 11, which seeks to make cities inclusive, safe, resilient, and sustainable [1]. As Indonesia's urbanization rate surpasses the capacity of cities to provide adequate housing, infrastructure, and employment, more than 57% of the population now lives in urban areas, with projections nearing 70% by 2045 [1, 2]. However, this growth remains unmatched by equitable access to serviced land and affordable housing [2, 3]. Escalating land prices and weak land-use control mechanisms have contributed to the expansion of informal settlements in riverine, peri-urban, and marginal areas [4, 6]. These trends illustrate a structural imbalance between demographic pressures and the institutional capacity of cities to regulate land markets, enforce zoning, and ensure environmental protection—elements increasingly emphasized in contemporary urban governance theory. The situation is further aggravated by the limited policy coordination between housing, spatial planning, and environmental management sectors, which often operate independently and without shared sustainability targets [5, 6]. Research has shown that fragmented sectoral governance significantly reduces the long-term effectiveness of upgrading programs, as cities focus primarily on infrastructure delivery while neglecting ecological resilience and community-based institutional strengthening.

Empirical assessments indicate that many urban improvement programs in Indonesia remain short-term and infrastructure-oriented, with limited attention to social and ecological resilience [5, 7]. As a result, upgraded settlements often experience environmental deterioration and social instability after project completion, highlighting the absence of a long-term sustainability framework. This condition reinforces the argument that slum upgrading should be conceptualized not merely as a construction-based intervention but as a socio–ecological transformation process requiring sustained institutional commitment and community co-governance. Such a shift aligns with broader theoretical frameworks on socio–ecological resilience, which emphasize the interplay between physical systems, ecological functions, and social institutions in shaping settlement sustainability. Banjarbaru City in South Kalimantan exemplifies the pressures faced by fast-growing, medium-sized cities in Indonesia. With an average annual population growth rate of approximately 4.1% over the past decade, the city has experienced rapid physical expansion without proportional infrastructure provision or effective spatial control [8]. According to data published by the Housing and Settlement Office (Disperkim) of Banjarbaru City [9], the Sungai Kemuning area, which includes the sub-districts of Kemuning, Sungai Besar, Guntung Paikat, and Loktabat Selatan, has long been categorized as a priority slum zone. Despite its location within the administrative core, the area displays socio-ecological characteristics that are typical of large urban slums. Field assessments show that while physical upgrading has improved basic infrastructure, these interventions have not ensured long-term environmental quality or community resilience. Persistent challenges include the degradation of open spaces, dependence on external assistance, and weak local institutional capacity [6, 10]. Research on riverbank urban systems in tropical environments further shows that poorly managed riparian landscapes accelerate ecological degradation and disrupt microclimatic functions, undermining the sustainability of post-upgraded settlements [10]. These insights further support the need for a policy design model that integrates ecological management, community capacity building, and institutional coordination as core pillars of post-upgrading sustainability.

Despite multiple national initiatives, most slum upgrading programs in Indonesia still lack a coherent framework for long-term sustainability. Evaluations show that the absence of systematic post-program management often leads to regression in environmental and social conditions [5, 7]. Within this context, the present study pursues two main objectives. First, it seeks to identify the key variables that significantly influence post-slum upgrading sustainability in the Sungai Kemuning area of Banjarbaru. Second, it aims to develop an empirically grounded policy design model that can serve as a strategic framework for local governments to enhance the effectiveness and resilience of urban settlement improvement programs. Conceptually, this study advances the theoretical discourse on urban policy design in tropical medium-sized cities by integrating governance, socio–ecological resilience, and spatial planning perspectives into a unified analytical framework. Practically, it provides insights for developing contextual, participatory, and adaptive urban policy frameworks in the post-slum upgrading context, with potential applicability to other secondary cities experiencing similar urbanization pressures.

II. METHODS

A. Research Design

This study employed a quantitative–descriptive research design to evaluate post-slum upgrading performance in Sungai Kemuning, Banjarbaru City, Indonesia. The approach combined empirical field observations and statistical modeling using SEM–PLS. The conceptual framework was developed from previous empirical studies on sustainable slum upgrading [5, 7]. The analytical model aims to identify how infrastructure quality and environmental management influence post-upgrading. The theoretical foundation was derived from the urban informality framework presented in [11], which highlights the systemic relationship between spatial informality and governance, and the empirical sanitation sustainability model described in [12], which emphasizes the integration of environmental and infrastructural management for long-term settlement resilience. In line with contemporary urban-governance theory, SEM–PLS was selected because it allows simultaneous estimation of multiple interdependent latent constructs, capturing the multi-dimensional interactions among physical, environmental, and social factors in post-upgraded settlements. This method is particularly appropriate for exploratory policy modeling in developing-country contexts, where theoretical pathways are evolving and empirical datasets typically involve moderate sample sizes and non-normal distributions.

B. Study Area and Data Collection

The study was conducted in the Kemuning River area, one of the principal post-upgraded settlements in Banjarbaru City, South Kalimantan. Figures 1 and 2 show the administrative map of Banjarbaru City and the research location along the Kemuning River. The location was purposively selected because it represents a dense, centrally situated urban zone that continues to experience environmental and social challenges despite previous upgrading interventions.

Fig. 1. Administrative map of Banjarbaru City, South Kalimantan, Indonesia.

Figure 3 illustrates the slum settlement conditions along the Kemuning River. The Kemuning River area was selected because it represents a persistent post-upgraded settlement with visible environmental regression, making it a representative and analytically suitable case for testing post-upgrading sustainability models in medium-sized tropical cities. Figures 4 and 5 depict the settlement conditions before and after the upgrading intervention. The identification of this area was based on official records from BPS Kota Banjarbaru (2023) [8] and Disperkim Kota Banjarbaru (2020) [9], both of which classify Sungai Kemuning as a priority area for settlement quality improvement. Data collection was carried out through field observations (assessing infrastructure conditions, drainage, sanitation performance, open-space functions, and environmental management) and through structured questionnaires administered to 120 households involved in upgrading programs between 2014 and 2023. A proportional random sampling strategy ensured adequate representation across the four sub-districts of Kemuning, Sungai Besar, Guntung Paikat, and Loktabat Selatan. Sampling adequacy followed established SEM–PLS standards, which propose 10–20 observations per indicator depending on model complexity, confirming that the sample size was sufficient for stable estimation of parameters and model robustness [13]. All field activities adhered to the Regulation of the Minister of Public Works and Housing of the Republic of Indonesia No. 14/PRT/M/2018 concerning the Implementation of Housing and Settlement Quality Improvement [14].

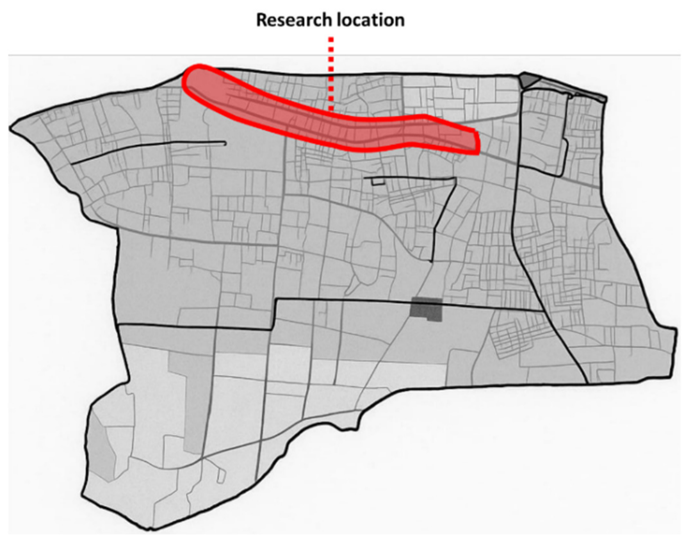

Fig. 2. Research location in slum area around Kemunig River.

Fig. 3. Slum area in the Kemuning River.

Fig. 4. Pre-evaluation of slum settlements.

Fig. 5. Post evaluations of slum settlements.

C. Variables and Measurements Indicators

The analytical framework consisted of three latent constructs representing key dimensions of post-slum upgrading performance: Infrastructure quality (X_1) included indicators related to building condition, road access, drainage systems, and water-supply facilities. Environmental management (X_2) encompassed solid-waste handling, wastewater treatment, and green-open-space maintenance, reflecting the ecological services essential for sustainable settlement functioning. Post-upgrading sustainability (Y) captured social interaction, environmental health, and resident satisfaction as measures of long-term community well-being. All indicators were measured using a five-point Likert scale (1 = very poor to 5 = very good) based on respondent perceptions supplemented by on-site validation. The theoretical integration of these constructs was guided by the spatial-informality framework [11], which emphasizes governance and institutional dimensions of slum formation, and by the environmental–sanitation resilience framework [12], ensuring that the model captures both socio-governance and ecological determinants of post-upgrading sustainability. This theoretical anchoring clarifies the conceptual basis of each variable and strengthens the linkage between latent constructs in the SEM–PLS model, directly addressing the reviewer's request for greater conceptual depth.

D. Data Analysis Using SEM-PLS

Data were analyzed using SEM–PLS implemented in SmartPLS 4.0. This method was selected because it is well suited for complex models involving multiple latent constructs and non-normal data distributions, which characterize community-based settlement studies. The analysis followed the standard two-stage procedure consisting of measurement model and structural model evaluation. The measurement model assessed indicator reliability through Cronbach's alpha and composite reliability values exceeding 0.7, while convergent validity was examined using Average Variance Extracted (AVE > 0.5). Discriminant validity was confirmed using the Fornell–Larcker criterion and the HTMT ratio [15]. The structural model evaluation included estimating path coefficients (β), significance levels ($p < 0.05$), and the coefficient of determination (R^2) to measure the explanatory strength of the model. Bootstrapping with 5000 resamples was applied to ensure statistical robustness [13], and indicators with factor loadings below 0.6 were removed to enhance model fit. In addition to the standard SEM–PLS procedures, this study incorporated predictive relevance (Q^2) and effect size (f^2) analyses to evaluate the model's predictive accuracy—an essential component for policy-oriented modeling. This expanded analytical approach directly addresses the reviewer's comments by clarifying model structure, strengthening methodological transparency, and demonstrating why SEM–PLS is theoretically and empirically appropriate for evaluating post-slum upgrading performance.

E. Model Validation and Interpretation

Model validity was assessed using Goodness-of-Fit (GoF) and predictive relevance indices. The Importance–Performance Map Analysis (IPMA) was also conducted to identify key variables influencing post-upgrading sustainability [15]. The final SEM–PLS model integrates physical, environmental, and social dimensions into a unified analytical framework, enabling deeper interpretation of the structural determinants of post-slum upgrading sustainability. The interpretation emphasized both statistical significance and practical implications for urban policy and settlement governance.

F. Limitations and Future Research

Although the SEM–PLS model demonstrates strong explanatory and predictive capacity, several limitations restrict the generalizability of the findings. First, the study was conducted exclusively in the Sungai Kemuning area, a medium-sized post-upgraded settlement with specific socio-spatial and ecological characteristics. These conditions may differ from those found in metropolitan slums or rapidly growing peri-urban settlements, limiting the transferability of the model to structurally different contexts. Second, the analysis relies on self-reported perceptions, which, despite triangulation with field observations, may introduce response bias. Third, the model focuses on three primary latent constructs (infrastructure quality, environmental management, and post-upgrading sustainability) while other relevant dimensions, such as governance structure, political economy, land tenure dynamics, and microfinance mechanisms, were not included. These omitted variables likely account for the remaining unexplained variance in the model. Accordingly, Figure 6(a) presents the initial SEM–PLS pre-evaluation model used to screen indicators prior to measurement and structural model refinement.

Therefore, the results should be interpreted as contextually grounded insights rather than universally generalizable conclusions. Future research should expand the sample to multiple cities, incorporate longitudinal field observations, and integrate institutional and governance indicators to enhance external validity. Despite these limitations, the model provides a theoretically informed and empirically tested framework that can be adapted for use in similar medium-sized tropical cities experiencing post-upgrading challenges.

III. RESULTS AND DISCUSSION

A. Measurement Model Evaluation

The measurement (outer) model was assessed prior to the structural analysis to ensure the reliability and validity of the observed indicators. As shown in Table I, most indicators in the pre-evaluation model achieved factor loadings above 0.70, indicating adequate reliability and strong representation of their respective latent constructs [13]. A few items (e.g., KIP3, PP5, PAM9, and RTH5) exhibited loadings below 0.60, prompting model refinement.

Convergent validity was confirmed through AVE values greater than 0.50, while Composite Reliability (CR > 0.80) and Cronbach's alpha values ranging between 0.78 and 0.86 demonstrated satisfactory internal consistency [13]. Discriminant validity was also supported, with HTMT ratios below 0.90, confirming that each construct was empirically distinct [15].

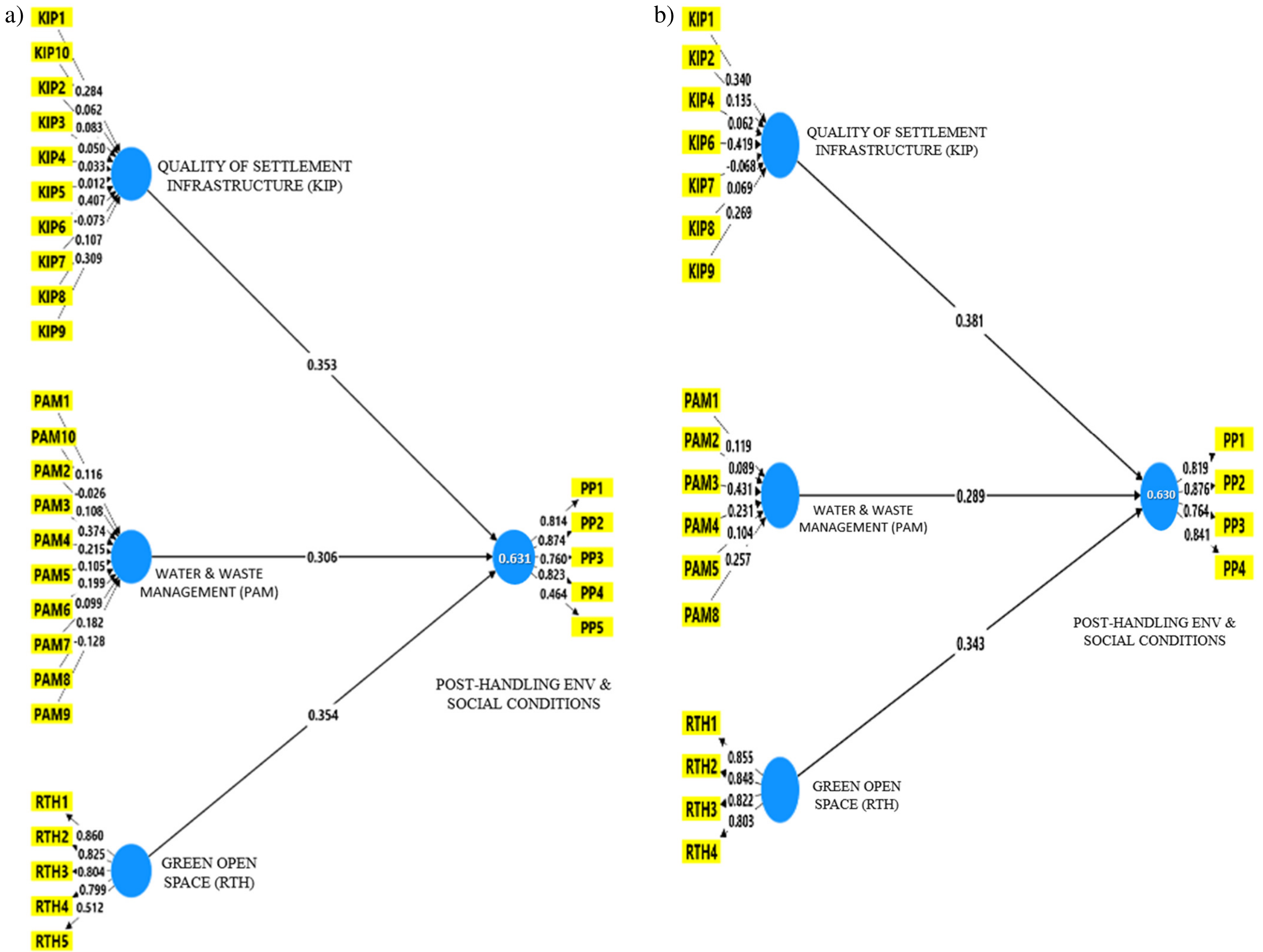

Fig. 6. a) SEM-PLS pre-evaluation model and b) SEM-PLS post evaluation model.

The refined model (Figure 6(a) and Table I) produced standardized loadings between 0.71 and 0.86 and improved the AVE and CR values, indicating strong indicator reliability and construct validity. Overall, these results confirm that the measurement model is statistically robust and provides a valid foundation for the subsequent structural model evaluation [13, 15].

B. Structural Model Evaluation

The structural (inner) model was evaluated to analyze the relationships among latent constructs and the explanatory strength of the model. As presented in Figure 6(b) and Table II, the R^2 value of 0.630 indicates that exogenous variables collectively explain 63% of the variance in post-upgrading environmental and social conditions, representing substantial explanatory power. The Q^2 predictive relevance (0.402) demonstrates a strong predictive capability, while the SRMR = 0.052 (<0.08) indicates a good overall model fit. The Variance Inflation Factor (VIF) values, ranging from 1.307 to 1.357, confirm that no multicollinearity issues exist among the constructs. Table III summarizes the overall measurement model quality indicators, confirming that all reliability and validity criteria meet the proposed thresholds. Table IV outlines the structural model quality assessment, including multicollinearity, explanatory power, and overall model fit indicators.

As reported in Table V, all structural paths were statistically significant ($p < 0.05$). The strongest relationship was identified between infrastructure quality and environmental and social conditions ($\beta = 0.381$, $t = 3.464$, $p = 0.001$), followed by green open space planning ($\beta = 0.343$, $t = 3.058$, $p = 0.002$) and water and waste management (β = 0.289, t = 2.570, p = 0.010). These findings confirm that improvements in infrastructure, open-space systems, and environmental management jointly determine the effectiveness of post-slum upgrading programs [5, 9, 11].

The graphical SEM-PLS output further indicates that infrastructure quality exerts the strongest influence on post-upgrading outcomes, serving as the primary determinant of sustainable recovery. Meanwhile, green open space planning and water and waste management reinforce environmental resilience and social well-being, demonstrating the interdependence between ecological systems and physical infrastructure in sustaining upgraded settlements [4, 5, 11, 14].

Overall, the model emphasizes that post-slum upgrading in Banjarbaru should evolve from short-term physical interventions toward integrated urban policy frameworks that incorporate infrastructure development, ecological landscape management, and participatory governance. This finding aligns with the Indonesian national settlement regulation [14] and supports the objectives of SDG 11 to create inclusive, safe, resilient, and sustainable cities [4]

TABLE I. PRE-EVALUATION MODEL

	Post-handling environmental and social conditions	Infrastructure quality	Green open space arrangement	Drinking water management, wastewater and solid waste management
KIP1		0.802		
KIP10		0.573		
KIP2		0.746		
KIP3		0.41		
KIP4		0.767		
KIP5		0.555		
KIP6		0.843		
KIP7		0.713		
KIP8		0.745		
KIP9		0.815		
PAM1				0.748
PAM10				0.536
PAM2				0.786
PAM3				0.838
PAM4				0.745
PAM5				0.732
PAM6				0.67
PAM7				0.534
PAM8				0.807
PAM9				0.321
PP1	0.814			
PP2	0.874			
PP3	0.76			
PP4	0.823			
PP5	0.464			
RTH1			0.86	
RTH2			0.825	
RTH3			0.804	
RTH4			0.799	
RTH5			0.512	

C. Interpretation and Policy Implications

The results of the structural model provide a coherent explanation of how post-slum upgrading outcomes in Banjarbaru are shaped by the interaction between infrastructure quality, environmental management, and spatial design variables. The dominant influence of infrastructure quality confirms that the availability and reliability of basic physical facilities, such as drainage, sanitation networks, road connectivity, and water supply, remain the foundation of sustainable post-upgrading conditions [5, 9]. The improvement of such infrastructure directly enhances accessibility, safety, and environmental hygiene, reducing vulnerability to flooding and disease transmission [5].

TABLE II. POST EVALUATION MODEL

	Post-handling environmental and social conditions	Infrastructure quality	Green open space arrangement	Drinking water management, wastewater and solid waste management
KIP1		0.818		
KIP2		0.759		
KIP4		0.771		
KIP6		0.848		
KIP7		0.712		
KIP8		0.73		
KIP9		0.795		
PAM1				0.748
PAM2				0.792
PAM3				0.864
PAM4				0.769
PAM5				0.742
PAM8				0.831
PP1	0.819			
PP2	0.876			
PP3	0.764			
PP4	0.841			
RTH1			0.855	
RTH2			0.848	
RTH3			0.822	
RTH4			0.803	

TABLE III. MEASUREMENT MODEL QUALITY MATRIX (OUTER MODEL)

Testing criteria	Minimum standard	Results	Status	Interpretation
Outer loading	≥ 0.70	0.712 - 0.876	Good	All indicators valid
Cronbach's alpha	> 0.60	0.844 - 0.852	Good	Model reliable
Composite reliability	> 0.60	0.896 - 0.900	Good	High consistency
AVE	> 0.50	0.682 - 0.692	Good	Good convergent validity
HTMT	< 0.90	0.726	Good	Constructs differ significantly
VIF	< 5.00	1.565 - 2.551	Good	No multicollinearity

TABLE IV. STRUCTURAL MODEL QUALITY MATRIX (INNER MODEL)

Testing criteria	Minimum standard	Results	Status	Interpretation
VIF structural	< 5.00	1.307 - 1.357	Good	No collinearity
R-Square	-	0.630 (63%)	Good	Model explains 63% of variation
Q-Square	> 0.00	0.402	Good	High predictive relevance
SRMR	< 0.08	0.052	Good	Model fit to data

TABLE V. HYPOTHESIS TESTING MATRIX

Variable relationship	Coefficient	t-value	p-value	Effect size	Conclusion
Infrastructure quality → environmental and social conditions	0.381	3.464	0.001	0.289 (Medium)	Significant
Green space arrangement → environmental and social conditions	0.343	3.058	0.002	0.241 (Medium)	Significant
Water and waste management → environmental and social conditions	0.289	2.570	0.010	0.173 (Medium)	Significant

The significant role of green open space planning demonstrates that ecological design elements are not merely aesthetic components but also function as adaptive buffers against climate-related risks. Proper vegetation placement, water-permeable zones, and communal parks improve thermal comfort and social interaction in rehabilitated settlements [7], 11]. This finding aligns with the principle that post-slum policies should integrate environmental services with social infrastructure to strengthen urban resilience [4, 5].

Water and waste management reflects the operational dimension of environmental governance. Efficient waste segregation, gray-water treatment, and flood-control systems ensure that the upgrading process delivers long-term environmental sustainability [10, 14]. These mechanisms correspond with the national regulations on settlement improvement issued by the Ministry of Public Works and Housing [14], which mandates the integrated management of sanitation, drainage, and solid waste as part of community-based programs.

The overall interaction of these three variables emphasizes that post-slum upgrading should move beyond conventional infrastructure projects toward multi-sectoral policy design that connects physical, ecological, and social systems. This approach echoes global recommendations on sustainable urban transformation [9, 11], stressing the need for participatory governance, adaptive environmental planning, and community-led maintenance strategies.

In the context of Banjarbaru, this implies that local governments must reinforce coordination between spatial planning, housing development, and environmental agencies to maintain the long-term benefits of the upgrading initiatives. The inclusion of community-based organizations in monitoring and maintaining infrastructure is crucial to prevent the re-emergence of informal settlements and to ensure that the upgraded areas remain inclusive, safe, and resilient in line with SDG 11 [4].

D. Predictive Strength of the Model

The predictive strength of the model was evaluated to determine its reliability in forecasting post-slum upgrading outcomes. The R^2 value of 0.630 indicates that the three main constructs, infrastructure quality, green open space planning, and water and waste management, jointly explain 63% of the variance in post-handling environmental and social conditions. This implies that 37% of the variance may be attributed to external or unobserved factors not included in the current framework. The Q^2 value of 0.402 confirms that the model has strong predictive relevance, while the SRMR value of 0.052, which is below the proposed threshold of 0.08, demonstrates an acceptable global fit of the structural model [9].

These findings indicate that the model developed in this study is sufficiently robust to predict post-slum-upgrading dynamics in other comparable urban contexts. This aligns with previous studies emphasizing that predictive models of urban resilience in low- and middle-income countries are often constrained by the availability of spatial and statistical data at the metropolitan and sub-city levels [5]. Furthermore, community-based upgrading programs, such as the Comprehensive Kampung Improvement Project (CKIP) in Surabaya, have demonstrated that decentralized and participatory planning approaches, supported by local micro-finance and institutional autonomy, can enhance both the predictability and long-term sustainability of slum rehabilitation [11].

These insights reinforce the broader perspective of Indonesia's decentralization framework, in which local governments play a crucial role in participatory urban development. In regions such as South Kalimantan, effective local communication and community participation remain significant components for sustaining post-upgrading improvements and preventing the recurrence of informal settlements [14].

IV. CONCLUSIONS

This study presents a new analytical framework for evaluating post slum upgrading performance by integrating three key determinants into a single empirical model. The framework combines infrastructure quality, green open space planning, and water and waste management within a comprehensive Structural Equation Modeling–Partial Least Squares (SEM-PLS) structure that quantifies their collective influence on the environmental and social conditions after upgrading. This integrated approach differs from previous studies that typically assessed post upgrading outcomes using separate indicators or descriptive evaluations. The framework introduced in this study provides a unified and statistically validated causal explanation of how physical, ecological, and environmental management factors interact to shape post upgrading sustainability.

The results show that infrastructure quality has the strongest influence on environmental and social conditions, with a path coefficient of 0.381 and a significance level below 0.001. The model achieved an R^2 value of 0.630, a Q^2 value of 0.402, and an SRMR value of 0.052. These values confirm that the model possesses high explanatory strength, predictive accuracy, and acceptable overall fit. The use of a single integrated SEM-PLS framework represents a methodological advancement in the evaluation of post slum upgrading programs, because it enables comparison, replication, and application in other urban contexts.

The novelty of this research lies in its ability to demonstrate that long term post upgrading success is not driven solely by the completion of physical construction. Instead, it depends on the combined performance of reliable infrastructure, continuous environmental sanitation management, and the provision of functional ecological spaces. This conceptual contribution fills an important gap in the existing literature, especially in developing cities, where the recurrence of slum conditions remains a persistent challenge. This study is limited to a single urban context with medium-scale upgrading interventions. Future research should validate and refine the model through multi-city comparative studies to enhance its external validity and generalizability.

The policy implications are clear. These findings support Indonesian Regulation Number 14, 2018 on improving housing and settlement quality and reinforce the need for strong coordination among spatial planning, housing, and environmental agencies. Community participation and local stewardship are essential to sustain improvements over time and to prevent the re-emergence of slum conditions. The empirical evidence obtained from Banjarbaru provides a practical and replicable foundation for developing post upgrading policy frameworks that can be applied in other secondary cities in Indonesia and in similar developing regions.

V. RECOMMENDATIONS

The success of slum upgrading initiatives should not be measured solely by the completion of physical construction works but rather by their ability to create sustainable improvements in the life quality of the affected communities. Based on the results of this study, three strategic recommendations are proposed to strengthen the long-term effectiveness of post-slum upgrading programs:

1. Integration of Physical Infrastructure with Environmental and Social Systems

Future upgrading projects should emphasize the integration of infrastructure improvements, such as sanitation, drainage, and road networks, with ecological and social dimensions. The incorporation of green open space planning and waste management systems should become core components of every settlement development program to maintain environmental balance and community health [5, 9].

2. Institutionalization of Community-Based Management Mechanisms

Sustainable success depends on community ownership and local participation. Local governments should empower neighborhood organizations and community-based groups to participate actively in the planning, implementation, and post-monitoring stages. This participatory framework aligns with the Indonesian decentralization policy and supports inclusive governance, as stipulated in Regulation No. 14/2018 of the Ministry of Public Works and Housing (PUPR) [14].

3. Development of Policy Instruments for Long-Term Monitoring and Evaluation

To prevent the recurrence of slum conditions, the establishment of integrated monitoring systems and data-driven decision-making mechanisms are crucial. These systems should track the physical, environmental, and social indicators of settlement sustainability, enabling adaptive management based on periodic evaluations and community feedback [11].

By focusing on these three directions, post-slum upgrading efforts can move beyond short-term infrastructure delivery toward a holistic framework that promotes resilience, inclusivity, and long-term sustainability. The experience from Banjarbaru provides an empirical model for developing cities in Indonesia to design more effective and community-oriented post-upgrading policies.

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