

AMPHIBIOUS HOMES FOR THE VULNERABLE

RETROFITTING EXISTING HOMES IN THE MEKONG DELTA FOR FLOOD RESILIENCE AND CLIMATE ADAPTATION



MEKONG DELTA RICE FARMERS IN THE DRY SEASON



TYPICAL MEKONG DELTA HOUSING ALONG A FLOODED RICE FIELD

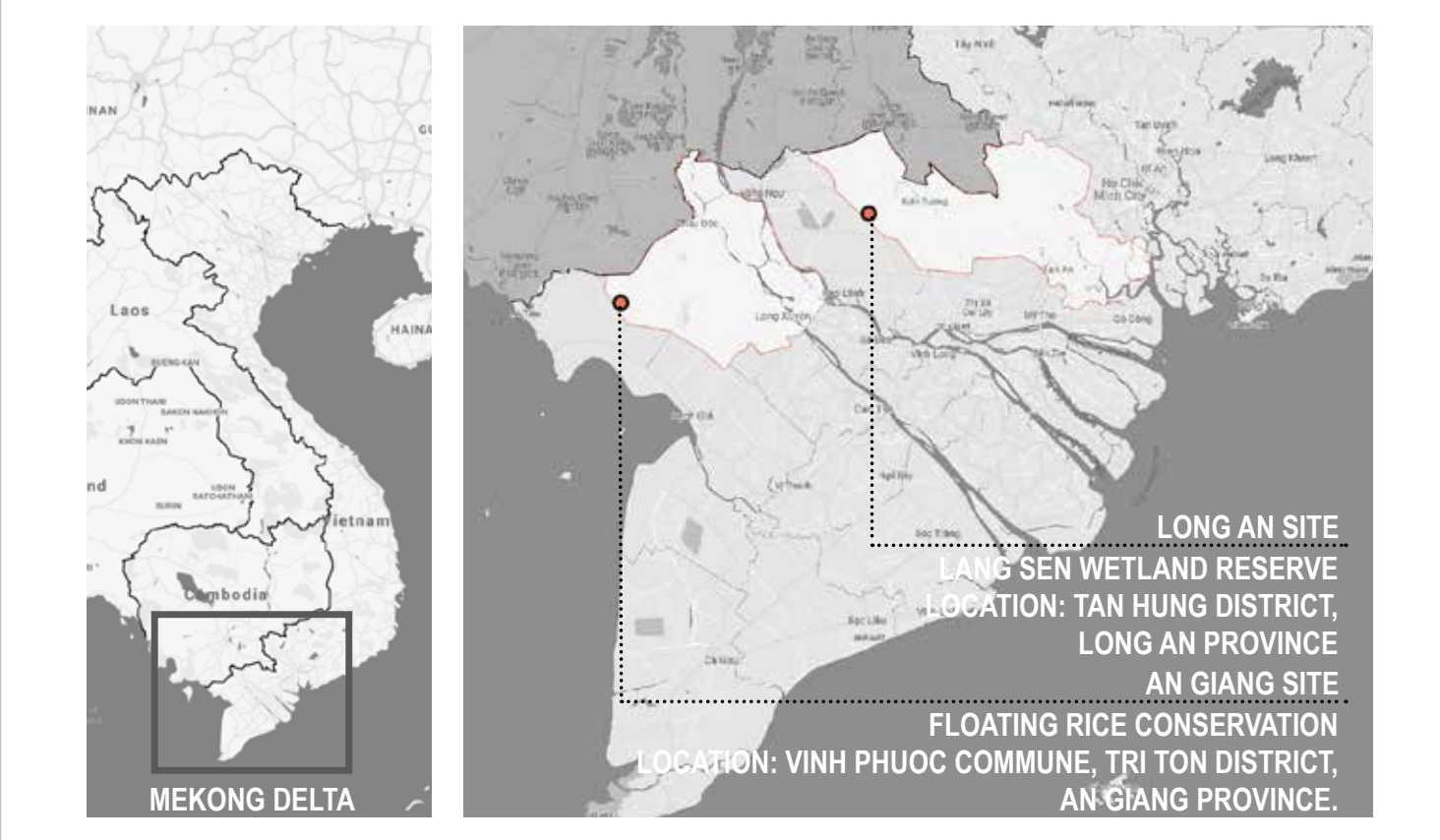


FLOATING RICE FIELD IN FLOOD SEASON

CONTEXT

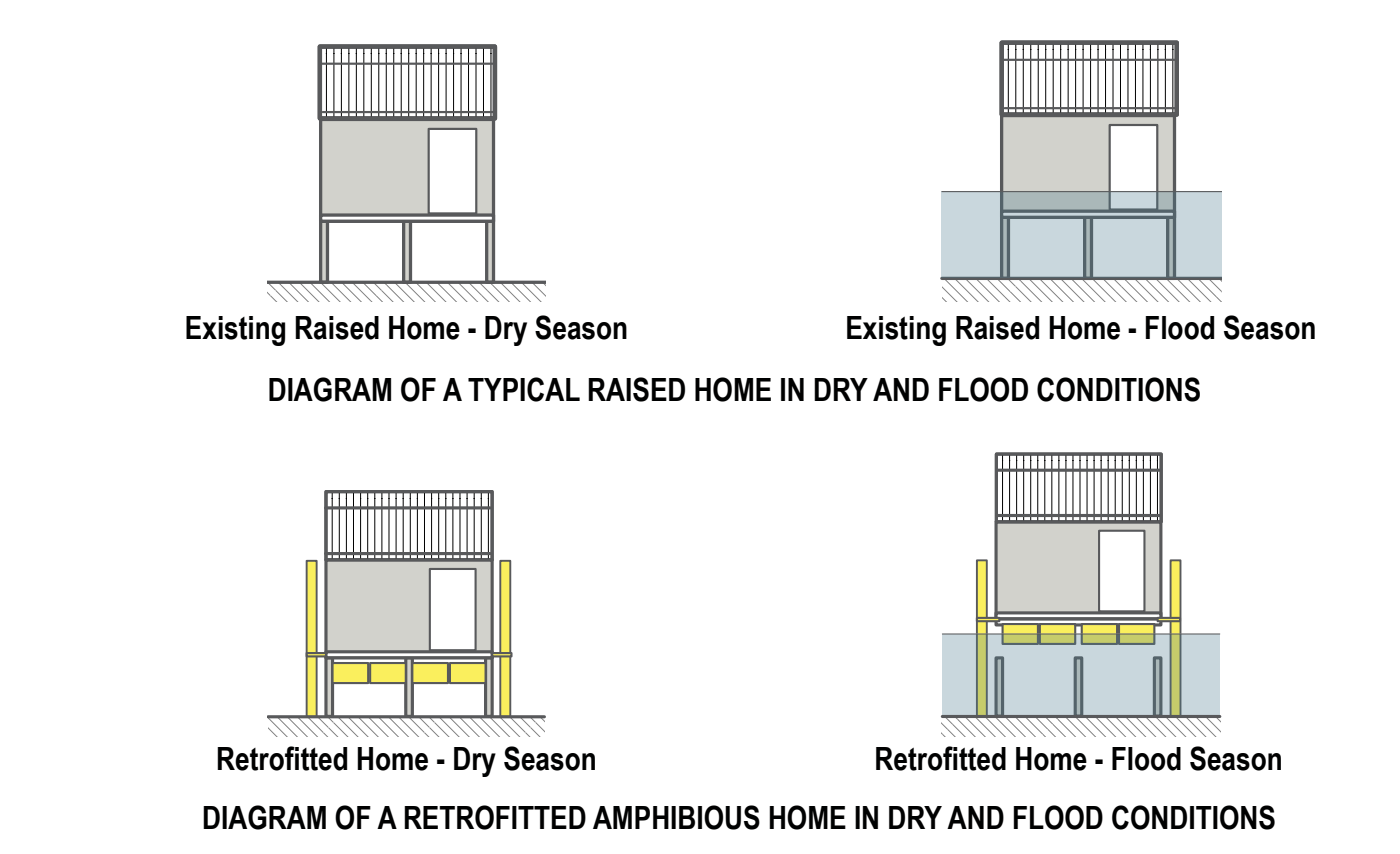
APPROACH

SITE SELECTION



THE MEKONG DELTA, VIETNAM
 Vietnam's Mekong Delta is home to 17 million people (22% of the national population), most of whom are agricultural and aquacultural farmers. The Delta is comprised largely of wetlands, which contribute 52% of the national rice production and 60% of the national fisheries and aquaculture production. Food produced in this region is also exported to other areas of Southeast Asia.

Traditionally, houses in the region are raised above ground to mitigate property damage during flood events. However, as the area anticipates increasingly severe floods, the current level of static elevation of these houses may no longer be adequate to protect residents and their property. Rebuilding or repairing homes after a flood event is costly and can require a lengthy period of time. During these repairs, residents are often displaced from their homes, increasing their economic burden and vulnerability.



COMMUNITY RESILIENCE
 In order to preserve residents' connection to their land and livelihoods, a passive climate change adaptation and flood mitigation technique can be implemented, allowing the land in the Delta to benefit from the seasonal flooding. Low-cost amphibious retrofits to existing houses can provide a solution to these vulnerable populations, allowing residents to remain on their farmland during flood events with little or no danger to their families or damage to their homes and belongings. Amphibious construction works in synchrony with a flood-prone region's natural cycles of flooding, rather than attempting to control them.

DISPLACEMENT
 Amphibious retrofits are an alternative to government plans to relocate vulnerable populations away from the flooding that may endanger them but provides their livelihoods. By allowing households to remain safely in place during flood events, amphibious retrofits act to enhance resilience, reduce flood-related expenses, and provide greater opportunity for households to pursue their daily economic activities without social and physical disruption.

ADAPTING TO FLOODS
 Amphibious retrofits offer resilience to flood-prone communities, primarily by reducing the destabilization that flooding causes. At the household level, floods can disrupt livelihoods, trigger displacement and trauma, and cause financial stress that lower-income families cannot afford. These shocks may also have cascading impacts: as households incur additional expenses trying to compensate for flood damages, accumulating debt restricts their access to healthcare and education, which further contributes to increased poverty and inequality.

KNOWLEDGE TRANSFER
 If amphibious housing takes hold, new entrepreneurial opportunities will become available for those trained in amphibious construction techniques. Currently, the limiting factor for expanding this project is the number of instructors qualified to teach these concepts and skills. The Buoyant Foundation Project is the only research group in the world dedicated to developing amphibious retrofit technology for the world's most vulnerable populations; we aim to expand our scope by teaching local populations how to implement this technology themselves using affordable, locally available materials. We will have succeeded in this goal when the communities we serve can carry on independently without our help.



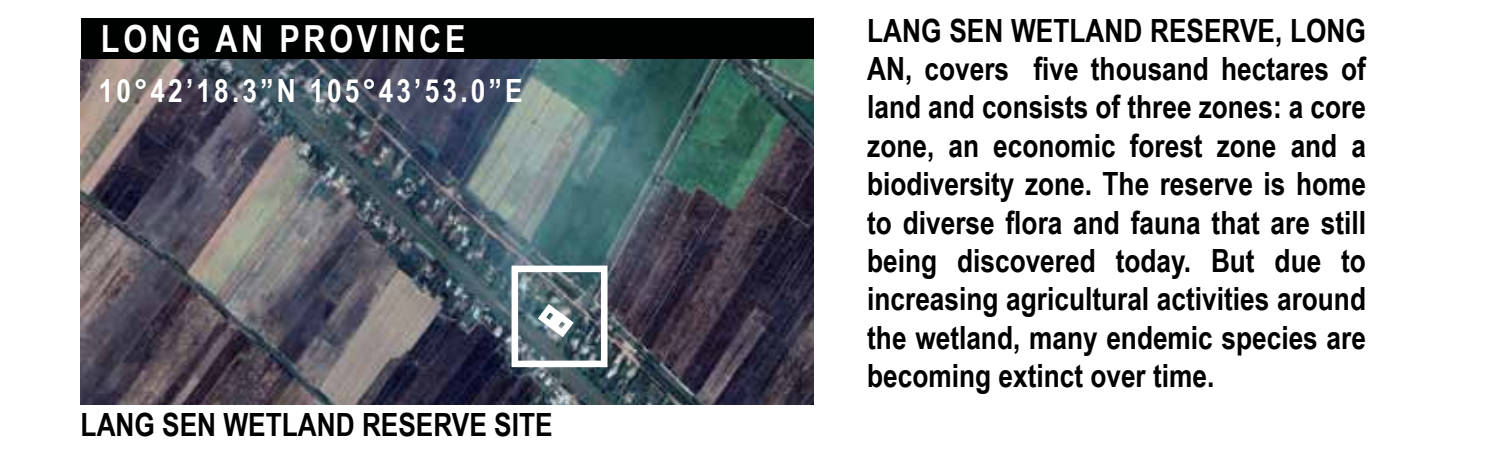
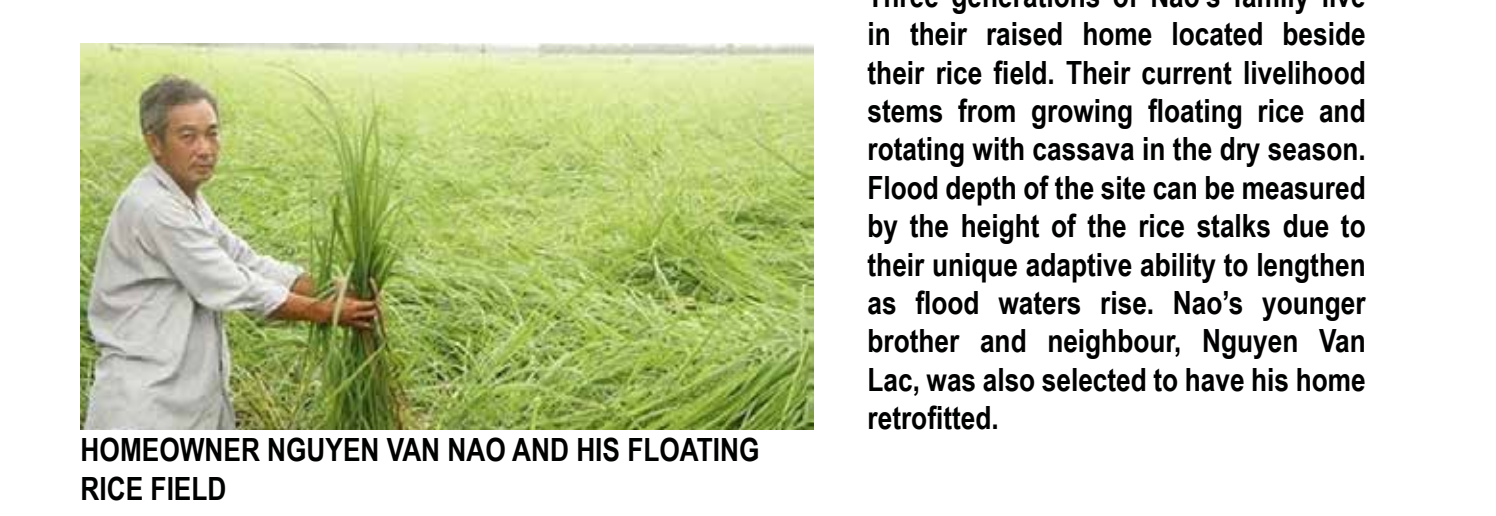
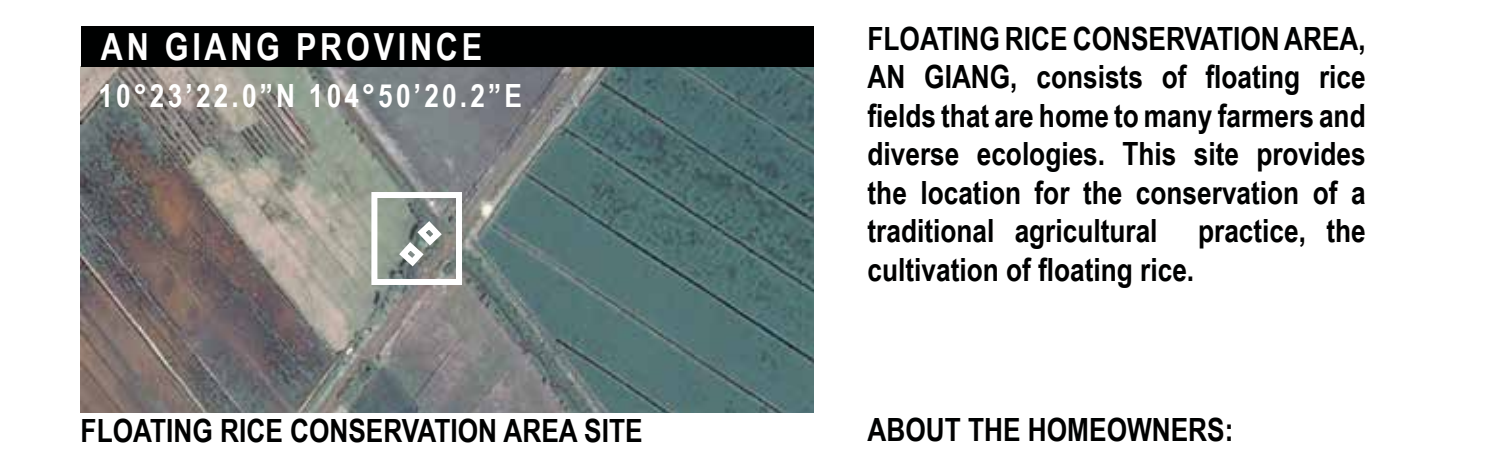
RETROFITTING WITH LOCAL CARPENTERS
 LOCAL CARPENTERS ARE TAUGHT how to implement amphibious retrofits themselves using locally familiar carpentry skills and construction techniques. The training program developed by our team will provide local communities with a stronger knowledge base and allow them to diversify their skillsets. It can be extended throughout the Mekong Delta, supporting a community-based bottom-up approach to flood risk reduction and climate change adaptation.



MONITORING EQUIPMENT ATTACHED TO NANG'S HOUSE
 PHYSICAL MONITORING EQUIPMENT has been installed to collect wind data and track the movement of the houses during the flood season. This will be used to make adjustments or improvements to our amphibious designs before scaling up.



- RETROFITTING PROCESS: NGUYEN VAN NAO'S HOUSE, AN GIANG PROVINCE**
1. Vertical guidance posts (VGPs) installed with poured-concrete foundations.
 2. Masonry centering devices constructed at column bases to ensure precise resettlement in original position.
 3. Connecting beams attached to underside of floor framing.
 4. Installation of new joists to carry uplift from buoyancy jugs.
 5. Buoyancy jugs tied in bundles and attached to new joists that carry uplift forces. Skirt boards protect jugs from force of flowing water.
 6. Installation of VGP rope sleeves on connecting beam ends.
 7. Concrete poured into VGP to 20cm above sleeve level to increase strength and damp noise.



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MASTER CARPENTER NGUYEN VAN TRUOC EXPLAINS FUNCTION OF CONNECTING BEAM



AERIAL VIEW OF NGUYEN VAN NAO'S HOUSE FLOATING ON THE FLOOD



PROJECT TEAM, CARPENTERS AND CLIENTS

PROCESS

EXPLODED ASSEMBLY OF COMPONENTS

- 1 Existing house
- 2 Connecting beams cross underneath house
- 3 Rope sleeve loops around guidance post
- 4 New joists to carry uplift
- 5 Recycled jugs for buoyancy
- 6 Skirt boards to protect jugs from force of flowing water
- 7 Vertical guidance posts to limit lateral motion
- 8 Centering devices for exact repositioning on ground



AN GIANG PROVINCE

LONG AN PROVINCE

- 1 Existing house
- 2 Connecting beam crosses underneath house
- 3 End centering device for exact lateral repositioning
- 4 Wood box sleeve with rope cushioning surrounds guidance post
- 5 New joists to carry uplift
- 6 Recycled barrels for buoyancy
- 7 Vertical guidance posts to limit horizontal motion
- 8 Side centering device for exact longitudinal repositioning



IMPLEMENTATION



Original house

With amphibious retrofit



NGUYEN VAN NAO'S HOUSE

Amphibiated house floating on floodwater



Original house

With amphibious retrofit



NGUYEN VAN LAC'S HOUSE

Amphibiated house floating on floodwater

DANG VAN NANG'S HOUSE



Original house

With amphibious retrofit



Amphibiated house floating on floodwater

NGUYEN THI DUNG'S HOUSE



Original house

With amphibious retrofit



Amphibiated house floating on floodwater

OUTREACH

Master carpenter Nguyen Van Truoc and trainee carpenters discussing fabrication details for the box sleeves that will connect Lac's house to the vertical guidance posts.



Team members and guests on Nao's front porch during the flood. Even with twelve people on the front porch, the house remained stable and level with little movement in response to all the human activity.



Professor Nguyen Duy Can of Can Tho University (right) interviews homeowner Nguyen Van Nao (left) to assess client satisfaction with the performance of the retrofitted house.



Luu Thi Tang of Vietnam National University (right) interviews Le Thi Dao (left), village resident and aunt of homeowners Nang and Dung.



Pham Duy Tien of An Giang University (right) in conversation with trainee carpenters from Long An Province.



The entire community comes out to help lift Dung's house to test the centering devices.

