

## Post-Occupancy Evaluation (POE) of Architectural Space and Livelihood Infrastructure in Resettlement Areas for Boat-Dwelling Communities in the Tam Giang – Cau Hai Lagoon: A Case Study of Thuy Dien Resettlement Area, My Thuong Ward, Hue City



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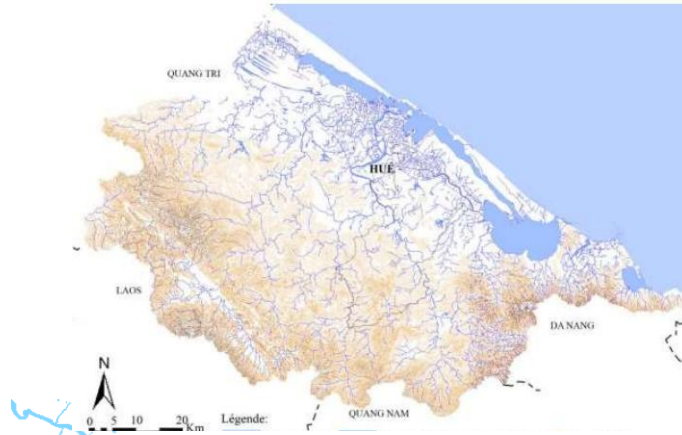
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# The Tam Giang - Cau Hai lagoon complex

## Introduction

As one of **Southeast Asia's largest brackish water bodies**, the Tam Giang – Cau Hai lagoon system spans 68 km along the coast (216 km<sup>2</sup>) and connects three main lagoons: Tam Giang, Thuy Tu, and Cau Hai.



Source: GIS Hue – Base topographic map data of Hue. Map annotated by the author.

# Chuon Lagoon

- Chuon Lagoon (An Truyen Lagoon) is located approximately 10 km from the center of Hue City.
- It is part of the Thuy Tu lagoon subsystem within the Tam Giang - Cau Hai lagoon complex.
- Spanning over 100 hectares, **Chuon Lagoon plays a vital ecological role and serves as the ancestral home of the boat-dwelling community.**



Source: Google Earth

## Introduction



Source: <https://gis21.thuathienhue.gov.vn/>

# The formation of Thuy Dien resettlement area

## Introduction

### From Vulnerability to Resettlement:

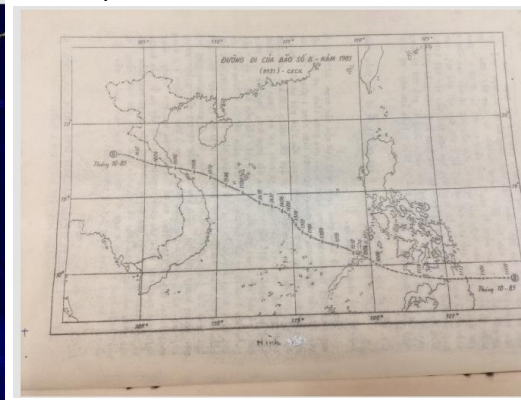
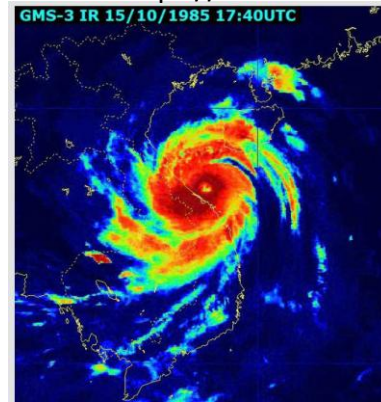
- **Pre-1985 | Life on Water:** Severe poverty, lack of land ownership, basic services, and constant threat from natural disasters.



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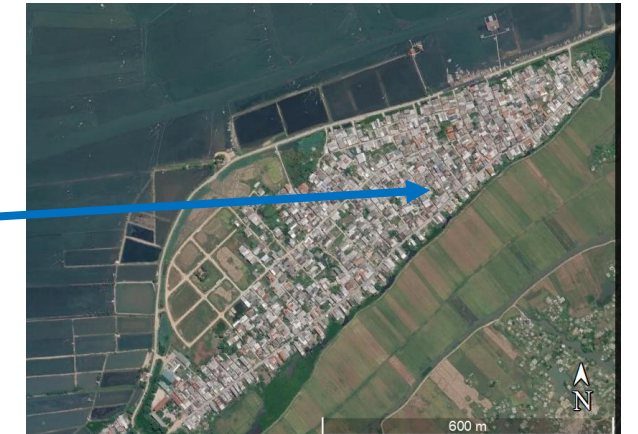
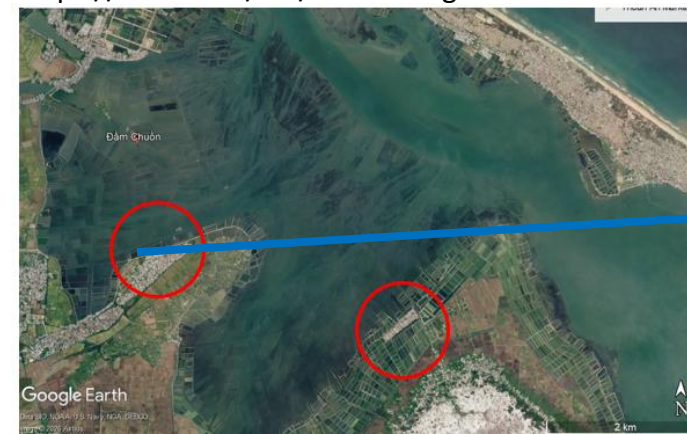


- **October 16, 1985 | The Trigger:** Typhoon Cecil struck, exposing extreme vulnerability and driving the transition to land-based resettlement.



<https://tuoitre.vn/nld/kinh-hoang-sieu-bao-40-nam-truoc-196251023114151022.htm>

- **Post-1985 | Thuy Dien Resettlement:** A strategic humanitarian program creating two lagoon-adjacent villages (Thon Thuy Dien in Phu An & Phu Xuan) for long-term climate adaptation.



- The Thuy Dien resettlement area, adjacent to Chuon Lagoon and built on vacant land, paddy fields, and burial sites near Dong Mieu Hamlet (An Truyen Village).
- Formerly Dinh Cu Hamlet (Phu An Commune, Phu Vang District), the area now forms An Thanh Residential Group, My Thuong Ward, Hue City,

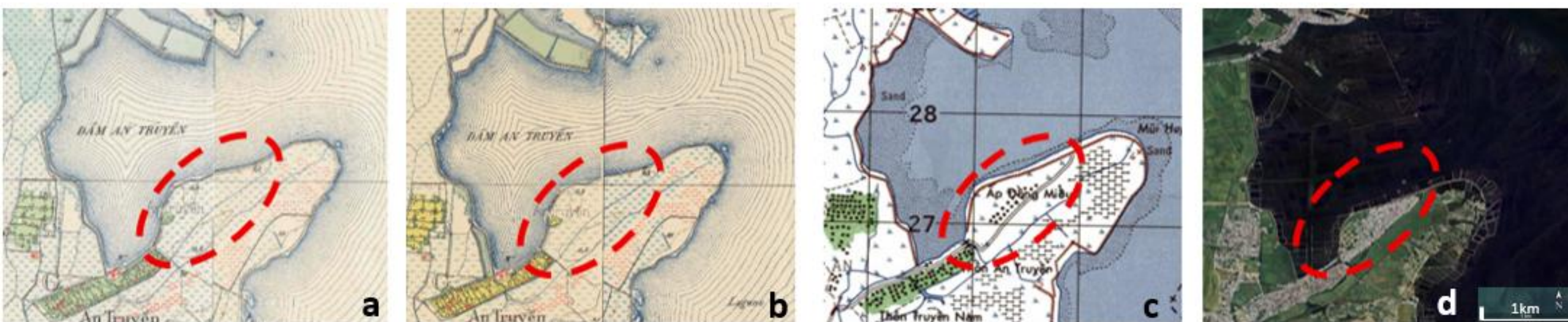


**Fig. 1.** Spatial evolution and land-use transformation of Dong Mieu Hamlet and Thuy Dien resettlement area: (a) 1908, (b) 1927, (c) 1965, and (d) 2026 (Source: Compiled by the authors from [3–6])



**Fig. 2.** Aerial views of Dong Mieu Hamlet and Thuy Dien Resettlement Site. Source: Authors

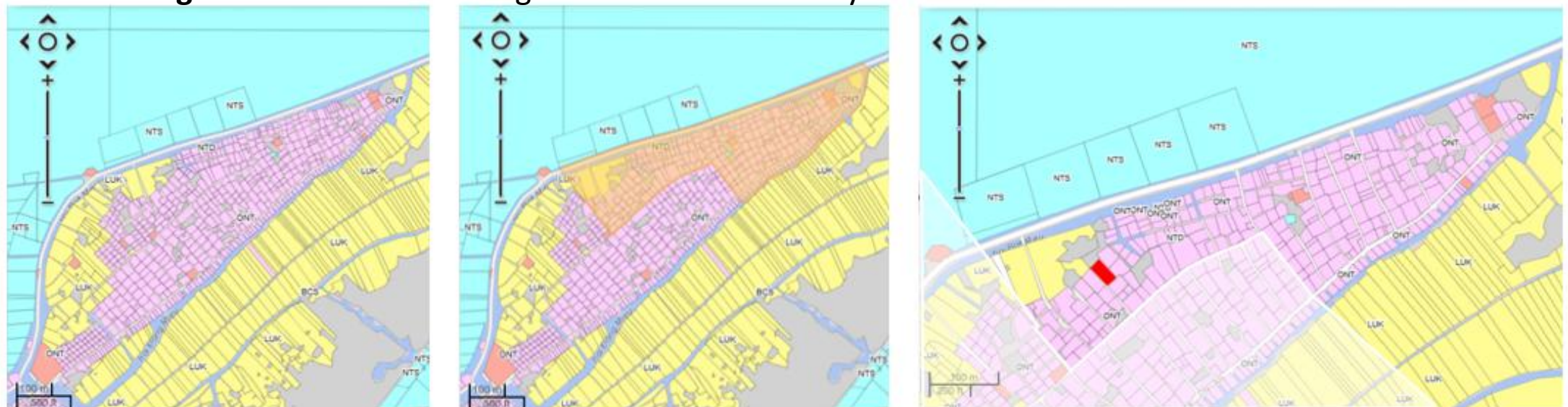
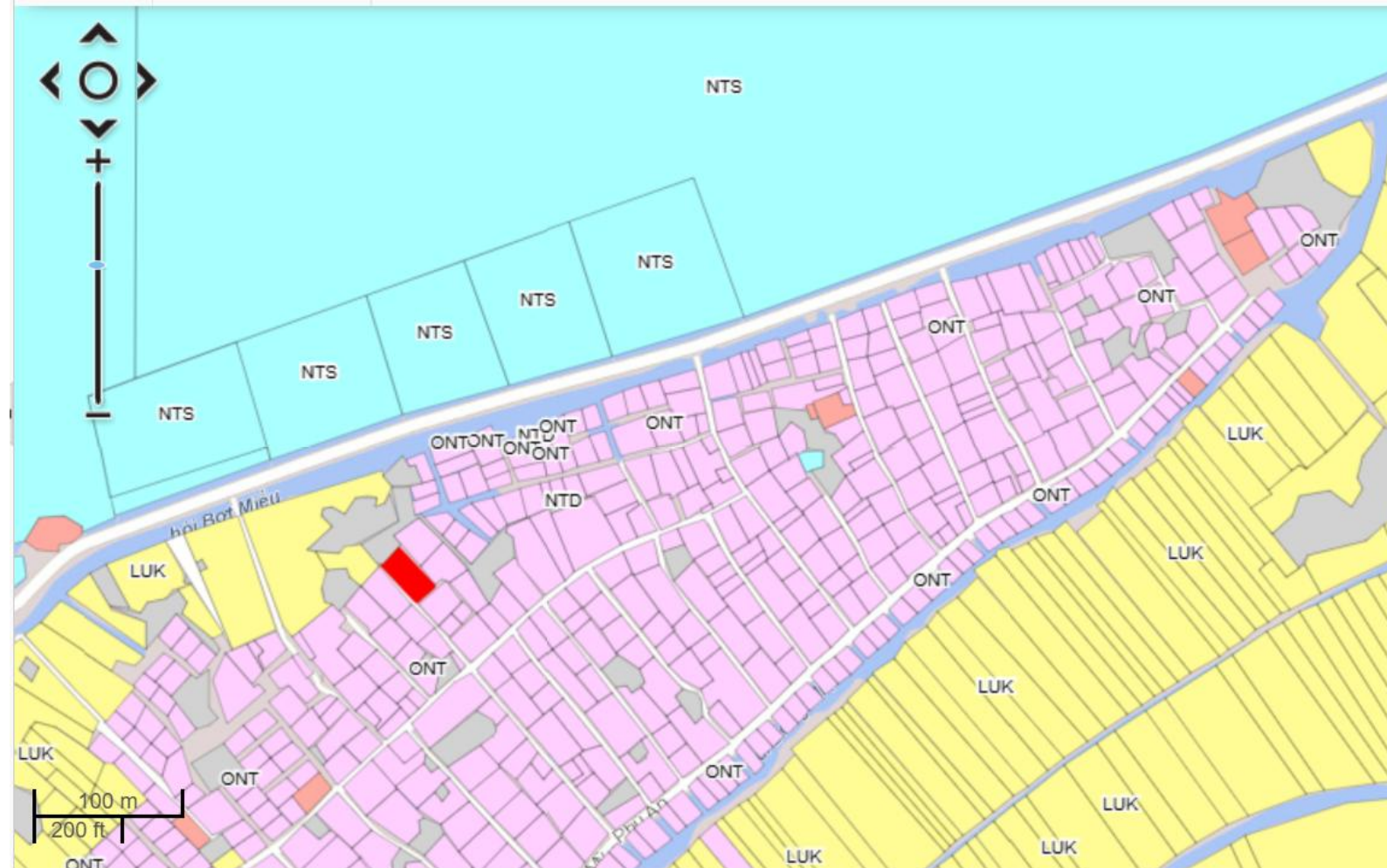


**Fig. 3.** Overall site map and boundaries of Thuy Dien Resettlement Site. Source: <https://gis21.thuathienhue.gov.vn/>

## Land Parcel Inventory & Size Distribution

- **Total Parcels:** 270 plots analyzed after data cleaning.
- **Parcel Area Statistics:**
  - + Range: 23.3 m<sup>2</sup> to 1,159 m<sup>2</sup>
  - + Average Area: 261.05 m<sup>2</sup> per parcel
- **Size Distribution Breakdown:**
  - 100 – 300 m<sup>2</sup> (Majority): 160 plots (~59.26%)
  - > 300 m<sup>2</sup> (Large): 87 plots (~32.22%) — including 9 plots > 500 m<sup>2</sup> (~3.33%)
  - < 100 m<sup>2</sup> (Small): 23 plots (~8.52%)



Source: <https://gis21.thuathienhue.gov.vn/>



**Fig. 2.** Aerial views of Dong Mieu Hamlet and Thuy Dien Resettlement Site (Source: Authors)

A mixed-methods (qualitative & quantitative) POE approach to evaluate architectural spaces and livelihood infrastructure at Thuy Dien resettlement area.

### Research Framework and POE Workflow

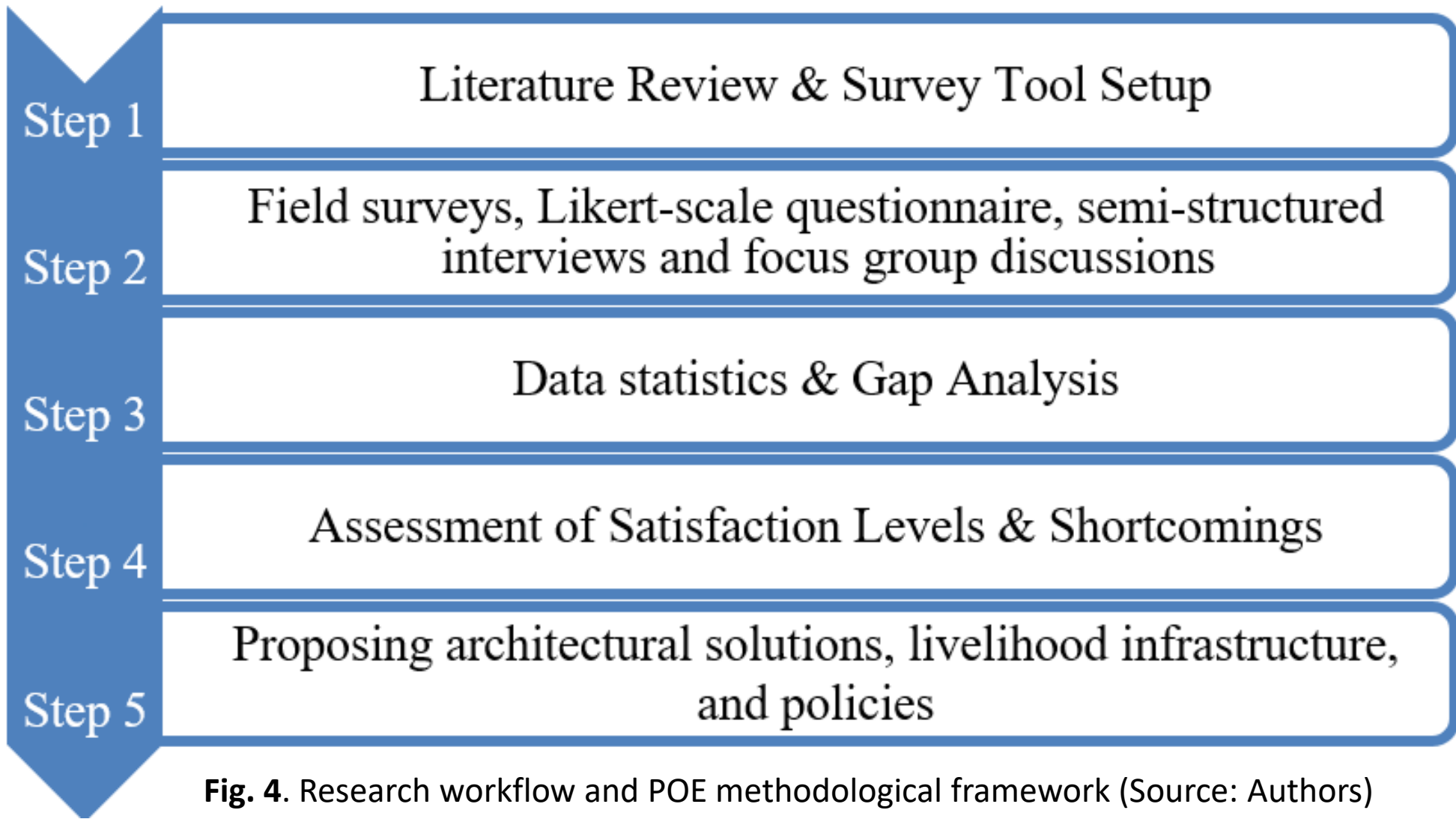


**Fig. 4.** Research workflow and POE methodological framework (Source: Authors)

| POE Indicator Group                                   | Evaluation Criteria (Metrics)                                                           | Core Content & Measurement Indicators                                                                                                                                                                                                                                                        |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Group 1: Functional & Spatial Adaptability            | 1.1. Meeting functional living needs<br>1.2. Expandability & Adaptability               | <ul style="list-style-type: none"><li>Satisfaction with spatial efficiency and average floor area (m<sup>2</sup>/person).</li><li>Ease of renovation, raising floor levels, or expanding space based on needs and budget.</li></ul>                                                          |
| Group 2: Technical & Climate Resilience               | 2.1. Flood Resilience<br>2.2. Storm Resilience<br>2.3. Microclimate Comfort             | <ul style="list-style-type: none"><li>Effectiveness of flood mitigation measures</li><li>Satisfaction with structural safety against severe storms</li><li>Evaluation of natural ventilation, lighting, and leakage resistance</li></ul>                                                     |
| Group 3: Living Environment & Livelihood Connectivity | 3.1. Home-based Space<br>3.2. Lagoon Access<br>3.3. Living Environment & Infrastructure | <ul style="list-style-type: none"><li>Satisfaction with space for fishing gear, seafood processing, and trading</li><li>Perceived convenience of distance to Chuon Lagoon and safety of boat mooring</li><li>Satisfaction with wastewater drainage and waste collection efficiency</li></ul> |
| Group 4: Socio-Cultural Performance                   | 4.1. Socio-Cultural Spaces<br>4.2. Community Interactions                               | <ul style="list-style-type: none"><li>Satisfaction with communal places of worship</li><li>Perceived adequacy of spaces for community gatherings and social interactions</li></ul>                                                                                                           |
| Overall Outcome                                       | DV. Place Attachment & Overall Satisfaction                                             | <ul style="list-style-type: none"><li>Overall satisfaction with onshore life,</li><li>Level of adaptation, and intention for long term attachment.</li></ul>                                                                                                                                 |

Table 1. POE Framework: Architectural Space and Livelihood Infrastructure (Source: Authors)

## Target Stakeholders and Scope Justification

## Research Methodology

| Stakeholder Group             | Role in the Project                                              | Contribution to POE                                                                                                                                                                              | POE Value                                                                                                                                                     |
|-------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Resettled Residents</b> | Primary residents directly manage and modify their living spaces | <ul style="list-style-type: none"> <li>• Provide empirical data (Likert surveys &amp; interviews)</li> <li>• Highlight architectural space and livelihood infrastructure inadequacies</li> </ul> | <ul style="list-style-type: none"> <li>• Translate practical needs into scientific evidence</li> <li>• Access flexible, adaptive housing solutions</li> </ul> |
| <b>2. Local Authorities</b>   | Manage planning, infrastructure investment, and administration   | <ul style="list-style-type: none"> <li>• Provide policy frameworks &amp; socio-economic reports.</li> <li>• Share management insights on urban order, infrastructure, and tourism</li> </ul>     | <ul style="list-style-type: none"> <li>• Receive objective evaluations</li> <li>• Gain actionable guidelines for future lagoon resettlement</li> </ul>        |

**Table 2.** Matrix of stakeholder roles and contributions in POE (Source: Authors)

| Method                              | Target Sample                                                                                                                                                                                     | POE Framework                                                                                                                                                                                                                                                                                                                                                                   | Data Outputs                                                                                                                                                                                    |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Quantitative Survey              | 70 households (stratified sampling by plot location, size & livelihood profile).                                                                                                                  | <ul style="list-style-type: none"><li>5-point Likert scale evaluating:<ul style="list-style-type: none"><li>10 IVs: 4 indicator groups (Functional &amp; Spatial Adaptability; Technical &amp; Climate Resilience; Living Environment &amp; Livelihood Connectivity; Socio-Cultural Performance).</li><li>1DV: Overall Satisfaction &amp; Place Attachment.</li></ul></li></ul> | <ul style="list-style-type: none"><li>Statistical data (Mean, SD, Cronbach's Alpha).</li><li>Gap analysis chart between planning supply and actual livelihood/self-construction needs</li></ul> |
| 2. Qualitative Research (SSI & FGD) | <p>Semi-Structured Interviews (SSI) &amp; Focus Group Discussions (FGD)</p> <ul style="list-style-type: none"><li>Residents: 20 household heads.</li><li>Authorities: 3 local officials</li></ul> | <ul style="list-style-type: none"><li>Residents: Housing self-extension causes, livelihood &amp; water access barriers, socio-cultural responsiveness</li><li>Authorities: Initial planning design, construction control issues, future relocation policy adjustments</li></ul>                                                                                                 | <ul style="list-style-type: none"><li>Key direct quotes</li><li>Comparative analysis of policy intent and user practice</li><li>Assessment of policy gaps and local adaptive capacity</li></ul> |
| 3. Spatial Mapping & Physical Trace | <ul style="list-style-type: none"><li>Thuy Dien master plan.</li><li>10 typical self-adapted housing models</li><li>Access routes connecting the site to Chuon Lagoon</li></ul>                   | <ul style="list-style-type: none"><li>Field observation of housing transformations driven by economic conditions and living needs</li><li>Assessment of technical infrastructure deficiencies (wastewater drainage), livelihood infrastructure, and lagoon access bottlenecks</li></ul>                                                                                         | <ul style="list-style-type: none"><li>On-site photographic documentation</li><li>Architectural drawings of typical housing adaptation patterns (AutoCAD/diagrams)</li></ul>                     |

Table 3. Methodological framework for POE data collection and outputs (Source: Authors)

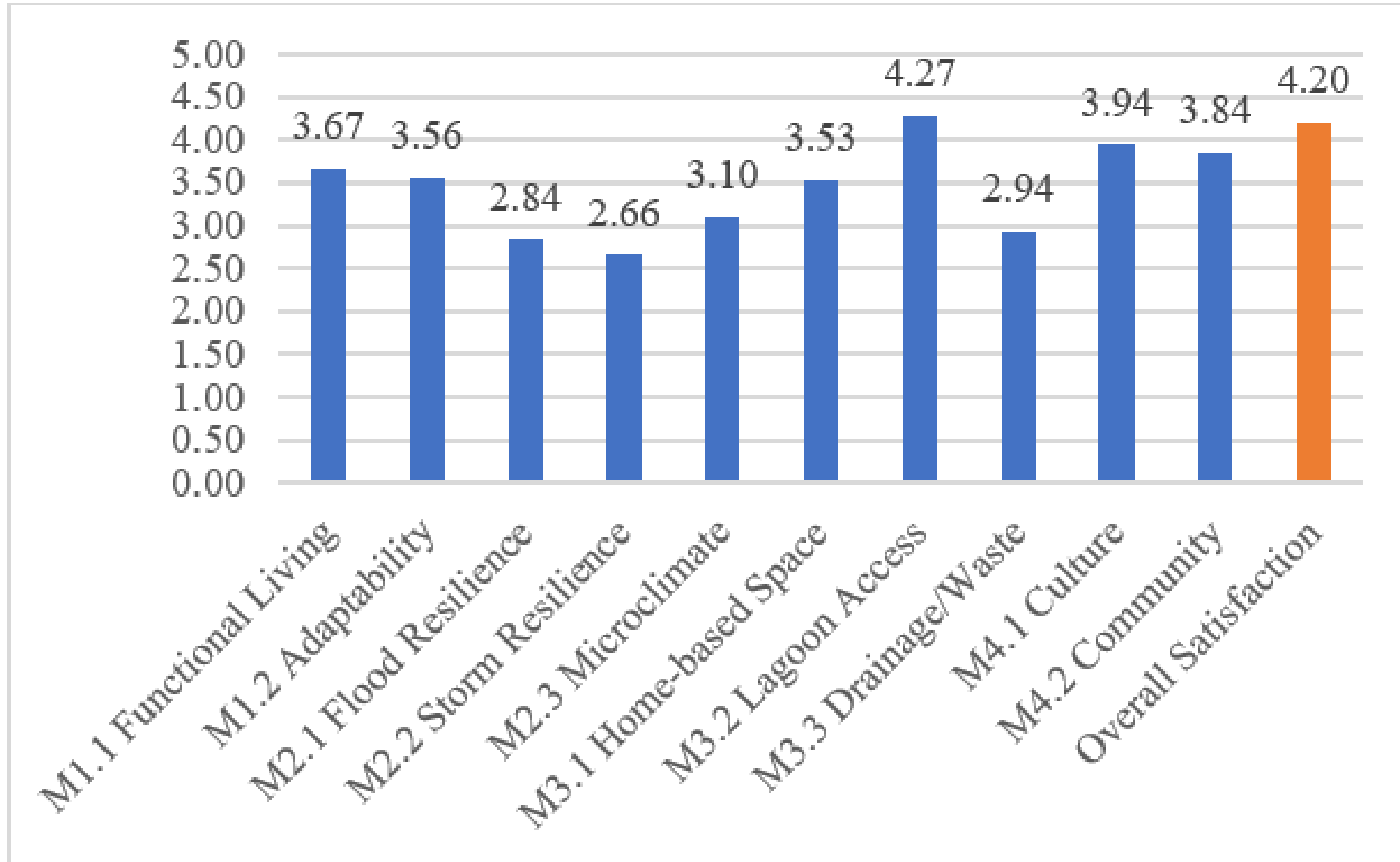


**Fig. 5.** Mean score evaluation of 11 POE metrics ( $n = 70$ ) (Source: Authors)

Post-Occupancy Evaluation (POE) results

Results and Discussion

| ID       | Indicator Group                              | Metrics | Mean | Benchmark | Gap    | Performance                                   |
|----------|----------------------------------------------|---------|------|-----------|--------|-----------------------------------------------|
| M1       | Functional & Spatial Adaptability            | 2       | 3.62 | 4.00      | -0.38  | Moderate Adaptability                         |
| M2       | Technical & Climate Resilience               | 3       | 2.87 | 4.00      | -1.13  | High Vulnerability                            |
| M3       | Living Environment & Livelihood Connectivity | 3       | 3.58 | 4.00      | -0.42  | Moderate Performance (Drainage/Waste Deficit) |
| M4       | Socio-Cultural & Performance                 | 2       | 3.89 | 4.00      | - 0.11 | High Performance                              |
| IV Total | Sub-total Performance                        | 10      | 3.44 | 4.00      | - 0.56 | Sub-optimal (Infrastructure Bottleneck)       |
| DV       | Overall Satisfaction                         | 1       | 4.20 | 4.00      | +0.20  | High Satisfaction (Outcome)                   |

Table 4. POE Indicator Group Evaluation vs. Planning Benchmarks (n = 70) (Source: Authors)

Multiple Linear Regression Results for Overall Satisfaction (DV)

Results and Discussion

| Independent Variables (IVs) | Unstandardized Coefficients (β) | Standard Error | t-statistic | p-value | Confidence Interval | Significance Level |
|-----------------------------|---------------------------------|----------------|-------------|---------|---------------------|--------------------|
| (Intercept)                 | 0.000                           | N/A            | N/A         | N/A     | N/A                 | —                  |
| M1.1 Functional Living      | 0.062                           | 0.096          | 0.646       | 0.521   | [-0.130, 0.254]     | Not Significant    |
| M1.2 Adaptability           | -0.212                          | 0.123          | -1.718      | 0.091   | [-0.458, 0.035]     | Marginal (*)       |
| M2.1 Flood Resilience       | 0.273                           | 0.135          | 2.026       | 0.047   | [0.003, 0.542]      | Significant (**)   |
| M2.2 Storm Resilience       | 0.095                           | 0.126          | 0.756       | 0.452   | [-0.156, 0.346]     | Not Significant    |
| M2.3 Microclimate Comfort   | 0.321                           | 0.136          | 2.356       | 0.022   | [0.048, 0.594]      | Significant (**)   |
| M3.1 Home-based Space       | -0.108                          | 0.135          | -0.799      | 0.427   | [-0.377, 0.162]     | Not Significant    |
| M3.2 Lagoon Access          | 0.262                           | 0.102          | 2.559       | 0.013   | [0.057, 0.466]      | Significant (**)   |
| M3.3 Drainage/Waste         | 0.230                           | 0.130          | 1.777       | 0.081   | [-0.029, 0.489]     | Marginal (*)       |
| M4.1 Culture                | 0.111                           | 0.092          | 1.209       | 0.232   | [-0.073, 0.294]     | Not Significant    |
| M4.2 Community Interactions | 0.230                           | 0.110          | 2.093       | 0.041   | [0.010, 0.449]      | Significant (**)   |

**Table 5.** Multiple Linear Regression Results for Overall Satisfaction (DV) (Source: Authors)

Notes: Model statistics:  $F(10,60) = 402.715, p < 0.001$ .  $p < 0.05$ , \*  $p < 0.10$ . Values rounded to 3 decimal places.

### Locational Advantage & Spatial Connectivity:

- **Strategic Location:** Adjacent to Chuon Lagoon (Tam Giang – Cau Hai system), driving resettlement success.
- **Livelihood Access:** Direct water access for boat navigation and fishing.
- **Cultural Continuity:** Preserves lagoon economy, community identity, and daily routines.



Fig. 6. Access to lagoon livelihood spaces and residential areas (Source: Authors)

### Flexibility in architectural space adaptation

#### - Initial Relocation (1985):

Boat-dwelling families relocated ashore after a major storm.

Allocated 200–500 m<sup>2</sup> land plots, initial food aid, and basic materials (bamboo, tarpaulins, roofing felt) for temporary stilt homes.

#### - Disaster Vulnerability (1999):

The historic 1999 flood completely swept away makeshift structures, exposing severe safety risks.



**Fig. 7.** Housing evolution: (a) Type of "Nhà chõ" by bamboo; (b) Corrugated iron house "*nhà tôn*"; (c) Modified single-story house; (d) Two-story concrete house (Source: Authors)

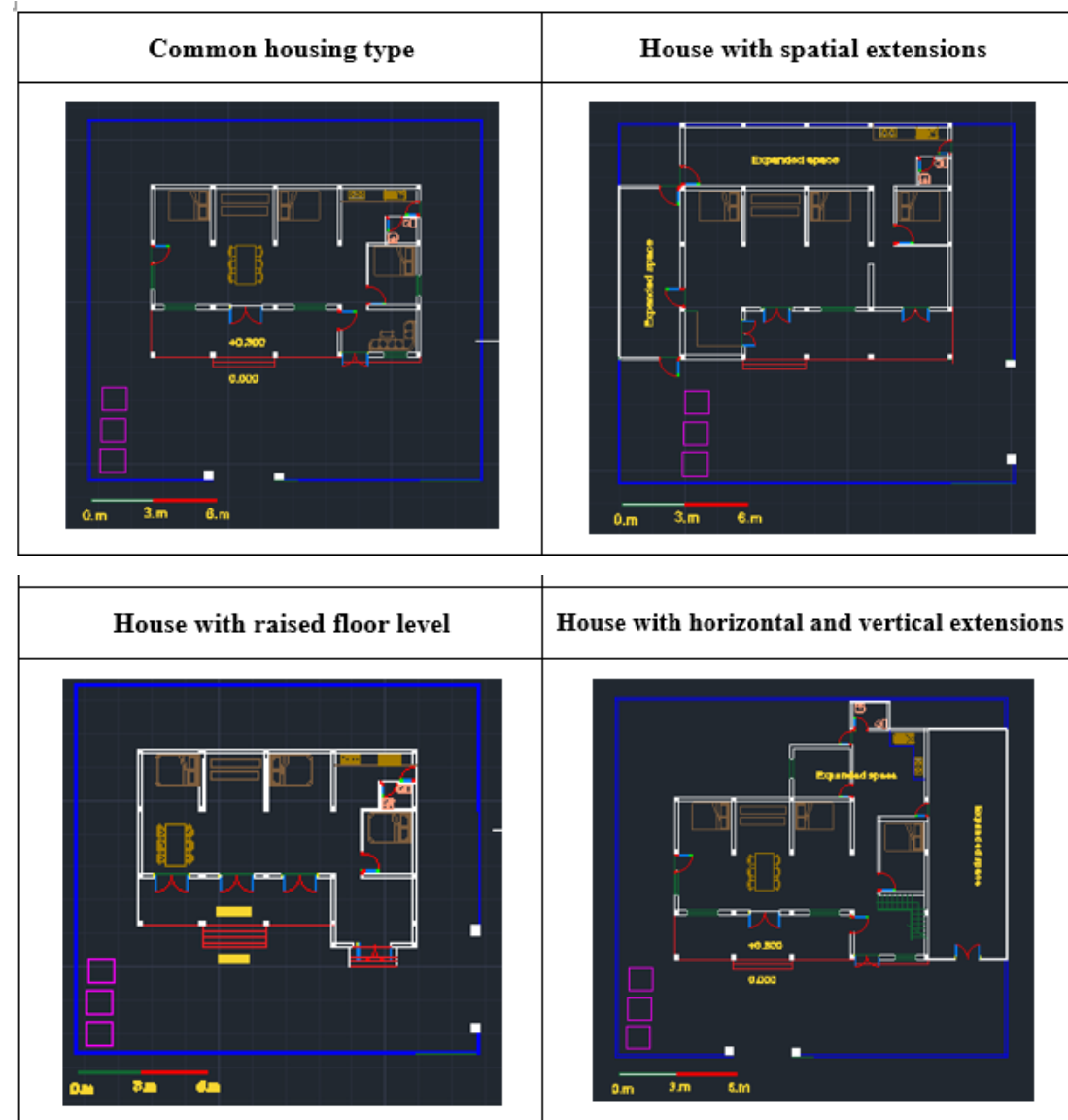
### Flexibility in architectural space adaptation

- **Flexible Mechanism:** Empowers households through a "self-adjusting housing" approach.
- **Mitigated Financial Risk:** Avoids rigid pre-built housing designs, preventing debt from high upfront costs.
- **Phased Construction:** Enables residents to build and expand gradually according to their financial capacity.
- **Optimized Functionality:** Allows residents to allocate living and production spaces to suit their specific household routines.



Fig. 8. Common housing types and livelihood spaces in front of the house (Source: Authors)

## Flexibility in architectural space adaptation:



## Incremental Adaptation & Upgrading:

- Driven by economic recovery, residents saved funds to rebuild permanent concrete housing.
- Progressively raised floor levels, expanded living areas, and completed housing as financial capacity allowed.

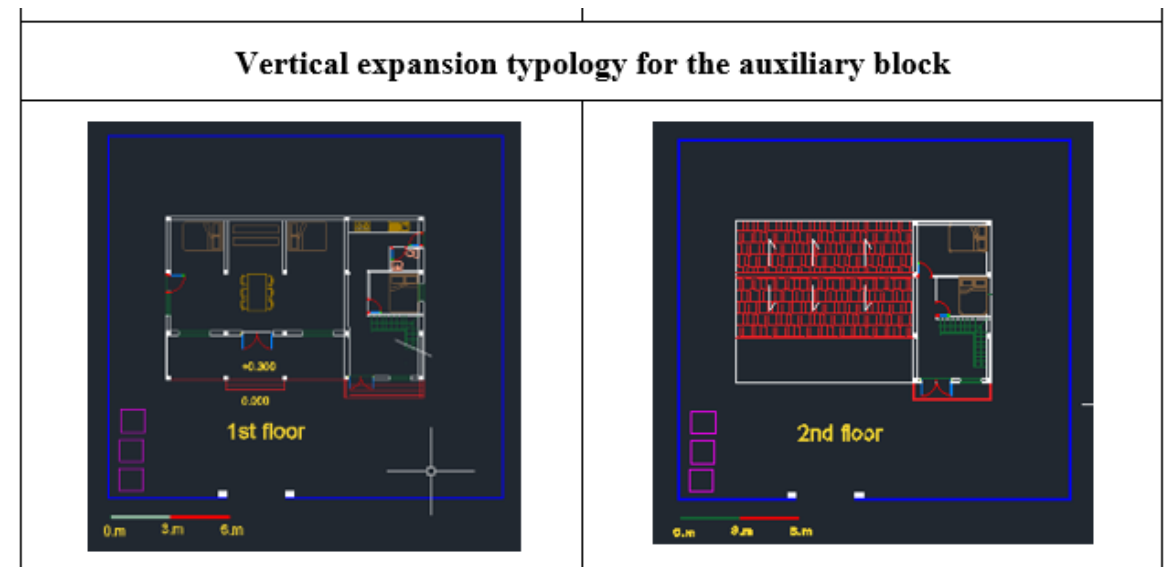


Fig. 9. Spatial transformation typologies and housing modifications . Source: Authors

### Spontaneous spatial adaptability: Land & plot transformations

- **Land Expansion:** Encroachment on adjacent vacant land/burial grounds, or acquisition from relocating households.
- **Land Reduction :** Unofficial plot subdivision for married children, or partial land sales to newcomers.
- **Socio-Spatial Impact:** Emerging non-boat-dwelling households within the resettlement area.



**Fig. 10.** New houses spring up as landowners divide plots for children or sell off parts of their property  
(Source: Authors)

## Spaces for religious practices, community activities, and social cohesion

- **High Satisfaction (M4):** 3.89/5.00 — Strong approval of spiritual life and public spaces.
- **Spiritual & Cultural Practices:**
  - Annual Cau Ngu festival (Water Deity shrine & Đình).
  - Daily worship at neighborhood shrines & courtyard altars (Ba Cau).
- **Infrastructure & Spatial Layout:**
  - Đình & cultural centers host community activities.
  - Traditional village clusters (Xóm).
- **Cultural Identity & Impact:**  
Preserves riverine identity and fosters social cohesion for former boat dwellers.



<https://huengaynay.vn/>



Fig. 11. Spiritual spaces: (a) Lagoon shrine; (b) Village communal house; (c) Neighborhood shrine; (d) Household altars

### Vulnerability to natural disasters and climate change, and community adaptive capacity

- **High Climate Exposure:** faces frequent tropical storms and prolonged flooding.
- **Low Infrastructure Ratings:** Technical infrastructure (M2): **2.87/5.00**
  - Storm Resilience (M2.2): **2.66 / 5.00**
  - Flood Response (M2.1): **2.84 / 5.00**
- **Inadequate Boat Anchorage:** Lacks capacity and basic safety standards to secure vessels during flood seasons.
- **Proactive Self-Adaptation:** Residents replace stilt houses with solid concrete structures, raised floors, and flood-refuge lofts.



**Fig. 12.** Raising floor elevation and adding vertical floors for flood resistance  
(Source: Authors)

### Inadequacies in environmental technical infrastructure

- **Low Community Satisfaction (M3.3): 2.94 / 5.00** — High frustration with drainage & waste quality:

- **Incomplete Wastewater Drainage:**

- Open channels discharging untreated domestic wastewater
- Causes stagnation, foul odors, hygiene hazards, and degraded area aesthetics.

- **Deficient Waste Collection:**

- Infrequent collection (3x/week), Fails community demand
- Direct risks: Waste accumulation, animal scavenging & public health hazards.

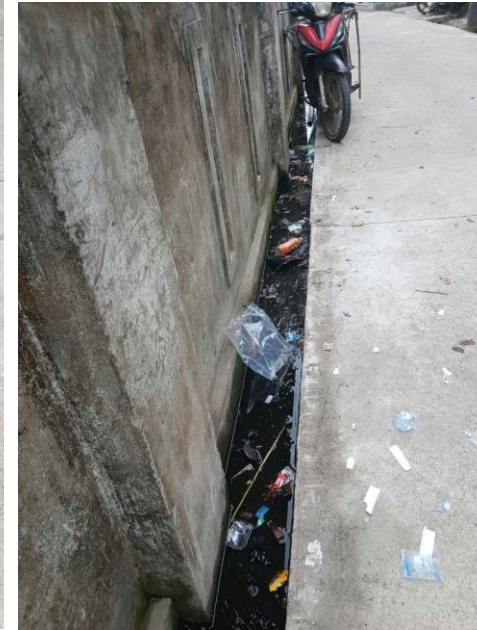


**Fig. 13.** Technical and environmental infrastructure deficits (Source: Authors)

### Livelihood fluctuations and environmental trade-offs

- **Economic vs. Ecological Trade-off:** Ecotourism boosts income but strains Chuon Lagoon ecosystem.
- **Severe Waste Accumulation:** Trash concentrates near restaurants & boat moorings; debris-blocking nets fail.
- **Water Degradation:** Surface encroachment & aquaculture nets trap refuse, causing foul odors & poor water quality.
- **Sectoral Conflict:** Environmental decline reduces wild catch, triggering conflict between tourism services & traditional fishing.



**Fig. 14.** Livelihood dynamics and environmental tradeoffs in Chuon lagoon (Source: Authors)

**The Post-Occupancy Evaluation (POE)** of the Thuy Dien resettlement area provides a comprehensive overview of the resettlement process for the water-based community in the Tam Giang – Cau Hai lagoon region.

### Architectural & Livelihood Successes

- **Livelihood & Cultural Continuity:** Lagoon-adjacent site preserves riverine identity and traditional fishing connections.
- **Housing Adaptability:** Self-managed land allocation empowers flexible home expansion based on family capacity.

### Infrastructure & Environmental Bottlenecks

- **Inadequate Infrastructure:** Low resilience to storms/floods, poor wastewater drainage, and insufficient waste collection.
- **Livelihood-Ecology Conflict:** Unplanned tourism/aquaculture expansion causes environmental strain, directly threatening traditional fishing

The study proposes **three core sets of policy recommendations to guide the future planning of resettlement areas in the lagoon region:**

### **Flexible Architectural Standards:**

**Adopt adaptive standards integrating disaster-resilient solutions:**

- Raised ground levels
- Safe mezzanine spaces

**Alignment:** Aligned with residents' phased investment capacity.

### **Synchronized Technical Infrastructure:**

**Mandate integrated technical and livelihood infrastructure:**

- Decentralized wastewater treatment
- Systematic waste collection
- Safe mooring facilities

### **Inter-Sectoral Management Mechanism:**

**Implement community-based management for tourism and fisheries to:**

- Control waste
- Protect the lagoon ecosystem
- Secure fishers' long-term livelihoods

### CURRENT LIMITATION

- **Sample Uniformity:** Criterion M1.1 evaluates overall living area satisfaction across total sample only.
- **Missing Subgroup Analysis:** Lacks correlation analysis across distinct landholding categories:
  - $< 100 \text{ m}^2$  |  $100 - 300 \text{ m}^2$  |  $> 300 \text{ m}^2$
- **Key Gap:** Does not account for satisfaction variance across varying property scales.

### FUTURE RESEARCH DIRECTION

- **Core Proposal:** Expand POE assessment by explicitly categorizing households based on their landholding sizes.
- **Expected Policy & Spatial Impacts:**
  - Identify optimal land-size thresholds for resident satisfaction.
  - Inform local resettlement guidelines with empirical data.
  - Manage and prevent spontaneous subdivision of land parcels.

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THANK YOU  
FOR YOUR ATTENTION!

