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BUILDING FLOOD RESILIENCE THROUGH LOW-RISE HOUSE TYPES

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ABSTRACT

The climate crisis and rapid urbanization have worsened the shelter situation faced by vulnerable, low-income households living in historically redlined informal settlements, where basic infrastructure and services to support wellness and health are inadequate. Countless urban migrants seek affordable housing in informal settlements, yet these areas are low-lying and prone to flooding. Climate change-induced flooding has degraded the living conditions of about 60% of low-income households in Kampala City's 62 informal settlements. The research conducted in this area is not preventive; it focuses on urban poverty and the social consequences of marginalization, viewing them as a disease rather than a housing solution. Housing, sanitation, waste management, and flooding are described only in terms of material and structural flood resilience, rather than as solutions involving house types suitable for low-income households living in flood-prone zones. This paper aims to address this issue by proposing housing solutions appropriate for low-income households in flood-prone areas. The area under study is Bwaise III, one of the most heavily affected suburbs of Kampala, situated near a channel called Nsooba-Lubigi, which was constructed by the government to reduce flooding. During heavy rainfall, houses in this area flood up to bed-height levels. Households improvise by building houses on plinths, placing furniture on platforms, or blocking openings to prevent indoor flooding. This study examines the feasibility of developing low-rise housing for flood-prone areas. Flooded houses can have adverse health effects and cause significant property damage. An exploratory and descriptive qualitative approach was adopted for this study. The methods used were personal observations, semi-structured expert interviews, and systematic sketching to investigate housing-related responses to flooding. The findings established that low-rise housing solutions would suit the lifestyles of low-income households, as they often require access to outdoor spaces. Low-rise houses can free up space on the ground for outdoor activities, infrastructure, and services, and they prevent the encroachment of housing on wetlands and agricultural land.

KEY WORDS Flooding, Vulnerability, Climate Change, Low-Rise Housing, Low-Income Households, Affordable Housing.

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1. KAMPALA'S INFORMAL SETTLEMENTS AND VULNERABILITY TO CLIMATE CHANGE

Global warming has manifested through extreme weather events and changing rainfall patterns, with the increased frequency and magnitude of flood incidences worldwide worsening global climate change (Li et al., 2024; UNDESA, 2023; UNISDR, 2015). Floods are primarily natural events, and the scale of their impact is often exacerbated by human activities, such as deforestation or the conversion of forests, which disrupt the intrinsic equilibrium of hydrological systems, increasing their vulnerability to flooding. The most affected places in these countries are the informal settlements (Hussainzad & Gou, 2024). In theory, water reservoirs may also increase the force of severe rainstorms in adjacent areas (Hoang & Liou, 2024). One in three urban households in the Global South reside in makeshift houses in informal settlements characterized by insecure tenure, inadequate infrastructure, and services (UN-Habitat, 2010, 2013). Over the coming decades, Southern cities are predicted to house the majority of the world's population, while informal settlements are expected to absorb most of them (UN-Habitat, 2012; UNDESA, 2015; World Bank, 2013). Vulnerability to climate risks is greater in the Global South due to inherent challenges, including housing, infrastructure, and service deficiencies, and limited resources for mitigation and adaptation.

The International Emergency Events Database (EM-DAT) (2022) reveals that 7 million people's lives have been claimed by flood risk disasters from 1900 to 2020, while the associated social and economic losses are estimated to be USD 9.6 trillion. Flooding is the most common disaster in cities of developing countries (Echendu, 2023). Referenced in SDG11 (Sustainable Cities and Communities) and SDG13 (Climate Action) is the need to address floods, with both goals aiming to build resilient and sustainable communities that can withstand the impacts of climate change. Across cities in sub-Saharan Africa (SSA), the commonalities in the increased regional experience of emergent urban flood risks have been attributed to several theories associated with extensive urbanization trajectories. The increased incidence of haphazard flooding can be attributed to urban population growth, which activates the urbanization processes that directly or indirectly impact flooding experiences (Arinabo, 2023a). For example, the El Niño phenomenon in Uganda was accompanied by widespread deforestation on hillsides, leading to landslides. Subsequently, such deposits raised water levels in adjacent water bodies such as rivers and lakes, thereby causing flash floods in neighboring urban areas (Arinabo, 2024). Loss of vegetation density can also significantly influence the perpetuation of flood risk in urban areas. In SSA, wetlands have been severely degraded due to encroachment caused by reclamation for housing construction, resource extraction, industry, and agriculture, affecting the sustainability of wetland-reliant livelihoods. Urban vegetation is recognized for its ability to reduce stormwater runoff, improve air quality, and improve the quality of living for a growing population. However, differences are often observed due to uneven distribution of vegetation (Endsley et al., 2018). A decrease in vegetation cover combined with land clearing can increase surface runoff into streams after rainfall. According to a study on the emerging nature of urban flood risks (see Plate 1) (Arinabo, 2024), environmental factors account for 43.4% of urban flooding, while socio-economic aspects account for 13.3%.

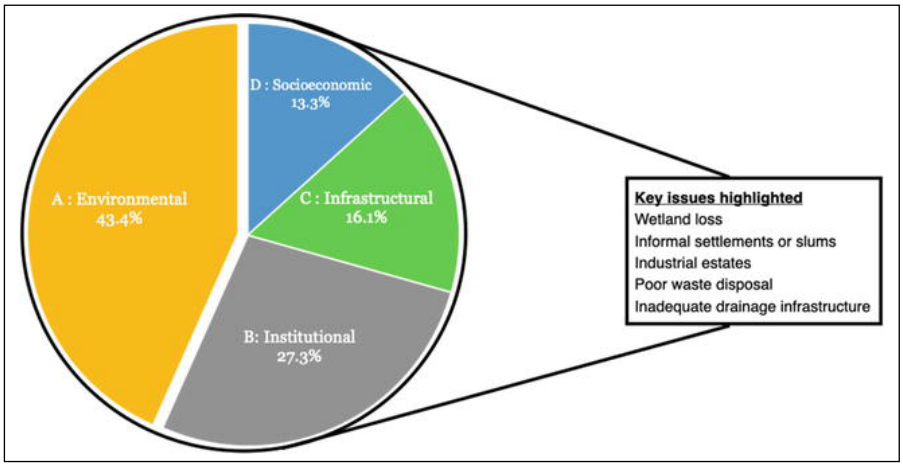

Plate 1: Categorization of key flood drivers (Source: Arinabo, 2024).

Flooding, a growing concern in many cities and urban areas, has significant consequences for human health, buildings, and the socio-economic fabric of people, making it a pressing issue (Li et al., 2020). Uganda's capital city, Kampala, is vulnerable to climate change due to rapid urbanization, poor land use planning, perilous weather events, impacted urban livelihoods and infrastructure, and environmental degradation. Several studies related to climate change have noted variations in Uganda's rainfall patterns. Uganda has two main rainfall seasons – extensive rainy periods from March to May (MAM) and short rainy periods from September to November (SON). Anomalies in the short rainy period have intensified the frequency, intensity, and duration of heavy rainfall events, flash flooding, increased water levels, and increased landslides (Alupot et al., 2024). Throughout the rainy season, Uganda has experienced substantial rainfall recently and sometimes during what is conventionally the dry season, in part due to the devastating effects of climate change. Such rainfall has resulted in recurrent floods, leading to the destruction of properties and increased prevalence of disease. Floods pose a significant threat as they endanger human life, impair economic activities, and cause cumulative pollution from industrial contaminants. The practice of burying surface water, including streams and wetlands, during the urbanization process to support housing development also contributes to flooding. In Uganda's capital city, floods affect more than 10 percent of all jobs,

several main roads, and over 170,000 people who regularly live in flood-prone areas. The flash floods exacerbate the problem, which various stakeholders have attempted to address (Mwambu & Akena, 2023). If not halted, Uganda risks losing all its wetlands by 2040. Wetland mapping exercises conducted in 1994 and 2015 indicate that the wetland coverage has deteriorated from 15.6% in 1994 to 8.9% in 2021, with the most significant loss occurring between 1986 and 2011 (ACME, 2023).

The Ugandan government has worked for years to improve, manage, and restore wetland cover. The government's intentional plans and determinations to restore the wetlands are also stipulated in the Third National Development Plan (Republic of Uganda, 2020), aiming to increase the percentage of land area covered by wetlands from 8.9% in FY2020/21 to 9.57% in FY2024/25. Several approaches are being implemented to achieve this target; however, in Kampala city, an increase in urban development has led to a rise in impervious surfaces in ecologically sensitive places like wetlands, where the informal settlements are located. Such development has led to increased surface runoff and decreased water infiltration. Floods severely affect low-income households in informal settlements due to the low-lying nature of their residential areas. During flooding seasons, surface runoff overflows, and houses flood to the point of soaking people's beds. Households in informal areas have implemented low-cost strategies to prevent rain from accessing their houses, such as constructing barriers at their thresholds, sealing off some openings, building houses on plinths, or placing furniture on platforms to prevent flooding indoors. The location of informal settlements is often a result of the government's inability to address housing supply shortfalls and to deliver affordable housing and public infrastructure (Richmond et al., 2018).

Floods in Kampala trigger a series of adverse effects that, if left unaddressed, can potentially lead to more severe floods in the future. Infrastructure degradation, community uprooting, and water source pollution (contaminated water sources) are characteristic of the cycle that can worsen the conditions for future floods. Three fundamental elements make informal settlements particularly vulnerable to climate change: their actual location, which is often ecologically sensitive and environmentally fragile. Households' socioeconomic characteristics include high levels of poverty resulting from the migration of unskilled labor from rural to urban areas. The lack of risk-reducing infrastructure and shock-reduction assistance is the outcome of political and institutional marginalization. The deterioration of habitats and ecosystems, including stressors and catastrophes linked to climate change, exacerbates vulnerabilities already caused by insufficient income and assets, poor infrastructure and services, and lack of a voice in governance. This study offers theoretical insights from research on the construction of houses designed to mitigate the impact of weather and floods on human life, particularly for low-income households residing in wetlands who are disproportionately affected. The development of housing and infrastructure in flood-prone areas aggravates flood damage globally (Andreadis et al., 2022). Ample literature about housing in flood-prone areas primarily focuses mainly three aspects: the damage caused by floods or structural issues to houses, information regarding floods such as "flood depth" and "flood duration," and details about house structures including "area, plinth height, and ceiling height," along with the necessary amounts of materials, labor, and finances for required for repairing damages after a flood event. The present research aims to understand the types of low-income houses that are suitable for living in flood-prone areas.

2. THE RIGHT TO HOUSING FOR THE URBAN POOR

Ensuring access to affordable and sustainable materials for housing in informal settlements is a key condition for implementing global commitments such as the UN-Habitat Resolution on Accelerating Transformation of Informal Settlements and Slums and the Ministerial Declaration of the Buildings and Climate Global Forum (PDF). Urban planning and housing in urbanizing countries have primarily been a process of adoption and adaptation from the urbanized countries. In the past few decades, urbanization trends in urbanizing countries have deviated significantly from their historic patterns. Industrialization played a significant role in driving urbanization in urbanized countries. As the cities developed, so did the factories. Despite being highly developed, many urbanizing countries do not have large industrial sectors today. The tight linkage between urbanization and industrialization does not apply to most of the urbanizing world. The large number of natural resource exporters who are urbanizing without industrializing demonstrates the discrepancy. For example, the percentage of the Nigerian population living in the city is the same as that of China (Vollrath et al., 2016).

Rapid urbanization creates circumstances that hinder the mere transference of theory, policy, and practice from a previously urbanized world. This leads to an increase in the spatial distribution of impervious surfaces due to the development of new services and infrastructure, as well as the construction of new houses as more people settle in urban areas. This reduction in hydrologic response time leads to increased flooding (Feng et al., 2021). Adopting a nuanced approach based on actual context is imperative (Jenkins et al., 2006). Reflections from theories on compact types indicate that houses cannot be designed simply as physical shelter without consideration for the appropriateness of the house types, for instance, to people's ways of life and the local setting. Informal settlements are a reflection of how ordinary people live in urban areas. The cultures of households and their societies greatly influence the nature of housing and settlement forms, evidenced by the formation of human settlements. Housing usage can

be perceived through cultural attributes that are reflected in the way spaces are used and furniture and other living equipment are arranged. (Jenkins et al., 2006). Houses intended to improve the livelihoods of urban low-income people must be built to support the efforts towards achieving the SDGs (United Nations, 2023). The Government of Uganda has tried to provide low-income housing, but due to a lack of political will, such efforts have not been successful (Nnaggenda Musana, 2008). However, the emergence of a dysregulated informal land market and the commodification of land, combined with the prevailing political climate, have made it challenging to achieve comprehensive upgrading of informal settlements. Fragmentary informal settlement improvements have been implemented in conjunction with city authorities and various funding organizations to facilitate access to clean water and sanitation (Ouma et al., 2024). The households in Kampala's informal settlements can be considered marginalized due to the lack of affordable housing, proper infrastructure, and adequate services, denying them what Henri Lefebvre termed the right to a city. In response to this rejection, many urban migrants turn to the informal sector as a means of gaining access to space and to the economy (Huchzermeyer, 2021).

Kampala's informal settlements support various groups of people, including "camper communities" or temporary visitors to the city, the internally displaced persons, and refugees. This study was conducted in the Bwaise III Kalimali zone to investigate ways to enhance the housing conditions of low-income households in this flood-prone area. Housing-related improvements aimed at reducing flood risk in the vulnerable informal settlement, particularly addressing SDG 11, aimed at making cities and human settlements safe, resilient, and sustainable, at the same time addressing SDG 6, which promotes clean water and sanitation. SDG11 emphasizes the protection of low-income households in vulnerable housing situations, ensuring equal access to adequate, safe, and affordable housing, as well as sustainable and resilient buildings, and effective human settlement planning and management (UNDESA, 2015). Working towards SDG 11 helps achieve other goals, like reducing the growth of informal settlements and their related environmental issues, and objectives that are essential for meeting basic development needs.

2.1. House Types and Wetland Encroachment

At times, people attribute livable cities to the zoning of activities, while others attribute it to mixed compact spaces with intensive use. Socio-cultural and economic advantages have supported the two principles of zoned activities and mixed-use. New Urbanism and Smart Growth theories recognize the compact city approach to design and urban planning, which is considered more environmentally friendly. Proposals for realizing compact types have ranged from developing low-rise types to building at higher densities, and gaining knowledge of the implications and impacts of different densities. Building heights can be classified into six categories: i. Single-Storey or Ground Only, ii. Two-Storey or Low-Rise, iii. Three-Storey or Ground Related, iv. Four-Storey or Ground Related, v. Five-Ten Storeys or Medium-Rise, and vi. Eleven or more Storeys or High-Rise (Senior, et al, 1987, p.14). Achieving compact types necessitates careful consideration of spatial planning, social and cultural adequacy, plot and house size, housing typology, and environmental appropriateness (Acioly & Davidson, 1996). Urban planners often overlook the developmental implications and effects associated with the different densities (Senior et al., 1987). High densities present various challenges, including transportation choices, living conditions, pollution, and congestion (Richardson et al., 2000). This study establishes that compact types must not only demonstrate an increase in built-up area, residential density, and a reduction in travel distance through the incorporation of home-based enterprises, but also achieve these objectives while protecting households from floods and preventing the encroachment of housing on wetlands. This is crucial, as a significant percentage of low-income households in SSA live in low-lying areas.

In SSA countries, we need to reconsider the concept of compact cities. Particularly for low-income households, we should consider compact building types that increase residential densities and curtail encroachment on wetlands. Informality helps meet the shelter needs of low-income households. Additionally, it supports the benefits of compact city living, smaller ecological footprints, higher densities, diverse architecture, mixed-use areas, walkable neighborhoods, and incremental growth. Due to the duality of informality, some scholars argue for the inclusion of informality characteristics in formal planning (Kolowa et al., 2024). In Kampala, like in many cities in SSA countries, official standards exist to regulate urban development. Official standards can, to some extent, aid the propagation of urban sprawl and the encroachment on wetlands—the building bylaws in Kampala date back to 1968. In the formal areas of Kampala, the Building Standard, Code of Practice encouraged detached single-story houses on large plots. For instance, in the formal low-income areas, very few two- to five-story houses were planned. Despite these areas being intended to be high-density (Nnaggenda-Musana, 2004). The building bylaws also stipulate 20 feet (6.1 meters) of open space in front of buildings. This open space is supposed to *extend along the entire length and for the full height of the said building*‖ (Republic of Uganda, 1968, p. 18). These "borrowed" building standards and norms control everything from the width of roads to the sizes of rooms. Detached houses can be viable in Kampala since they can receive adequate daylight and ventilation from all four exposures, providing the user households with privacy. They provide space and security for children to play, as well as areas for gardening, parking, and other outdoor uses. Most detached houses in Kampala are owned by individual households on privately owned land, except for a

few built by the government during the post-independence years. From this, it is clear that the increase in detached one-story house types is one of the most predominant causes of the sprawling nature of residential housing in Kampala. The present study focuses on the sprawl of housing development and the type of appropriate housing solutions that can be proposed for informal settlements to prevent surface runoff water from entering people's houses. Since the bungalow is a symbol of status (King, 1984), it is most probable that, in a bid to build the same house type, the urban poor are increasingly building one-story houses for themselves, but only in a way that is affordable to them.

2.2. Housing Vulnerability in Informal Settlements

One way to understand vulnerability is as a condition that precedes and is linked to the characteristics associated with the traits of an entity that is at risk, predisposing it to the impacts of hazards. Vulnerability is calculated as the expected uninsured percentage of a community's property loss for a specific water depth (Desmond et al., 2024). Researchers and organizations are increasingly utilizing vulnerability analysis to identify areas where people and habitats are most exposed to climatic and environmental changes. Addressing vulnerability and exposure is crucial in informal settlements, where millions of people are at risk of harm. Addressing vulnerability and exposure is crucial in informal settlements, where millions of people are at risk from extreme climatic events. For instance, poor solid waste management has led to blocked drainage systems in informal settlements on the outskirts of Greater Kampala's business. Increased seasonal rainfall has also contributed to climate change, making already vulnerable households more susceptible to flash flooding. The location of Kampala's informal settlements in low-lying flood-prone areas exacerbates the situation. Floods are associated with enormous socio-economic losses because of damage to property and goods, and disruption of work and business activities. The International Labor Organization estimates that in sub-Saharan Africa, informal work accounts for 72% of all employment (Richmond et al., 2018).

To make decisions that improve the standard of living for households in the informal settlements and stop the widening of equity gaps in urban areas, decision-makers should be aware of the scope of mitigation and adaptation techniques in the housing sector. Such an approach might reduce the likelihood that the well-being of households in the informal settlements will continue to deteriorate (Jean-Baptiste et al., 2018). In the informal settlement, households have inadequate access to clean water, solid waste management, sanitation, and healthcare. A changing climate could worsen the situation; for instance, waterborne illnesses, including cholera, malaria, lymphatic filariasis, and diarrhea, would pose a threat as a result.

When studying informal settlements, one might uncover underlying theories that explain their dynamics and existence. An interdisciplinary approach incorporating ideas from urban planning, sociology, economics, and political science is necessary to comprehend the dynamics of informal settlements and urban regeneration. After World War II, the modernization theory of growth, based on Western principles and strategies, emerged to provide solutions for the nations that were becoming more urbanized. The theory has been criticized for its limited effectiveness in improving the lives of people in these countries, despite its ongoing influence in the context of globalization (Nambassa & Purnomo, 2024). In Uganda, the application of modernization theory has often had inadvertent consequences. Foreign-funded large-scale projects have displaced local communities, disrupted traditional farming practices, and made socio-economic inequalities worse (Akbari, 2022). Alternative perspectives advocate for development ethics that prioritize local cultures and values in response to the limitations of modernization theory. Different frames of view support development ethics and put local traditions and values first (Mason, 1994).

In Africa, where it continues to play a crucial role in conversations about urban development, informality is a subject of interest and a matter of scholarly and policy concern. Informality is described in planning regulations as unusual and an exception to the formal order (Olajide, 2023). The effectiveness of urban informalities in promoting sustainable cities in sub-Saharan Africa (SSA) is a topic of debate among academics and urban planners. Modernization theorists in the early 1960s strongly opposed urban informalities, arguing that as countries ascend the development ladder, the formal sector eventually grows and absorbs informal activities, promoting Rostow's (1960) phases of economic growth (Azunre et al., 2021).

The study of informal settlements and urban regeneration is informed by several key ideas and conceptual frameworks (Chrispus & Shema, 2025). The method emphasizes how urbanization, industrialization, and technological innovation lead to economic development. However, critiques from a postmodernist perspective argue that development is not a universal narrative of reality, but rather a socially constructed reality that reflects power relations and cultural biases (Nambassa & Purnomo, 2024). The modernization theory has been applied in this study to support Kampala's urbanization (Williams & Bidandi, 2018).

Despite aiming to improve economic indicators, these programs often overlook the social and cultural factors that are vital for sustained development. The limitations of modernization theory have spurred the emergence of alternative paradigms, particularly the Theory of Dependency, as it overlooks

the effects of colonialism and the unequal global relationships that still influence development. It suggests that underdevelopment is an externally produced phenomenon in urbanizing countries (Edet & Adie, 2024). Today, the dependency theory criticizes the modernization model (Sociology Institute, 2022). Dependency theory can be viewed theoretically as the result of the underdevelopment of both the industrialized and non-industrialized nations due to unequal power dynamics. Despite the apparent improvements, the metrics of economic growth and firsthand observations of the Global South indicate that urban informalities are increasingly prevalent. Are urban informalities helping the economies of the Global South, or could the progress have been more impressive if they had been eradicated? These enquiries spark discussions on the usefulness of urban informalities for developing sustainable cities in the Global South. Two main differences are present in the discussions: the consideration of informalities as potential solutions and development catalysts (Azunre et al., 2021).

Informality, as a significant source of housing and income in Africa, is a crucial aspect that warrants emphasis (Olajide, 2023). The idea of coloniality serves as the basis for the formal–informal binary instrument of colonial control, which (re)produces and sustains racialized displacement and racial hierarchies in modern times. As a theoretical tool, racialized displacement describes how households in informal settlements are not acknowledged and are always in danger of being forcibly evicted or physically relocated because they are deemed unworthy of residing in the city's desirable areas. Restoring domination over racialized groups is exemplified by the upholding of hierarchies of superiority and inferiority based on colonial taxonomies and the classification of individuals into "zones of being" or "nonbeings" (Olajide, 2023). Export planning initiatives regarding informal settlements should not view these regions as issues that must be solved, but rather acknowledge the possibilities and undercurrents that now exist there. It is essential to acknowledge informal settlements as a source of social cohesion and economic support for the city. Given the limited benefits of formal methods for housing and urban planning, particularly for low-income households, the growing trend in urbanization points to the importance of innovative approaches. One should seek methods to include them in the larger urban development plans (Jenkins et al., 2006). The rising trend in rapid urbanization highlights the need for innovative approaches to urban planning and housing, as current formal methods have demonstrated limited positive effects, especially for low-income households.

3. METHODOLOGY OF THE STUDY

This paper aims to introduce readers to a typical approach in low-income housing research, especially when the topic has received little prior attention. The study employed a phenomenological research design, examining the lived experiences of individual households within their respective lifeworlds. The focus was on exploring, understanding, and describing the subjective experiences and perceptions of each household. The study used a methodology called Exploratory-Descriptive Qualitative (EDQ) because low-income housing suitable for flood-prone areas is little understood. These methods, when combined, ensure that qualitative research is comprehensive, revealing both the broader context and specific nuances needed for actionable insights (Lim, 2024).

The research, conducted from July 2023 to May 2024, focused on identifying key issues and variables, such as house types, that are vital to the livelihoods of low-income households, as well as understanding possible ways to provide professional guidance and developing appropriate house types and house clusters. These are based on exploration, discovery, and inductive logic. The research was inductive in that it explored possibilities rather than what necessarily exists, demonstrating that the research is qualitative. Four sources of evidence were employed: observations, semi-structured expert interviews, and systematic or experimental sketching and expert assessment. Observations were conducted to document the spatial qualities and the use of space. Houses and spaces were photographed as an additional way of documenting spatial qualities in the Bwaise III Kalimali zone. The semi-structured expert interviews were conducted with 45 residents from different households and four key persons. The 45 residents comprised men, women, and the youth (mixed gender). Each group was interviewed alone. Key persons and low-income households were interviewed to gather and analyze views from professionals about their understanding of urban sprawl, detached house types and their drawbacks, and house types and appropriate house clusters, especially for low-income households, considering flood control. Systematic or experimental sketching and expert assessment were employed to investigate different ways in which building types and house types could be combined within house clusters in order to understand the kinds of spaces created and to judge whether these spaces were appropriate. This informal settlement was selected as a study area because it is one of the places in Kampala that experiences extreme weather events.

4. THE EXISTING SITUATION

The Bwaise III Kalimali Zone informal settlement in Kampala, Uganda, was studied to explore the possibility of developing house types that are resilient to the impact of flooding and cloud burst. The household members who were interviewed mentioned that they live temporarily in Bwaise III and often travel back to the rural areas to visit their families' homes in the villages, where their burial grounds are located. When asked why they came to the city, most mentioned that they came to "kuba

kyeyo".[1] Since farming for sustenance in rural areas took a long time to yield benefits, they saw it better to move to urban areas *for a better life and access to better services, such as proximity to water sources*. They further stated that during the festive seasons, they must return to their homes in the rural areas to celebrate as a way of escaping the harsh living conditions of the city.

The Bwaise III Kalimali Zone informal settlement was established due to illegal encroachment on a wetland. Households here do not have legal ownership of the land. Most live here on Ndagano.[2] The majority have either "bought the land" or a house from someone, while others are renting. Sale agreements are often a cause of disputes, especially between women and men, which can lead to domestic violence. Rental prices range from 40,000/= ($10.88) to 50,000/= ($13.60) for one-room house types, and are about 100,000/= ($27.21) for the more expensive ones. Ironically, housing construction in the area requires permission from KCCA; therefore, builders often work at night to avoid legal repercussions.

The houses are mostly one- to two-roomed types with a small veranda for cooking. The preferred houses are those with separate bedrooms and separate outdoor kitchens. Some houses have windows on the front walls, while a few have small openings on the back wall, allowing for some cross ventilation. The building materials most commonly used in informal settlements are those that are affordable to low-income households. Many recycled materials, such as clay bricks, adobe blocks, timber boards, and tin sheets, are combined to construct the houses.

The Bwaise III Kalimali informal settlement is bordered on all sides by roads. The interview participants mentioned that when many people first moved to the area between 1990 and 1998, it was characterized by banana plantations, swamps, coffee trees, yams, and cassava plants. According to interview participants, flooding in the area was minimal until the Northern Bypass Highway was constructed. Many households would wish to be able to grow crops for sustenance, but the ground is barren (see Plate 2). Farming in the area is impossible because the topsoil (humus) has been washed away.

Plate 2: Barren ground, no sign of vegetation

Bwaise III does not have any public open green areas, except one adjacent to a community hall. Circulation pathways serve as public areas where friends may gather and converse. The roads are primarily small, and many people were seen simply moving through the settlement with little space for children to play. Some participants expressed their inability to allow their children to grow up here. People with disabilities (PWD) have a hard time getting in or moving around once inside. Due to the overcrowding and flammable living equipment, the settlement is in significant danger of catching fire.

A few income-generating activities or home-based enterprises (HBEs) are carried out in the broader circulation spaces, while many residents of the area sell merchandise on the pavements along the roadsides outside the residential area, where there is greater exposure. Households establish small HBEs to supplement their limited earnings. They stated that floods continuously disrupt these businesses. The businesses include small shops, salons, eateries, pubs, and dhobis. Floods destroy their hard-earned merchandise or equipment, and the businesses also become inaccessible to customers, worsening the financial strain on households.

Households struggle to connect to the regular electric grid, resorting to illegal methods to power their cooking or television. The sanitation is poor; there is a lack of safe drinking water. Luckily, there are small private clinics within the settlement. The households had prepaid for a few water meters, which they believed were cheaper, but they no longer functioned. Tap water is available, but it is expensive. Households have access to water for domestic chores and other uses.

[1] "Kuba kyeeyo" in Luganda means "to be a casual or low-paid worker" or "to be unskilled". It's often used to describe someone who is not formally employed or who holds a job that doesn't require specialized skills.

[2] Ndagano means agreement in Luganda.

Initially, households helped themselves with plastic bags; today, a few have constructed their pit latrines, while many have shared pit latrines, with cubicles allocated to several households. Pit latrines are emptied with the help of Tukutukus.[3] The collection of waste between houses is difficult, which can attract disease-transmitting vermin. A public sewer line passes through the area, and the households wish that they could tap off it. Rudimentary drainage channels for surface runoff in the area are self-built, crisscrossing the area. The households cited clogged drainage channels caused by the dumping of plastic waste as the cause of flooding in their community. A group of men periodically cleans these channels for a small fee.

Garbage collection is tendered privately at 3000/= (USD 0.82). The households mentioned that the private sector has done an excellent job because the Kampala City Council Authority (KCCA), which is responsible for collecting garbage, does so only occasionally. Bwaise III Kalimali zone has no vehicular access routes; therefore, garbage collection is conducted with the assistance of wheelbarrows. Participants mentioned noise from born-again worshippers, prostitution, and rampant crime—alcoholism, and drug usage (marijuana, khat or miraa chewing)—and inhaling aviation fuel as additional issues in the neighborhood. There are many prostitutes in the Ki-Mombasa neighborhood, they said.

The paper aims to highlight how to develop houses that are safe for areas at risk of flooding by observing the everyday lives of low-income households and studying the basic features of their informal housing. The design proposals incorporated the key findings. The study aims to develop suitable house designs that can save lives by preventing water from seeping into living spaces and providing essential spatial qualities to support domestic activities, thus improving the living conditions of households living in flood-prone informal settlements. To prevent informal settlements from expanding into wetland areas and to make room for essential infrastructure, their house styles should also increase residential densities by extending single-story houses vertically upwards. In this way, natural surveillance and defensible space concepts can be enhanced to ward off crime.

The study examines the housing preferences of low-income households residing in Kampala's informal settlements to create new types of housing clusters that cater to their lifestyles and to develop new models based on local informal housing practices. The difficulty that households face accessing adjacent semi-private outdoor space in multi-storied building types has been a significant negative aspect of government-provided accommodation (Nnaggenda Musana, 2008). This study, therefore, proposes minimum infrastructural services, like access roads and water systems (water stands) that can be enhanced gradually during further upgrading. During the planning process for upgrading and improving accessibility to formal housing for low-income households, the design decisions considered in this study aim to enable households' control of their environments, thereby increasing their self-sufficiency and self-esteem. Specifically, the study includes two-story, ground-related houses that provide the households easy access to outdoor spaces. The significance of outdoor space for low-income households has been undervalued by building professionals. The current study reveals that households residing in informal settlements frequently use outdoor spaces. Houses and rooms are clustered around modifiable, flexible spaces.

Observations have shown that households in informal settlements tend to transform their houses. In this study, activity patterns, including space provision for HBEs, were considered on the ground floor. Field studies reveal that HBEs play a crucial role in generating income for low-income households, particularly women who tend to stay at home longer than men. This study presents general design guidelines for planning and designing an enabling urban environment for low-income households, based on vertical growth, adaptability, and self-help. The HBEs can be allocated the ground floor of the proposed housing solutions during the wet seasons, and outdoor spaces can be utilized during the dry seasons. Household living can happen on the upper floor during floods. Access to clustered houses is considered for the circulation of service vehicles such as cesspool trucks, which are used to empty pit latrines

5. DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

Numerous low-income households residing in self-built houses located in informal settlements lack the safety and comfort necessary for living in flood-prone areas. Building low-rise houses that also consider environmental appropriateness (Acioly & Davidson, 1999) could potentially mitigate this problem. However, a challenge arises in finding low-cost construction elements, especially floor slabs that can be self-built while providing safe support for low-rise buildings. The objective of this paper is to identify housing types suitable for low-income households in informal settlements located in flood zones. These house types would, at the same time, be compact enough to increase residential densities and limit the sprawl of informal settlements into wetlands. In Kampala's informal settlements, some vertical houses are built to prevent floods from affecting interior living spaces (see Plate 3). These can also allow for an ecological footprint since the ground is relieved of crowded houses.

[3] Tukutukus are motorised tricycles; they are a mode of transport in Uganda.

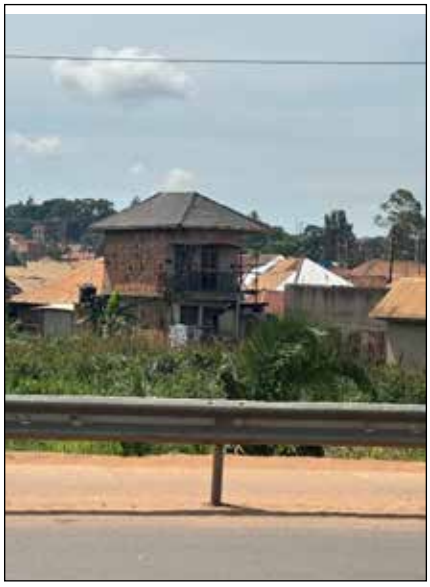

Plate 3: A Two-Story house in the informal settlements

"Camper households", which are people who come to Kampala for employment but wind up staying longer, are a distinctive aspect of the dynamics surrounding informal settlements in the city. Informal settlements are regarded as permanent residences by the countries' internally displaced individuals and refugees who lack second houses. This necessitates the regularization of informal settlements by implementing new, adequate long-term housing options, supported by an appropriate legal framework that directs the process of upgrading. Regularization may involve integrating informal characteristics into formal planning (Kolowa et al., 2024). To provide livable housing clusters in informal settlements, physical restrictions must be established to ensure planned, adequate space in and around homes.

Informal settlement upgrading resembles urban renewal but does not represent a development perspective. Minimum relocation should be key during transformation. Households in Kampala's informal settlements are involved in diverse forms of informal activities, either as HBEs for subsistence or other purposes. One way to curb sprawl and prevent flooding of houses without requiring major relocation of households is to guide low-income households to build incrementally, but horizontally and vertically; for example, see Plate 4.

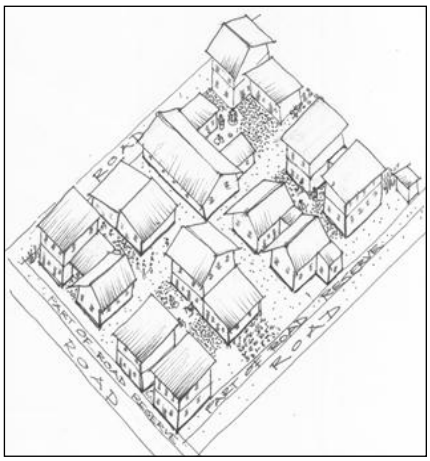

Plate 4: An example of vertically and horizontally extended houses

Low-rise houses would create more ground space for activities such as HBEs or small-scale agriculture conducted by households. The residual space between houses can also be improved to form access routes to the plots or extended into open spaces, thereby preventing pollution by allowing for ventilation, daylighting, privacy, and horizontal and vertical house extendibility, for the compact, low-rise types. There is a symbiotic relationship between housing and HBEs. Incomes from HBEs enable house owners to transform their houses incrementally, depending on when the finances allow. Money accrued from income-generating activities enables households to buy building materials in small amounts, which they can use to construct house extensions incrementally whenever they acquire cash. The majority of low-income households do not have permanent jobs; hence, HBEs can be their only source of income. Many households would not have their houses if they were not involved in some income-generating activity. Similarly, some income-generating activities would not exist without the use of the house. Low-income households struggle to increase their revenue through the process of acquiring and improving their shelter. Despite increasing research into HBEs in low-income settlements, their interrelationship with housing is an issue that has received relatively little attention. How they should be planned in relation to other domestic spaces is usually not explained (Kellett & Tipple, 2000). I propose that to reduce the suffering of low-income households during floods, the ground floor of their house can be used for HBEs and the upper floor for living. During floods, the households can remain on the upper floor.

When low-rise, vertically extended housing is introduced, environmental conservation can be improved in Kampala's informal settlements through green upgrading by incorporating green spaces in areas previously occupied by the sprawled housing. Combining the backyards of rectangular houses blocks can create negative space for the introduction of greenery. Vegetation contributes to mitigating flood risks by absorbing water, slowing down surface runoff, reducing erosion, decreasing the local air temperature, and improving air quality through the reduction of pollutants in the neighborhood (Jean-Baptiste et al., 2018). To protect low-income households from flooded houses, it is essential to construct low-rise cluster-type houses that connect limited indoor spaces to outdoor areas, allowing households to utilize their outdoor spaces more effectively. This, in turn, means that the proposed houses should not be too high to enable the households to carry out outdoor activities comfortably, for instance, the need to light charcoal stoves. Another reason for not building too high is the need for outdoor sanitary facilities. Houses with indoor WCs (water closets) are unaffordable to low-income households because they require septic tanks or connection to public sewerage systems.

African cities can be key assets for development if urban planning focuses on the drivers of vulnerability and their impact on human livelihoods. Urban planning should also involve community members in the decision-making process. Well-managed cities can offer significant potential and opportunities. The organization and layout of a space determine the level of happiness in a

city. Congested and poorly planned cities like Kampala are not only stressful to live in; they are dream killers because of the effort it takes for people to afford necessities." (Richmond et al., 2018). Flooding events in informal settlements make the low-income households disproportionately vulnerable due to poor housing and limited access to resources, and they are uninsured against the impact of floods (Desmond et al., 2024). Low-rise house types combined with space for income-generating activities can greatly enhance resilience.

The Ugandan government has at times invested in infrastructure to prevent severe flooding, such as enlarging drainage channels in areas prone to flooding. However, its lack of commitment has caused the infrastructure to deteriorate quickly, wasting taxpayers' money and leaving the households in informal settlements at risk (KCCA, 2015). To raise living standards and lessen vulnerability in these settlements, adequate municipal infrastructure and services are required. Infrastructure placement, including water pipelines and sanitary facilities, can be influenced by bottom-up urban planning techniques. Sound urban planning and sufficient financing for essential infrastructure directly enhance the city's sustainability and well-being. The majority of the study's localities are susceptible to flooding. The government's investment alone in informal settlements has led to their rapid deterioration, resulting in the wastage of funds and leaving the households in these settlements vulnerable. The top-down approach has not been successful in directing development through policies rather than design and planning. The study's findings demonstrate the importance of considering a community's unique housing needs when developing an urban area. It will be easier to identify hazards, implement policies, and create resilient urban plans if architects and urban planners are involved in community-specific requirements. Community participation in flood management is often overlooked due to the dominance of contemporary central government-funded partnerships that overshadow urban policy (Arinabo, 2023b). Enlarging the circle of climate discourse to include the perspectives and concerns of all parties affected is crucial for developing effective housing solutions for tackling climate change. By leveraging a diverse range of skills, experiences, and information, this inclusive approach has the potential to enhance the effectiveness of design and planning work. In the past, beneficiaries of informal settlement improvement programs have not received any benefits.

Conditions that create disasters in informal settlements need to be addressed holistically; they cannot be addressed solely by the communities; they require coordinated efforts by professionals, civil society organizations, organized communities, and government support to reduce the underlying causes of vulnerability. Continuous sensitization of households in informal settlements about the social and environmental threats associated with encroaching on the wetlands is necessary. Individual and community household needs can only be met through bottom-up urban planning approaches, which can better inform urban planning and policy by focusing on alleviating overall flood vulnerability and ecosystem protection. The National Environment Act (2019) provides principles for environmental management like maintaining stable functioning relations between the living and nonliving parts of the environment and the restoration of lost or damaged ecosystems, where possible, even reversing the degradation of the environment and natural resources however there might be a knowledge gap in ways to implement this. All-inclusive innovation models for climate adaptation need to be developed so that households are empowered to manage the flow of surface runoff water in their neighborhoods. According to Nyam et al., 2024, understanding the factors that influence perceptions of flooding, such as environmental degradation, homelessness, and infrastructure destruction, along with the factors impacting the adoption of flood adaptation strategies and how they affect the livelihoods of the flood-affected community, is essential for guiding effective and efficient policy implementation. This knowledge enables practitioners and policymakers to develop sustainable adaptation measures that enhance resilience and promote long-term sustainability.

Gender, a socio-cultural component in the housing process, is disregarded mainly during the housing innovation process. It was noted that the youth and women revealed more information about their problems in Bwaise III than the men. There is little information in housing-related literature about how flooding affects men and women differently in informal settlements. Gendering flood-friendly housing innovations could significantly increase technological uptake in informal settlements and improve livelihoods by mitigating flood insecurity and flood poverty. The study focused on Kampala, Bwaise III, a poorly drained area vulnerable to riverine and surface water flooding due to its low-lying nature and proximity to River Lubigi, whose tributaries run through the area. Bwaise III has a high water table, making the area prone to saturation and increased flooding. Low-income informal settlements predominate in the area. The services and infrastructure in the area are inadequate; therefore, flooding is worsened by inadequate drainage systems or blocked drains resulting from poor waste management. Efforts to limit flooding, such as community mapping, GIS and modelling, drainage system improvement, and wetland restoration, have not been practical. Flooding events pose a significant financial burden on low-income households. Energies related to preventing further encroachment on the wetlands by housing, such as proposing houses that are livable for low-income households, are the focus of this study.

6. FURTHER STUDIES

Informal settlements demonstrate resourcefulness. The houses in these areas are built using principles of a circular economy, such as the reuse of materials, recycling of waste, and the sharing of resources. Developing strategies and roadmaps for circular built environments is a valuable endeavor. Still in its infancy, circularity strategies and roadmaps should be developed through cooperation with key built environment players, including governments, civil society, building professionals, and developers. A circular roadmap or strategy must outline the circular built environment, emphasize the advantages of the approach, provide an implementation plan, and be expansively publicized.

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Notes