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THE IMPACT OF INCREMENTAL VERTICAL HOUSING DEVELOPMENT ON QUALITY OF SPACE AND RESIDENTIAL ENVIRONMENTAL SATISFACTION: A CASE STUDY OF SWARNA PLACE, COLOMBO, SRI LANKA

M.S.M. Senarathna[1] and A.A. Hettiarachchi[2]

ABSTRACT

This study critically investigates how incremental vertical expansion in low-income housing affects the quality of space (QoS) and residential environmental satisfaction (RES) over time. Using Swarna Place, a low-income settlement in Colombo, Sri Lanka, as a case study, the research examines the transition from single-story core units to four-story structures. Through a mixed-methods approach, the study employs spatial observation, architectural documentation, and resident surveys based on the QoS framework and the Residential Environmental Satisfaction Scale (RESS).The analysis identifies seven stages of physical transformation and evaluates each using six QoS indicators (lighting and ventilation, thermal quality, acoustic quality, spatial layout, functionality, and accessibility) and three RESS domains (internal neighbourhood reputation (INR), dwelling satisfaction (DS), and social climate (SC)). Findings reveal that, although DS increases due to improved housing quality and aesthetics, the overall RES declines in later stages as a result of reduced social engagement and community cohesion. Originally a multifunctional communal area, the ground floor living space becomes increasingly restricted in later stages due to staircase additions and fixed layouts. As vertical growth progresses, the QoS declines, and although residents make minor adaptations to the built environment, these adjustments offer limited relief. The study concludes that unregulated vertical expansion may compromise spatial and social liveability in incremental housing, leading to reduced environmental satisfaction despite physical improvements. It highlights the importance of balancing flexibility with design regulation and resident guidance to prevent the evolution of vertical slums. The research contributes to the discourse on sustainable housing by offering actionable insights into how urban settlements can preserve community identity, functionality, and spatial quality amidst vertical densification.

Keywords: *Dwelling Satisfaction; Incremental Housing; Internal Neighbourhood Reputation; Quality of Space; Residential Satisfaction.*

[1] Student, Department of Architecture, University of Moratuwa, Sri Lanka. sachini.senarathna20@gmail.com

[2] Senior Lecturer, Department of Architecture, University of Moratuwa, Sri Lanka. anishkah@uom.lk

1. INTRODUCTION

In the context of global urbanization and rapid population growth, incremental housing has emerged as a widely adopted solution (Turner, 1976; Boonyabancha, 2005) for addressing the shelter needs of low-income communities along with their economic growth. Particularly in the Global South, where formal housing programs often fall short (Gilbert, 2016), self-built incremental developments offer residents flexibility to adapt and expand their homes over time based on financial capacity, family growth, and social aspirations. While this approach allows for a gradual improvement in housing conditions, it also presents new spatial, social, and environmental challenges; especially as communities move from horizontal to vertical development without regulatory oversight.

In Sri Lanka, this phenomenon is evident in settlements like Swarna Place, a low-income community in Colombo, where residents have incrementally expanded their dwellings from single-story starter homes to multi-story vertical structures, a pattern consistent with observations in other Sri Lankan informal settlements (Warakapitiya et al., 2024).These transformations, often informal and self-managed, have reshaped not only the architectural form but also the quality of living spaces and community interactions. Although physical upgrades are visible, questions arise regarding how these changes affect the QoS (quality of space) within individual homes and the broader RES (residential environmental satisfaction) of occupants.

This study critically examines the implications of such vertical incremental development by evaluating seven stages of physical growth in Swarna Place. By integrating the QoS framework, comprising lighting and ventilation, thermal comfort, acoustic quality, spatial layout, functionality, and accessibility and the RESS (Residential Environmental Satisfaction Scale), which includes INR (internal neighbourhood reputation), DS (dwelling satisfaction), and SC (social climate), this research offers a comprehensive, resident-informed analysis of the evolution of space and satisfaction.

The study has three specific objectives: (1) to evaluate the impact of vertical growth on QoS and RES across seven incremental stages; (2) to highlight the trade-offs between physical improvement and social liveability; and (3) to emphasize the need for design regulations, spatial planning, and participatory approaches in managing self-built housing in low-income urban settings. By doing so, it challenges the assumption that vertical expansion automatically translates to better living conditions and contributes to the discourse on sustainable and inclusive housing.

2. LITERATURE REVIEW

The evolving dynamics of incremental housing have sparked critical academic debate across urban studies, environmental psychology, and housing policy. This section situates the current study within established literature, emphasizing theoretical foundations, empirical insights, and identified gaps related to incremental development, spatial quality, and residential satisfaction.

2.1 CONCEPTUAL FOUNDATIONS OF INCREMENTAL HOUSING

Turner (1976), a pioneering voice in self-help housing, argued that incremental housing offers autonomy and empowerment to low-income residents. He emphasized that allowing households to build over time, based on their evolving needs and resources, leads to more meaningful and adaptable environments, which is known as incremental

development. This philosophy underpins many Global South housing strategies and remains influential in current participatory development frameworks. Boonyabancha (2005) reinforced this view through Thailand's Baan Mankong initiative, showing that community-led upgrading fosters self-reliance and better socio-spatial outcomes.

However, critiques have emerged. Gilbert (2016) warned that incremental housing, though conceptually appealing, often results in substandard living environments, especially when vertical expansion lacks regulatory oversight. These criticisms are echoed in Gifford's (2007) psychological analysis, which associates high-rise living with social isolation, stress, and poor well-being. In the Sri Lankan context, Warakapitiya et al. (2024) observed similar behavioural adaptations and dissatisfaction in high-rise settlements like "Sahaspura", indicating a disconnect between policy goals and lived experiences.

2.2 SPATIAL QUALITY AND HOUSING SATISFACTION

According to Kurian and Thampuran (2011), the quality of space is a subjective concept that depends on various parameters, including spatial functions and environmental qualities. It reflects not only the physical characteristics of a dwelling, such as size and organization, but also how well the space can be adapted to the needs and preferences of its users, considering factors like location, infrastructure, design, aesthetics, materials, construction techniques, sustainability, and cultural context. The QoS is central to evaluating the success of incremental housing as established by Rashid (2019) and Mohit et al. (2010), who empirically demonstrated that spatial quality directly determines the long-term viability and resident satisfaction in self-built environments. Rashid (2019) highlighted that in low-income settlements, domestic spaces often serve multiple functions, evolving with household needs. His study in Ershad Nagar, Bangladesh, emphasized the value of spatial flexibility. Likewise, Kaitilla (1993) identified user participation and adaptability as critical to satisfaction in Papua New Guinea's public housing. Although this study is over three decades old, its insights remain foundational for understanding participatory design in Global South contexts, and recent studies (e.g., Rashid, 2019; Warakapitiya et al., 2024) confirm the ongoing relevance of these factors in contemporary vertical housing developments.

Nevertheless, as housing becomes denser and vertically layered, QoS can deteriorate. Nix et al. (2015), in a study of Delhi's low-income housing, found that indoor environmental quality (IEQ) declined sharply with reduced natural ventilation and light, especially in stacked dwellings. These findings mirror Gifford's (2007) critique that high-rise buildings often compromise thermal, acoustic, and psychological comfort.

In contrast, Mohit et al. (2010) showed that in Kuala Lumpur's low-cost housing, spatial satisfaction improved with better infrastructure, despite limited unit size. This suggests that spatial quality is not solely a function of area but of usability, access to light and air, and layout efficiency. Similar insights were drawn by Salleh et al. (2012), who linked perceived liveability to thoughtful spatial arrangements rather than material affluence.

2.3 RESIDENTIAL ENVIRONMENTAL SATISFACTION

RES is a multidimensional construct involving physical, social, and psychological factors. Adriaanse (2007) proposed the RESS, comprising three key dimensions: INR,

SC, and DS. This framework has been widely applied in housing studies (e.g., Galster, 1987; Mohit & Nazyddah, 2011) and informs this study's empirical approach.

Galster (1987) emphasized that housing satisfaction is not just about physical dwellings but also about neighbourhood reputation and social engagement. He critiqued traditional housing evaluations for neglecting contextual and subjective elements. Adriaanse (2007) advanced this view by validating RESS as a tool that integrates built form with social perception, particularly in low-income environments. The current study extends this framework into the Sri Lankan context, focusing on how vertical housing affects these satisfaction domains with inspirations from previous research.

2.4 THE SOCIAL DIMENSION OF INCREMENTAL GROWTH

Social cohesion is often strongest in early stages of incremental development. Turner (1976) noted that when people build their environments collectively, social capital increases. Bourdieu (1986) also emphasized the role of social capital in shaping everyday spatial practices and neighbourhood identity. In Stage 01 of incremental housing, residents often share resources, socialize in open spaces, and personalize their environments, leading to high INR and SC scores (Adriaanse, 2007; Ong'ayo, 2016).

However, as housing becomes more individualized and vertically stratified, these ties weaken. Warakapitiya et al. (2024) showed that high-rise living in Colombo led to behavioural fragmentation, with fewer shared activities and increased reliance on private, enclosed spaces. Ha (2008), in his study of Korean social housing estates, also observed that physical form directly influenced social interaction. The more rigid and stratified the environment, the lower the social cohesion.

Gilbert (2016) added that upward expansion can reflect not only a physical but also a symbolic distancing, where households seek to separate themselves socioeconomically from their neighbours. This notion is echoed in the field observations conducted by the authors at Swarna Place (this study) and corroborated by Warakapitiya et al.'s (2024) surveys, in which upper-stage residents report higher DS but lower INR and SC, suggesting a shift from community-centric to privacy-oriented values.

2.5 CONTEXTUALIZING THE STUDY IN SRI LANKA

In the Sri Lankan context, the evolution of informal housing has mirrored global patterns of incrementalism. Gamage et al. (2015) and Samaratunga and O'Hare (2013), documented the failures of top-down high-rise relocation projects like Sahaspura, where physical improvements did not translate into resident satisfaction. Warakapitiya et al. (2024) provided a nuanced analysis, showing that while behavioural adaptations occurred (e.g., space personalization, balcony use), they did not compensate for the loss of shared spaces and community ties.

Drawing on Adriaanse's (2007) Residential Environmental Satisfaction Scale (RESS) and Rashid's (2019) spatial typologies, this review critically examines how vertical layering and spatial organization influence the lived residential experience.

2.6 GAPS AND CONTRIBUTION

Despite the wealth of literature on incremental housing, few studies integrate QoS and RES frameworks to examine how vertical growth affects both physical and social dimensions of housing. While Gilbert (2016) and Gifford (2007) highlight the risks of

vertical expansion, and Adriaanse (2007) provides a robust framework for satisfaction analysis, their combined application remains limited in low-income South Asian contexts.

This study contributes by empirically assessing QoS and RES across distinct vertical development stages in a real Sri Lankan settlement. It incorporates verified tools (RESS), validated empirical methods, and critical spatial analysis, offering practical implications for policy, especially in contexts where self-built vertical housing is proliferating.

In summary, while incremental housing provides a pathway to affordability and autonomy, its long-term success hinges on maintaining spatial quality and social cohesion. A balanced approach grounded in resident engagement, environmental design, and contextual policy is essential to create not just houses, but liveable communities.

3. METHODOLOGY

3.1 RESEARCH DESIGN

This study adopts a mixed-methods case study approach to critically evaluate the evolution of spatial quality and RES in a low-income housing settlement undergoing incremental vertical development. The research focuses on Swarna Place, Colombo, Sri Lanka, as a single in-depth case, reflecting a broader typology of informal, self-built urban housing.

3.2 CASE SELECTION JUSTIFICATION

Swarna Place was selected for its unique representation of vertical incremental housing built on 2-perch government-allocated plots, developed organically over several decades. It demonstrates a range of transformation stages from single-story basic units to four-story self-extended dwellings, making it ideal to analyse spatial, functional, and social changes over time. The site includes more than 250 units, with varying architectural and socio-cultural expressions reflecting individual and collective adaptation strategies.

3.3 DATA COLLECTION METHOD

The study integrated both primary and secondary data sources:

- On-site observations and architectural mapping (plans, elevations, cognitive maps).
- 60 Resident surveys (n=60) to gather qualitative feedback on spatial use, satisfaction, and social experience.
- Semi-structured interviews with residents to understand adaptive strategies and lived experience.
- Photographic and sketch documentation of different housing types and communal spaces.
- Archival material and policy reviews to contextualize housing regulations and support mechanisms.

3.4 STAGE IDENTIFICATION AND TYPOLOGY FRAMEWORK

The identification of seven distinct incremental development stages was based on a synthesis of field observations, resident interviews, and insights from existing housing literature. Drawing inspiration from Turner's (1976) notion of "housing as a process," the following parameters were used to define development stages:

1. Vertical layers (number of storeys).
2. Structural completeness (finished roof vs slab-incomplete).
3. Layout and spatial organization (room arrangements, openings).
4. Functionality and usability (use of ground floor and upper floors).
5. Material finishes (walls, floors, roofing).
6. Facade treatments and architectural expression.

This classification was also informed by Nix et al. (2015), Rashid (2019) and Warakapitiya et al. (2024), who similarly examined the spatial transformation and layering in low-income vertical housing.

3.5 STAGE CLASSIFICATION

Table 1: Incremental stages

Stage	Description
Stage 01	Single-storey, completed roof, highly flexible space use.
Stage 02	Single-storey with slab or partial walls for upper floor preparation
Stage 03	Completed two-storey dwelling with finished roof.
Stage 04	Two-storey unit with slab or half-built third floor.
Stage 05	Completed three-storey dwelling.
Stage 06	Three-storey with slab or partial fourth-storey extension.
Stage 07	Completed four-storey building, often with modern façade elements.

The categorization follows Nix et al. (2015) and Boonyabancha (2005) who argue that while incremental development provides flexibility, unregulated vertical extensions can result in compromised living conditions and community fragmentation. From the seven identified stages of incremental development, four stages were selected for detailed analysis in this study, as they are fully constructed and align with the study's limitations.

Figure 1: Incremental development of a housing unit. (Note: Each stage includes multiple subtypes, but one representative house is illustrated here to reflect the typical incremental transformation.)

3.6 EVALUATION CRITERIA FOR QUALITY OF SPACE (QOS)

A custom evaluation framework was developed based on six key physical-spatial parameters, drawing on the work of Nix et al. (2015), Gifford (2007), and Mohit et al. (2010):

- Lighting and Ventilation (LV)
- Thermal Quality (TQ)
- Acoustic Quality (AQ)
- Spatial layout and Quality (SQ)
- Functionality (FC)
- Accessibility (AC)

Each parameter was rated using a percentage-based scale derived from resident feedback and observational scoring. The ground floor living space was the primary focus due to its multifunctional use as established in Rashid (2019) and Mohit and Nazyddah (2011).

3.7 ASSESSMENT OF RESIDENTIAL ENVIRONMENTAL SATISFACTION (RES)

To assess Residential Environmental Satisfaction, this study adopted the RESS developed by Adriaanse (2007). The RESS evaluates three domains:

1. Internal Neighbourhood Reputation (INR)
2. Social Climate (SC)
3. Dwelling Satisfaction (DS)

These were used to derive the Overall Residential Environmental Satisfaction (ORES) score for each stage. The scale's validity and multidimensionality make it a suitable tool for analysing both social and environmental dimensions of housing, as supported by Ha (2008) and Kaitilla (1993).

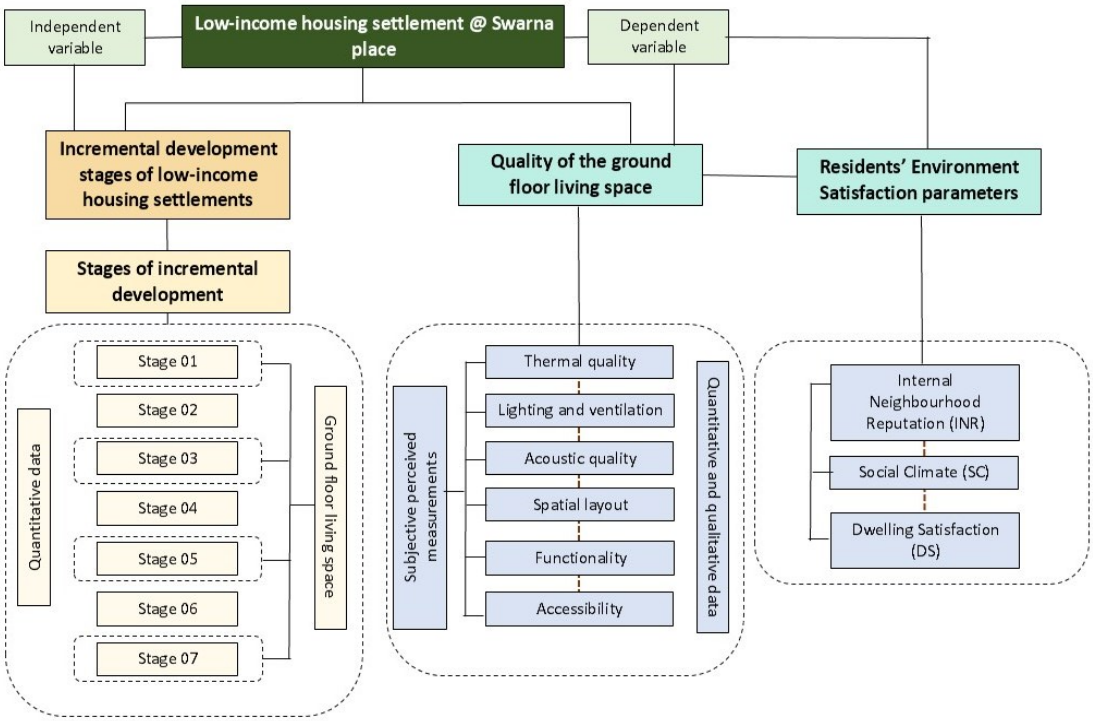

Figure 2: Independent and dependent variable

3.8 DATA ANALYSIS

- Quantitative analysis: Survey data (n=60) were processed using descriptive statistics (frequencies, means) - to identify trends across stages. Pearson correlation coefficients were calculated to quantify relationships between DS, INR, and SC.
- Qualitative analysis: Interview responses underwent - thematic coding using color-coded categorization, with emergent themes organized around three core areas: (a) spatial adaptations, (b) social cohesion, and (c) satisfaction drivers.
- Spatial analysis: On-site sketches, cognitive maps, and observational notes were compared through professional overlay techniques -. This involved physically tracing evolutionary patterns across the seven development stages using printed base drawings.
- Integrated comparison: QoS indicators and RESS scores were juxtaposed in comparative matrices developed for the study, which exposed divergences between physical upgrades and social satisfaction metrics.

4. RESEARCH FINDINGS

This study critically examined the evolution of QoS and RES across selected incremental development stages within Swarna Place, a low-income vertical housing settlement in Colombo, Sri Lanka. The findings highlight several interrelated spatial, functional, and social dynamics resulting from vertical housing growth.

- **Deterioration of Ground Floor Quality of Space:**

While incremental housing has often been associated with improved environmental quality over time (Nix et al., 2015), this study reveals a contrasting trend in vertically expanded units. As residents added floors incrementally, the ground floor living space: previously open, adaptable, and multifunctional; became increasingly constrained. The introduction of staircases, partition walls, and enclosed façades led to reduced natural lighting, poor ventilation, and decreased spatial flexibility. This aligns with Boonyabancha's (2005) warning that although incremental growth fosters autonomy, it must be balanced with regulatory and considerations of spatial quality.

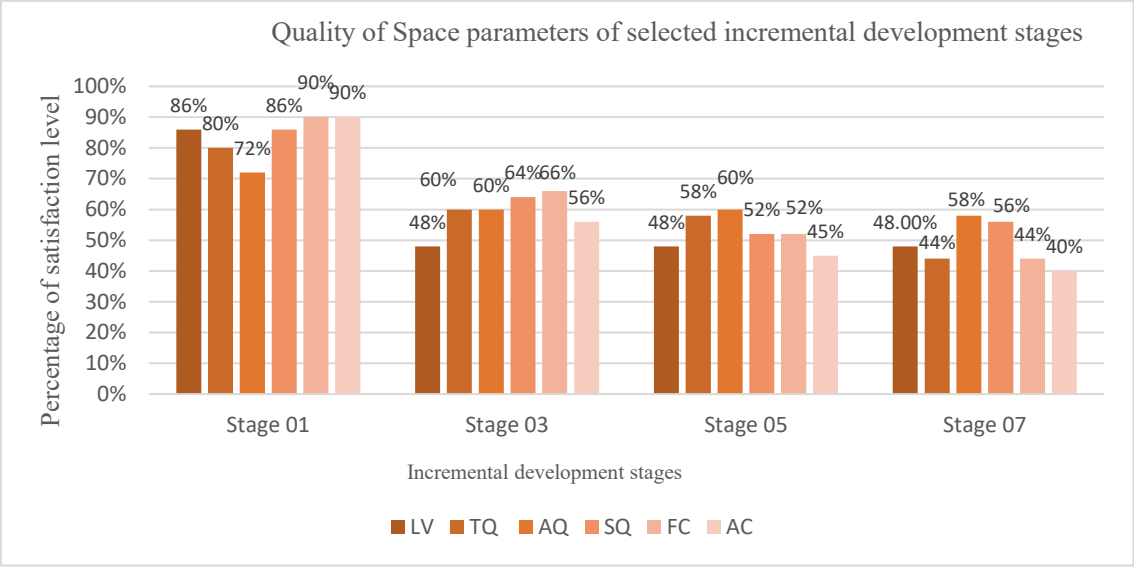

Figure 3: QoS parameters of selected 4 stages

Figure 3 illustrates how six key parameters related to the quality of space deteriorate along with the incremental development stages of Swarna Place.

- **Diverging Trajectories of Dwelling Satisfaction and Community Cohesion:**

A key observation was that DS increased steadily with each development stage, largely due to improved physical amenities, increased social status, and architectural embellishments. However, this rise in DS was inversely correlated with INR and SC; two core dimensions of the RESS framework. This inverse relationship was quantified through Pearson correlations, revealing strong negative associations between DS and both INR (r = -0.79) and SC (r = -0.82). Residents of stage 01 exhibited the highest social engagement, reporting shared boundaries, collective decision-making, and high levels of neighbourly interaction. In later stages, residents constructed more enclosed, private dwellings, reducing interpersonal connections and community identity.

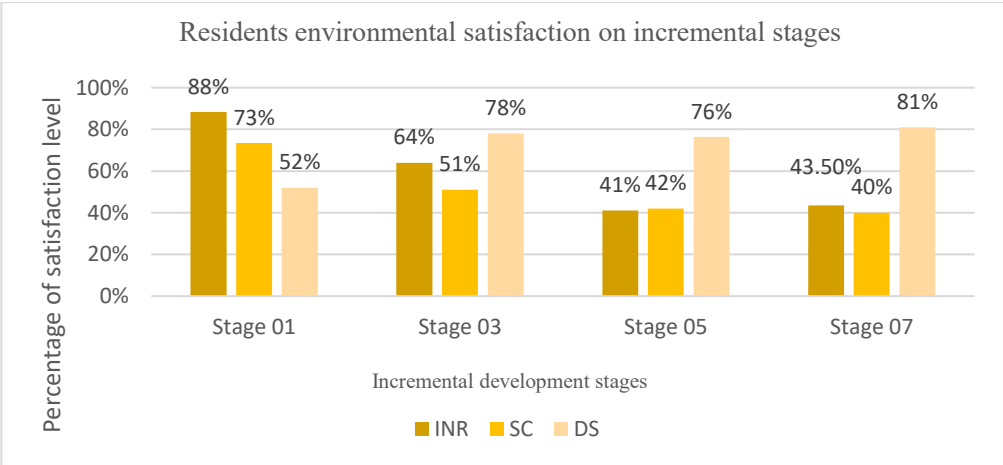

Figure 4: Residents environment satisfaction on incremental stages

Figure 4 presents the three RES parameters across the incremental stages showing that as the level of incremental development increases, the INR and SC decrease, while DS increases at higher stages.

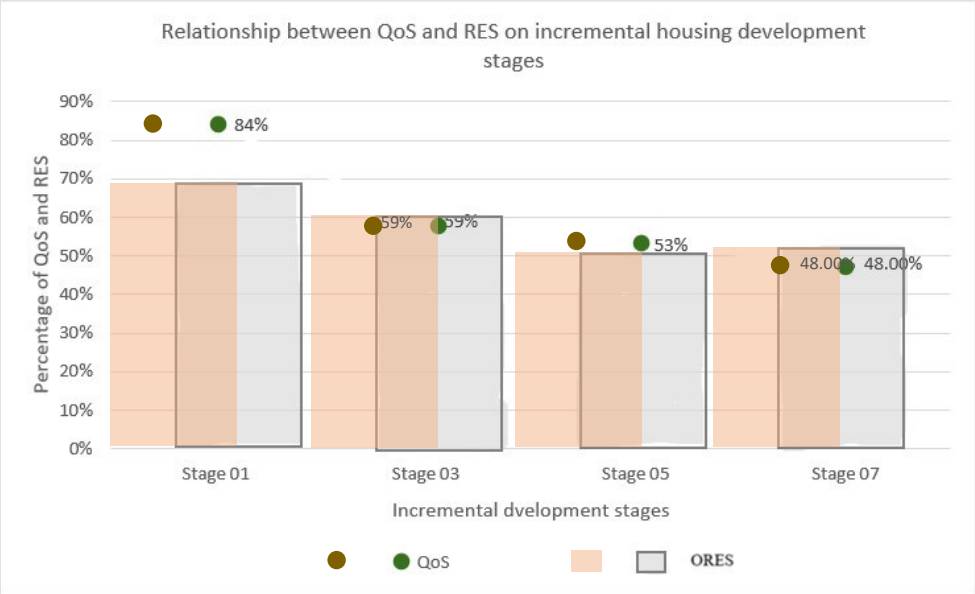

Figure 5: Relationship between QoS and RESS on incremental stages

Figure 5 illustrates the relationship between overall RES and QoS across the four stages studied. In the initial stages, both overall RES and QoS are relatively high, whereas in the later stages, a noticeable decline in both measures can be observed.

- **Loss of Space Adaptability and Functionality:**

The study further revealed a functional shift in the use of ground floor spaces. Initially, the living area served multiple roles; social gatherings, dining, studying, business operations, and sleeping; demonstrating high levels of spatial adaptability. Over time, the living space has lost its multifunctionality, becoming more rigid and defined, reflecting the prioritization of privacy and individual needs over collective usability. This mirrors observations in other South Asian contexts, where vertical infill limits flexibility and usability.

- **Intra-stage Subtypes and Spatial Diversity:**

Within each stage, multiple subtypes of housing emerged based on the configuration of staircases, window treatments, façade treatments, and layout variations. These variations underscore that while the community follows an incremental development path, it does so with high spatial heterogeneity, influenced by financial capacity, gendered spatial roles, and aspirations. However, despite this variation, feedback on spatial satisfaction was remarkably consistent within each stage, suggesting that stage-specific spatial qualities and limitations were collectively experienced and perceived.

- **Spatial Trade-offs and Vertical Densification:**

Finally, the study documented a measurable reduction in ground floor living space size and quality as vertical densification increased. The pressure to expand upward for additional bedrooms or rental income came at the cost of liveability on the ground floor contributing to reduced airflow, visual openness, and accessibility. This tension between verticality and spatial usability reflects broader critiques of unregulated high-rise developments in low-income communities.

Table 2: Summary of primary research outcomes

Finding Category	Observation	Implication
Diminishing Ground Floor Quality of space	Addition of upper floors leads to reduced lighting, ventilation, and spatial flexibility on ground floors.	Unregulated vertical growth compromises environmental comfort at the base level.
Inverse Relationship: Dwelling Satisfaction, Internal Neighbourhood Reputation Social Cohesion	DS increases over stages, while INR and SC decline.	Social cohesion weakens as privacy and architectural embellishment become prioritized.
Decline in Spatial Adaptability and Functionality	Earlier stages had multifunctional spaces; later stages show rigid, single-use layouts.	Loss of flexibility reduces the home's ability to support dynamic family needs.
Intra-stage Spatial Variations	Within each stage, variations in layout and design occur due to household-specific choices.	Despite diversity, residents share similar spatial experiences and constraints per stage.
Spatial Trade-offs in Vertical Densification	Vertical expansion reduces ground floor liveability due to space occupied by stairs and structural additions.	Tension between maximizing space vertically and maintaining functionality at lower levels.

5. CONCLUSION AND RECOMMENDATIONS

This study provides a critical empirical lens on the spatial and social implications of incremental housing in vertically expanding settlements, offering new insights into the evolving nature of spatial quality and resident satisfaction. While incremental housing enables resident-led, financially adaptive growth, this research confirms that unchecked vertical expansion can severely undermine the core qualities that make such housing sustainable; namely flexibility, adaptability, and community cohesion.

The research reveals that QoS; especially on the ground floor; deteriorates consistently with vertical growth, with the most advanced stages suffering from reduced ventilation, poor lighting, low functionality, and minimal accessibility. Although physical improvements enhance DS, they simultaneously erode INR and SC, resulting in a decline in overall RES. This divergence underscores the need to rebalance housing policy and design toward integrated solutions that maintain both spatial quality and social connectedness.

Moreover, the decreasing multifunctionality of ground-floor living spaces, a vital feature in early stages; suggests a gradual departure from the flexibility that defines successful incremental housing (Turner, 1976; Boonyabancha, 2005). Without interventions to regulate and support sustainable growth, such settlements risk transforming into densified enclaves of spatial discomfort and social fragmentation, echoing concerns about the emergence of vertical slums in the Global South.

To address these challenges, this research advocates for:

- Design guidelines that ensure flexibility and air-light-flow standards in all vertical expansions.
- Policy interventions that promote community engagement and cohesion in all stages.
- Technical support mechanisms for low-income residents to balance autonomy with spatial quality.

By advancing the understanding of how incremental growth shapes lived experience, this study contributes to a more nuanced and contextualized discourse on urban housing transformation in South Asia and beyond. It urges policymakers, urban designers, and community stakeholders to reimagine incremental housing not merely as a survival strategy, but as a platform for equity, liveability, and spatial dignity.

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