ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

Live-in Water Vessels: A Sustainable Response to Flooding in Lagos

Sadia Mahmud Ananna[1]; Sinthi Saha Nirupoma[2]; Dr. Rumana Rashid[3]; S. M. Arafat Hossain[4]; G. M. A. Balayet Hossain[5]

[1,2,3,4,5]Ahsanullah University of Science and Technology

Publication Date: 2026/04/07

Abstract: Lagos, Nigeria, is a seaside megacity that is growing quickly. It floods often and badly because of heavy rain, bad infrastructure, and rising sea levels. These problems affect low-income areas more than other communities. Many of the groups learned how to live on the water by making their own boats. The study suggests Live-in Water Vessels, a floating home that is adaptable, resistant to flooding, and sensitive to local culture. It is being made as part of the "2022 Lagos: Flooding City Architecture Competition." Drawing from global precedents in Nigeria, Thailand, the Netherlands, Bangladesh, Vietnam, and Cambodia, the research integrates affordable, locally sourced materials with passive design strategies such as rainwater harvesting, natural ventilation, and adaptable layouts. The design promotes social cohesion, resilience, and environmental adaptability by enhancing the current floating lifestyle in impacted communities. The paper evaluates the feasibility of the concept in Lagos, compares it to international examples, and outlines policy, technical, and social considerations for implementation. The proposed model offers a replicable housing solution for flood-prone regions across the Global South.

Keywords: *Floating Architecture, Flood Resilience, Sustainable Housing, Community Adaptation, Live-in Water Vessels.*

How to Cite: Sadia Mahmud Ananna; Sinthi Saha Nirupoma; Dr. Rumana Rashid; S. M. Arafat Hossain; G. M. A. Balayet Hossain (2026) Live-in Water Vessels: A Sustainable Response to Flooding in Lagos. *International Journal of Innovative Science and Research Technology,* 11(2), 3272-3281. https://doi.org/10.38124/ijisrt/26feb1169

I. INTRODUCTION

Flooding, defined as the inundation of usually dry land with water, is one of the most serious urban challenges in many coastal megacities. Lagos, Nigeria's commercial and cultural capital, has faced more frequent and severe floods in recent years. This is due to rapid urban growth, poor drainage systems, rising sea levels, and changing climate patterns (Olukunga et al., 2024; Israel et al., 2024).

The city's low elevation, long coastline, and loss of wetlands make the problem worse. Between 2022 and 2023, Lagos experienced repeated floods that displaced thousands of people, damaged homes, and disrupted daily life. In some districts, coastal erosion reduced the shoreline by more than 80 percent (Ogundeji, 2025).

In 2022, Nigeria experienced its worst flooding in ten years. More than 1.4 million people were affected, and over 600 lives were lost across the country (Reuters, 2024; Wikipedia contributors, 2025). Lagos was one of the hardest-hit cities. Floodwaters submerged business districts, informal settlements, and key infrastructure. In some areas, water remained for hours or even days. These events show the urgent need for housing and infrastructure that can live with water, not fight against it.

In response, the Lagos: Flooding City Architecture Competition 2022 was launched. It was organized by the Arc. Eddy Eguavoen Foundation, in partnership with Voen Associates. The competition invited architects, planners, and designers from around the world. The goal was to propose creative, affordable, and locally grounded solutions to Lagos's flood risks.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

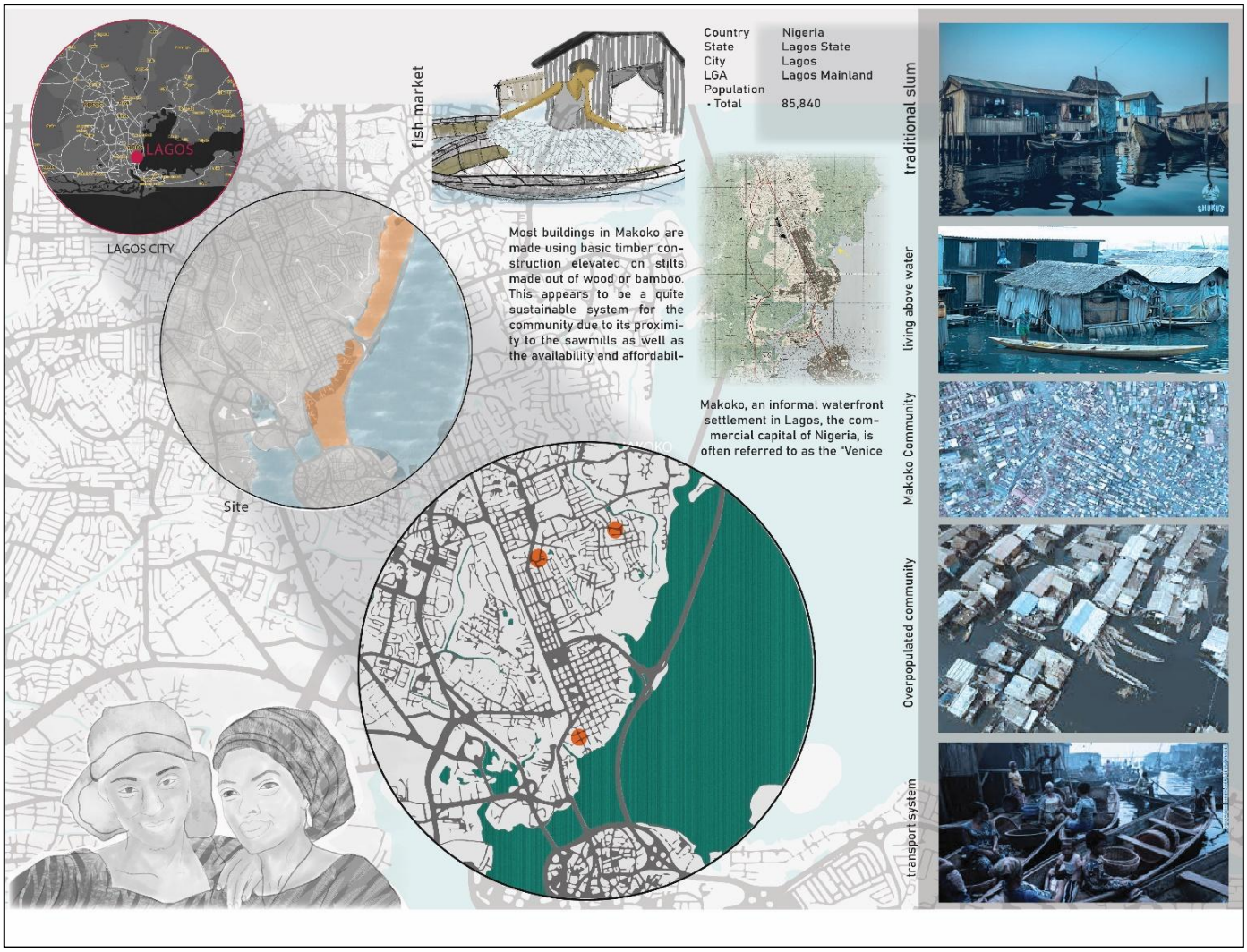

Fig 1 Site Context of Lagos City
(Source: Author's design studio)

The theme focused on resilience, adaptability, and community integration. Designers were asked to create safe and usable homes for flood-prone areas. The objectives included:

- Creating designs that embrace Lagos's aquatic landscape.
- Using sustainable materials and building methods suited to local needs.
- Exploring low-cost, scalable solutions for vulnerable communities.

Our team developed the concept *Live-in Water Vessels* within this framework. The design imagines floating homes that can move and adjust to changing water levels. These units support daily life while responding to floods. By combining building function with mobility, the proposal addresses both short-term risks and long-term urban growth in a changing climate.

This paper explores the following question: How can floating architecture support affordable and flood-resilient urban development in megacities like Lagos?

II. LITERATURE REVIEW

- *Flooding Condition in Lagos:*

Lagos is one of Africa's largest coastal cities. It has become more vulnerable to flooding due to many factors. These include coastline erosion, heavy rainfall, rapid urban growth, and poor drainage systems. A recent study showed that over 84 percent of Lagos's coastline has receded because of sea-level rise and erosion. Between 2022 and 2023, about 175,000 people were displaced, and property losses went beyond 262,000 US dollars (Ogundeji, 2025).

In July 2024, flash floods hit Lekki, Ikoyi, and Ajah. A single 10-hour rainstorm caused major damage and forced many residents to leave their homes (Ochogwu, 2025; Wikipedia contributors, 2025).

Rainfall is expected to stay above average in 2025, with longer rainy seasons ahead. In response, Lagos has taken emergency steps. These include clearing drains, setting up temporary pumping stations, and deploying flood response units (The Cable, 2025; Agbo, 2025). But these short-term actions show the need for more flexible and long-lasting

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

design solutions. Architecture must work with water, not against it.

This is the context in which the *Live-in Water Vessels* proposal was developed.

➢ *Global Case Studies in Floating Architecture*

- *Nigeria: Makoko Floating School and MFS II*

Makoko is a historic waterside community in Lagos Lagoon. It has long shown how people adapt informally to life on water. The Makoko Floating School, designed by NLÉ Architects, was a bold effort to formalize this way of living. The three-story A-frame structure floated on 256 recycled plastic barrels. It provided classrooms and space for community use.

The original building collapsed in 2016 due to structural issues. Still, it drew global attention to floating architecture in the Global South. A new version, Makoko Floating System II, was built in 2020. It used stronger materials, better buoyancy systems, and could be replicated in other places (Adeyemi, 2020).

Despite challenges with funding and regulations, Makoko's story shows the importance of designs that are rooted in culture and community.

Fig 2 Showing Makoko Floating School
(Source: Source: https://publicdelivery.org/makoko-floating-school/)

- *Thailand: Amphawa Floating Market*

Amphawa Floating Market in Samut Songkhram Province shows how floating architecture can support both culture and economy. The market was built to adjust to changing tides. Its stilted and floating structures allow trade to continue, even during heavy monsoon rains.

Tourism studies after 2020 found that Amphawa kept a steady income during flood events. This was possible because the market adapted its spaces to rising water and used eco-tourism strategies (Smith & Chantarang, 2021). Amphawa's example shows that flood-resilient design can protect cultural traditions and support economic growth at the same time.

Fig 3 Amphawa Floating Market
(Source: https://www.researchgate.net/figure/Floating-market-Wat-Saphan_fig1_364475000)

- *Netherlands: IJburg Floating Houses*

The Netherlands is known for its expertise in water management. One example is IJburg, a floating urban district in Amsterdam. Between 2018 and 2022, new groups of prefabricated homes were added. These homes float and are anchored with mooring systems. They connect directly to city services like sewage, electricity, and water (de Graaf, 2020).

Each unit is designed to rise and fall with changing water levels. This helps reduce flood damage. The system works well, but it is expensive. For cities like Lagos, there is a need for simpler and more affordable versions that can be built in low-income areas.

Fig 4 IJburg Floating Houses
(Source: https://www.archdaily.com/120238/floating-houses-in-ijburg-architectenbureau-marlies-rohmer)

- *Vietnam: Mekong Delta Floating Villages*

Floating villages in the Mekong Delta work as mobile communities. They shift location with the seasons, adjusting to changes in water levels. These villages include houseboats, fish farms, and shared spaces. Their mobility helps people live with water, making movement itself a form of resilience (Pham & Tran, 2022).

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

Still, these communities face growing challenges. Upstream damming and pollution threaten their long-term survival. Without stronger environmental protections, their way of life may not last.

Fig 5 Embarking on a Mekong Delta Floating Market Tour Allows Travelers to Witness the Dynamic Trading Scenes and Engage with Local Vendors
(Source: https://vinpearl.com/en/mekong-delta-floating-market)

- *Cambodia: Tonle Sap Floating Communities*

Tonle Sap Lake experiences major changes in water levels during the monsoon. The rise can reach up to 10 meters each year. Local communities have adapted by building fully floating settlements. These include schools, markets, and temples.

Despite limited access to healthcare and sanitation, these communities continue to function. They maintain strong social ties and active local economies (Sok et al., 2021). Tonle Sap shows why floating systems must include essential services, not just housing. It highlights the need for designs that support daily life on water.

Fig 6 Exploring a Floating Village on Tonle Sap Lake by Boat.
(Source: https://www.siemreap.net/attractions/sightseeing-nature/floating-villages/)

➢ *Comparative Insights*

Global examples show that successful floating architecture depends on three key principles. First, technical adaptability is crucial. Structures must handle changing water levels, strong winds, and wave pressure. They should also allow for modular growth or relocation as cities evolve.

Second, cultural integration matters. Designs that reflect local traditions, livelihoods, and social habits are more likely to be accepted and maintained by communities. They tend to last longer and feel more rooted in place.

Third, governance support plays a major role. Policies, subsidies, and partnerships help make floating settlements safer and easier to scale. Without this support, even strong designs may struggle to succeed.

In Lagos, the challenge is to bring these principles together in a way that works for low- and middle-income communities. Floating infrastructure must be affordable, flexible, and inclusive. It should support both climate resilience and fair urban development.

Table 1 Comparative Summery

Case Study	Key Strengths	Notable Challenges
Makoko (Nigeria)	Cultural relevance, community engagement	Structural vulnerability; limited scale
Amphawa (Thailand)	Cultural economy, tourism resilience	Tourism dependency; preservation pressure
IJburg (Netherlands)	Engineering precision, regulatory support	High cost; limited affordability
Bangladesh	Low-cost, grassroots adaptability	Limited infrastructure services
Mekong (Vietnam)	Social cohesion; mobility	Environmental pressures, sanitation gaps
Tonle Sap (Cambodia)	Shared services, market functionality	Health and sustainability concerns

III. CASE STUDY – COMPETITION & PROPOSED DESIGN

➢ *Lagos Flooding City Competition 2022: Background and Objectives*

The Lagos Flooding City Architecture Competition 2022 was organized by the Arc. Eddy Eguavoen Foundation, in partnership with Voen Associates. It called for creative design ideas to help Lagos respond to its ongoing flood challenges. The competition focused on affordability, resilience, and cultural relevance. It aligned with the UN Sustainable Development Goal 11, which promotes sustainable cities and communities.

- *The Main Goals Were:*

✓ To develop housing types that can withstand floods.
✓ To propose modular and flexible building systems.
✓ To include sustainable ways to manage water and energy.

Entries were judged on how innovative they were, how well they responded to the environment, how culturally

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

grounded they felt, and whether they could work for low-income communities.

➢ *The Proposal: Live-in Water Vessels*

The *Live-in Water Vessels* project was developed within the Lagos Flooding City Architecture Competition framework. It responds to Lagos's water-based culture and the urgent need for affordable, flood-resilient housing. The design draws inspiration from Makoko's informal floating settlements. It builds on their adaptive spirit while proposing a more structured and dignified way of living on water.

The concept centers on modular floating homes that can rise with floodwater and support daily life. These units are designed not just to survive floods, but to offer safety, self-sufficiency, and a sense of community.

- *Core Sustainability Goals*

✓ Flood resilience: Achieved through buoyant, modular construction that adapts to changing water levels.
✓ Affordability: Ensured by using locally available materials such as bamboo, timber, palm mats, and recycled barrels.
✓ Self-sufficiency: Supported by rainwater harvesting and solar photovoltaic systems for water and energy needs.
✓ Cultural relevance: Strengthened by designs that reflect community identity and support small-scale economic activities.

This proposal aims to create a housing system that is flexible, grounded in local realities, and capable of supporting life on water with dignity.

➢ *Technical Breakdown from Design Boards*

The Live-in Water Vessels employ a lightweight, yet robust structural system optimized for Lagos's aquatic environment.

- *Core Features:*

The *Live-in Water Vessels* are designed with modular components that support both resilience and replication. Each feature responds to the realities of life on water, while keeping construction simple and locally grounded.

✓ *Foundation and Buoyancy:*

Recycled plastic barrels are secured beneath a timber lattice. This system provides flotation and stability during tidal changes.

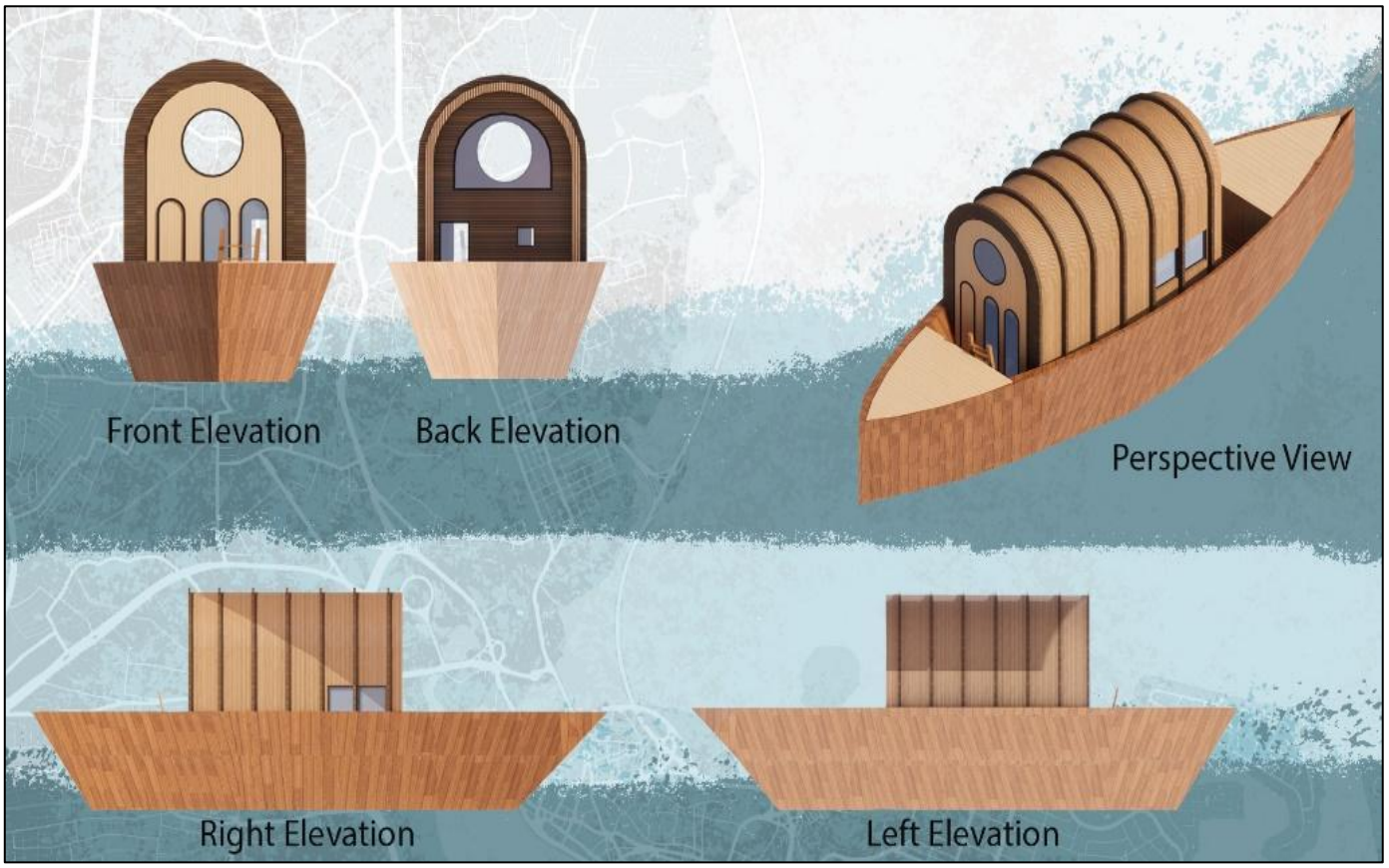

Figure 7: Technical Design Boards of Live-in Water Vessels
(Source: Author's Design Submission, 2022)

✓ *Structural Framework:*

The main structure uses prefabricated bamboo arches and timber beams. These materials are lightweight and easy to assemble.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

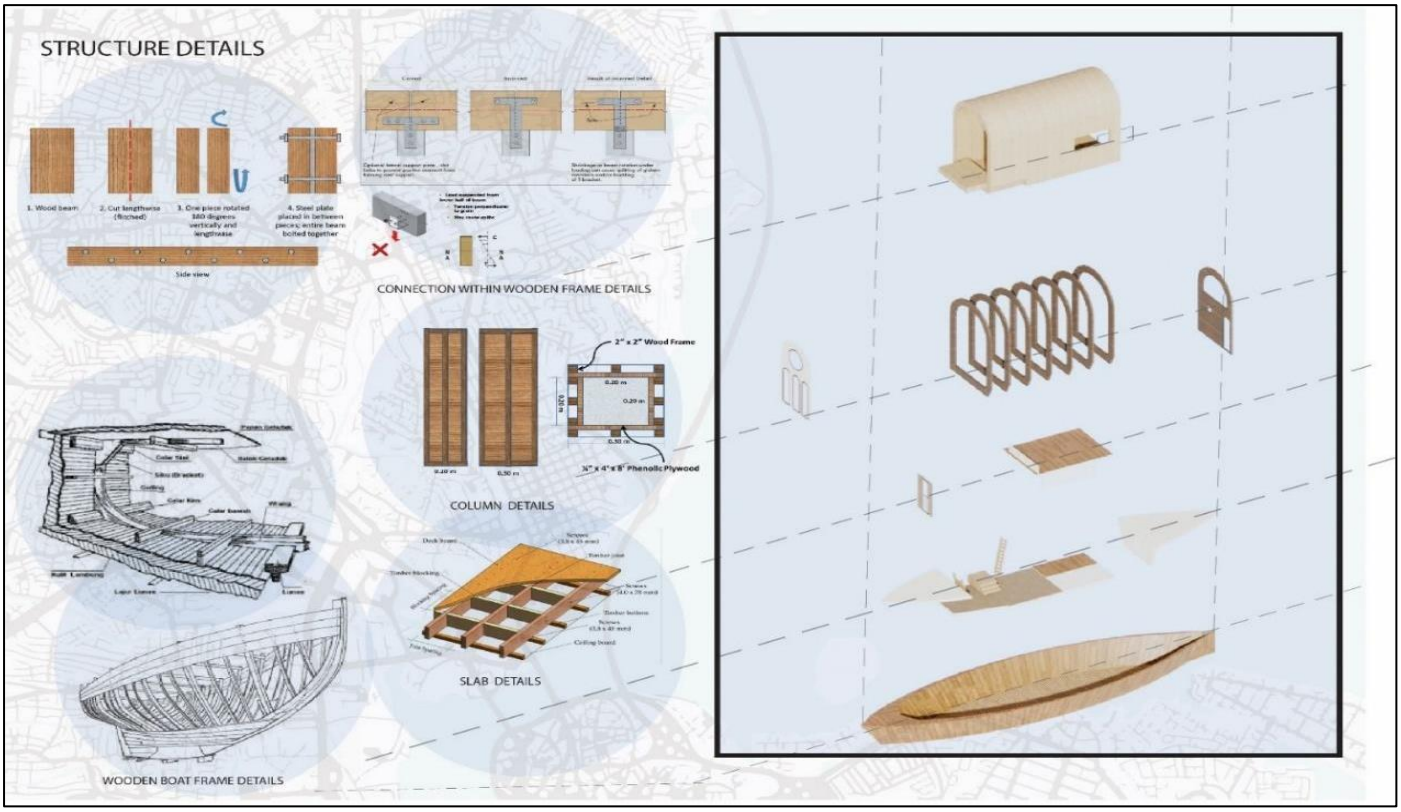

Fig 8 The Modular Timber Frame and Buoyancy System as Depicted in the Design Boards.

✓ *Material Strategy:*

Locally sourced bamboo and timber reduce environmental impact and support community supply chains.

✓ *Sanitation & Wastewater System:*

An arched roof collects rainwater. Gutters direct it into storage tanks under the house. There is a Water storage inside boat which supplies water through pipes in toilet and kitchen area. Another tank is maintained for waste management. Through ducting pipes, the wastage is collected from the toilet and kitchen. Above the wastage tank there's a biogas plant that can be set up from which gas can be produced inside the boat that serves the kitchen.

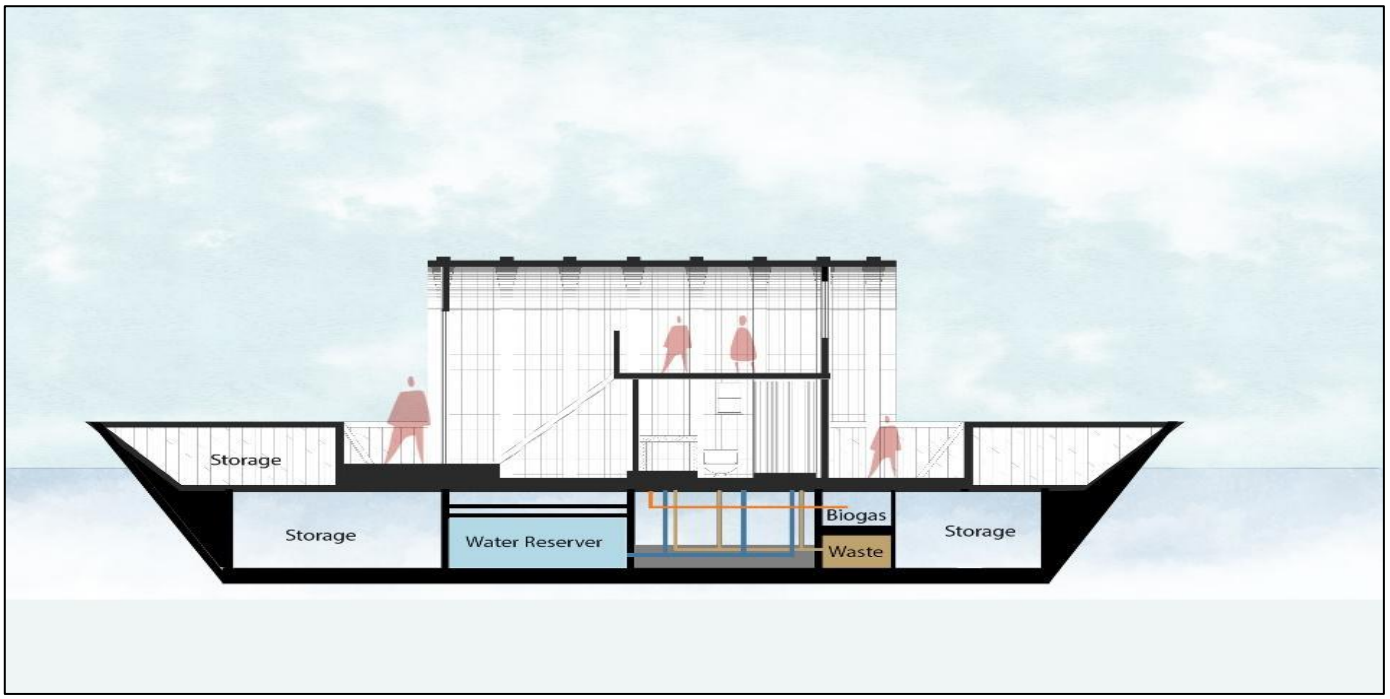

Fig 9 Sanitation & Waste Water System
(Source: Author's Design Submission, 2022)

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

✓ *Interior Zoning:*

Flexible partitions divide the vessel into zones for living, services, and livelihood. This allows families to adapt the space for daily needs and small businesses.

Fig 10 Technical Design Boards of Live-in Water Vessels
(Source: Author's Design Submission, 2022)

✓ *Mobility and Adaptability:*

Adjustable mooring systems make it possible to relocate seasonally or form floating clusters with other units.

This modular system is designed to scale. It can be replicated across Lagos's informal settlements, offering a flexible and affordable response to urban flooding.

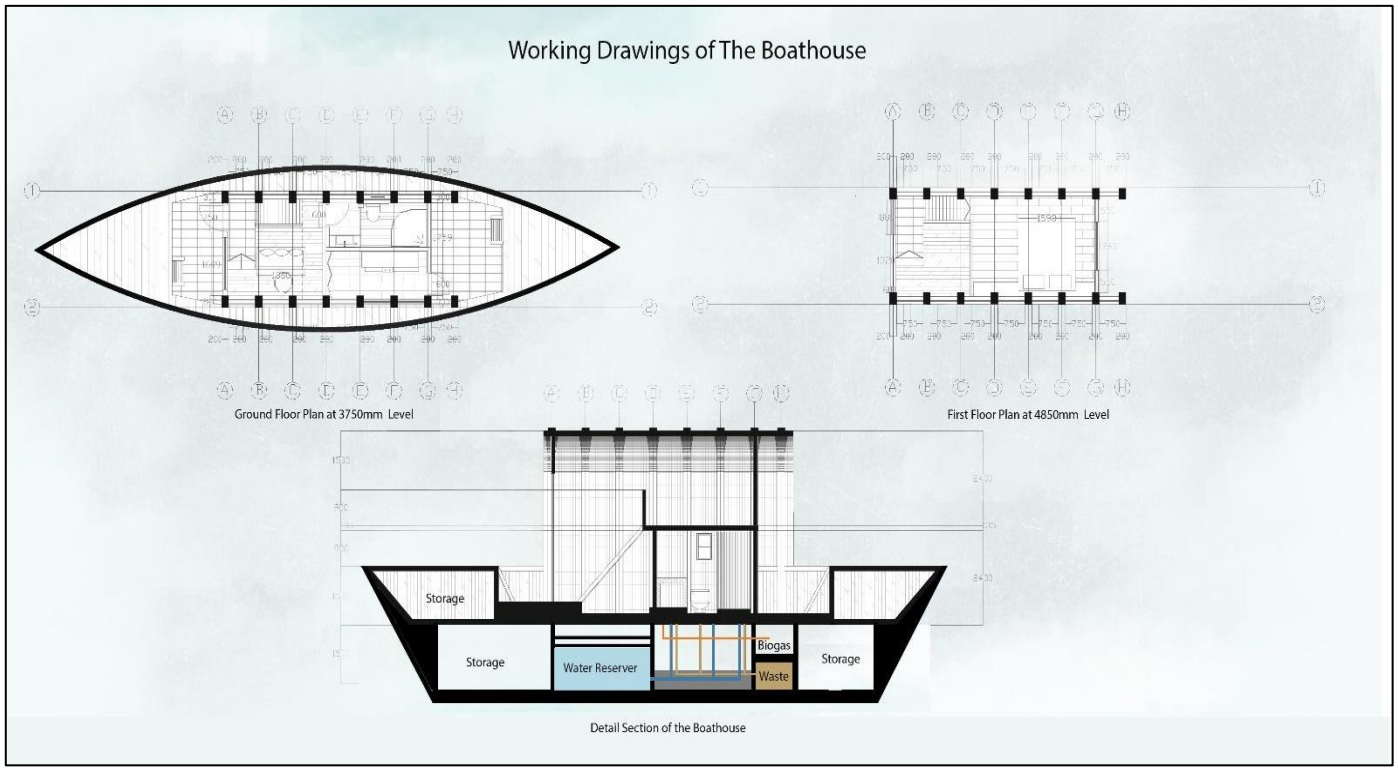

Fig 11 Technical Design Boards of Live-in Water Vessels
(Source: Author's Design Submission, 2022)

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

➢ *Comparative Positioning with Global Precedents*

The proposal draws lessons from global floating architecture but adapts them to Lagos's socio-economic realities:

- *Compared to IJburg (Netherlands):*

The vessels share the principle of buoyancy and modularity but prioritize low-cost local materials, avoiding the prohibitive costs of European models.

- *Compared to Makoko Floating School (Nigeria):*

Unlike a single-use educational facility, the vessels integrate permanent housing and livelihoods, making them more comprehensive.

- *Compared to Mekong and Tonle Sap (Vietnam & Cambodia):*

The vessels replicate the idea of seasonal mobility but embed sustainability features (e.g., solar power, water harvesting) to address ecological pressures.

Thus, the Live-in Water Vessels occupy a unique middle ground: combining community-led informality with technical reliability, making the model both feasible and scalable.

➢ *Reflections on Competition Outcomes*

Official records of the winning entries remain limited. Early observations suggest that many proposals focused on high-tech solutions. While innovative, these designs were often expensive and hard to apply in low-income settings.

In contrast, the *Live-in Water Vessels* stand out. They focus on replicability, fairness, and cultural relevance. The design responds directly to the needs of Lagos's most vulnerable communities. It offers a practical and inclusive path toward flood resilience.

IV. DISCUSSION

➢ *Competition Context*

The Lagos Flooding City Architecture Competition 2022 was launched as an international design challenge. It responded to the urgent climate risks facing Lagos, one of the world's most flood-prone megacities. The theme, *Living with Water*, invited designers to rethink housing. Instead of resisting floods, the goal was to create homes that could coexist with water (World Bank, 2022).

The judging criteria focused on four key ideas: resilience, affordability, cultural relevance, and scalability. These principles remain essential for helping cities like Lagos adapt to climate change—now and in the future.

➢ *Research Question*

This study was shaped by one central question: How can floating architecture support affordable and flood-resilient urban development in megacities like Lagos?

- *The Question Reflects a Pressing Need to Connect Three Key Aspects of Resilience:*

✓ Climate adaptation — designing homes that stay safe and usable as water levels rise.
✓ Socio-economic inclusivity — making sure solutions are affordable and accessible to low-income communities.
✓ Urban integration — placing floating settlements within city planning, not treating them as temporary or informal fixes.

Together, these dimensions guide the search for housing that works with water, supports daily life, and fits into the future of urban Lagos.

➢ *The Design Proposal: Live-in Water Vessels*

The Live-in Water Vessel is a modular floating home designed for Lagos's water-bound communities. It supports daily life while respecting local culture and environmental conditions. The design draws from traditional boat forms and stilted architecture. It focuses on adaptability, affordability, and sustainability.

- *Key Features and Sustainability Goals*

✓ Form and Structure The vessel uses an arched frame made of bamboo and timber. This shape improves strength and helps collect rainwater. Sealed plastic barrels under the platform provide buoyancy and keep the structure stable during floods.
✓ Spatial Zoning Inside, the space is divided into zones for living, storage, and services. Movable partitions allow families to adjust the layout for daily needs or small businesses.
✓ Material Selection The structure uses local bamboo, reclaimed timber, and lightweight panels. These choices reduce environmental impact and support local supply chains.
✓ Passive Design Strategies Natural airflow, solar orientation, and daylight use help lower energy needs. Solar panels on the roof provide electricity. A rainwater system collects and stores clean water.
✓ Mobility and Flexibility The vessel is anchored with adjustable mooring systems. It can move with the seasons or join other units to form floating neighborhoods.

This modular system is designed to grow. It can be repeated across Lagos's informal settlements, offering a scalable and community-led solution to urban flooding.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

Fig 12 Boathouse Launching Platform
(Source: Author's Design Submission, 2022)

➢ *Technical and Social Considerations*

For the Live-in Water Vessels to work as a viable urban solution, both technical systems and social frameworks must be considered together. On the technical side, the design must ensure the durability of bamboo structures, regular maintenance of buoyancy systems, and proper integration of sanitation and waste management. It also needs to meet basic safety standards. On the social side, success depends on community acceptance, active participation in co-design, and the inclusion of livelihood opportunities to support long-term use. The balance between these dimensions is critical. Without governance support and community ownership, technical innovation alone cannot lead to lasting resilience.

➢ *Comparative Positioning*

When viewed within the wider field of floating architecture, the *Live-in Water Vessels* offer a hybrid approach that blends global insight with local relevance. Unlike European floating districts such as IJburg in the Netherlands, which rely on advanced technology and high-cost materials, this proposal focuses on low-cost replicability using locally sourced resources. It also moves beyond the narrow scope of Bangladesh's floating schools, which serve educational needs but do not provide permanent housing or support daily livelihoods. Drawing from Makoko's informal water-based practices, the design adds structural strength and environmental sustainability, bridging the gap between informal adaptation and engineered resilience. This positioning shows how Lagos can lead the way in creating a flood-resilient housing model that is both globally informed and locally grounded.

➢ *Implementation Challenges*

Despite its potential, the *Live-in Water Vessels* proposal faces several challenges. One major issue is governance. Floating settlements are not yet legally recognized in Nigeria, which makes it hard to include them in formal urban plans. Infrastructure access is another concern. Reliable connections to clean water, sanitation, and energy are essential for scaling the model. Environmental risks also need attention. Without proper waste management, water pollution could threaten both health and ecology. Economic feasibility remains a barrier too. While the materials are low-cost, long-term funding and subsidies may be needed to support widespread adoption.

Overcoming these challenges will require collaboration across multiple levels—government, civil society, and local communities must work together to make floating housing a viable and inclusive solution.

➢ *Toward Inclusive Water-Based Urbanism*

The *Live-in Water Vessels* show that floating architecture is more than a technical solution. It is a strategy for social and cultural adaptation. By protecting traditional water-based livelihoods and embedding sustainable systems, the design offers a new way forward. It suggests that Lagos can move beyond reactive flood control and toward a more inclusive, water-based urban future.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26feb1169

V. CONCLUSION AND FUTURE SCOPE

As climate-related flooding becomes worse in Lagos, land-based housing is no longer enough. The Live in Water Vessels offer a new way to live. They are floating, modular, and shaped by local culture. The design uses local materials, passive cooling, and renewable energy. It gives flood-prone communities a housing model that is both affordable and flexible.

This study shows that floating homes can do more than resist water. They can protect culture, build strong communities, and support economic inclusion. But success depends on solving key problems. These include sanitation, waste management, legal approval, and long-term strength.

Future work should focus on five areas. First, study the full cost of living in these homes. Second, improve materials to make them stronger and safer. Third, involve communities in the design process. Fourth, test the homes in real conditions in Lagos. Fifth, include floating housing in city planning and policy.

If these steps are taken, Lagos can lead the way. It can build a model of water-based living that is strong, fair, and useful for other flood-prone places in the Global South.

REFERENCES

[1]. Adeyemi, K. (2020). *Makoko Floating System II*. NLÉ Architects. https://www.nleworks.com/projects/mfs-ii
[2]. Agbo, C. (2025, June 12). Lagos State intensifies flood response measures. *The Cable*. https://www.thecable.ng
[3]. de Graaf, R. (2020). *Floating urbanism in the Netherlands: Engineering resilience*. Amsterdam University Press.
[4]. Israel, D., Adebayo, O., & Musa, T. (2024). Flooding patterns and climate variability in Lagos. *Journal of Climate and Urban Studies, 12*(3), 115–129. https://doi.org/10.1016/j.jcus.2024.03.005
[5]. Ochogwu, S. (2025, July 18). Flash floods displace residents in Lekki, Ikoyi, and Ajah. *Daily Post Nigeria*. https://dailypost.ng
[6]. Ogundeji, T. (2025). Coastal erosion and flood vulnerability in Lagos State. *Journal of Environmental Studies, 15*(2), 34–48. https://doi.org/10.1080/jes.2025.0034
[7]. Olukunga, A., Bello, K., & Johnson, R. (2024). Urban expansion and drainage challenges in Lagos. *African Journal of Urban Management, 8*(1), 45–63. https://doi.org/10.1177/ajum.2024.0005
[8]. Pham, L., & Tran, H. (2022). Floating communities of the Mekong Delta: Adaptation and sustainability. *Asian Journal of Environmental Research, 11*(3), 145–163. https://doi.org/10.1016/j.ajer.2022.05.004
[9]. Reuters. (2024, October 15). Nigeria floods displace over a million residents. *Reuters*. https://www.reuters.com
[10]. Smith, J., & Chantarang, S. (2021). Amphawa Floating Market: Cultural resilience through tourism. *Journal of Urban Heritage Studies, 9*(1), 77–95. https://doi.org/10.1080/juhs.2021.009
[11]. Sok, V., Chan, L., & Dara, P. (2021). Resilient livelihoods in Tonle Sap floating communities. *Southeast Asian Studies Review, 18*(4), 201–220. https://doi.org/10.1177/seasr.2021.0184
[12]. Wikipedia contributors. (2025, March 1). *2022 Nigeria floods*. In *Wikipedia*. https://en.wikipedia.org/wiki/2022_Nigeria_floods
[13]. World Bank. (2022). *Climate vulnerability in Lagos*. World Bank. https://documents.worldbank.org