

Disaster Resilience of Low-cost Houses: Case Study of Thua Thien Hue Province, Vietnam

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Abstract This research documents the post-flood and typhoon conditions of low income housing in the Thua Thien Hue Province, Vietnam, an area prone to extreme flooding in Central Vietnam. The cost of rebuilding houses after a natural hazard has been always a burden for low income households and it often led to the elimination of essential construction practices for disaster resistance. While there has been remarkable improvement in relief and rehabilitation, poor people have been disproportionately vulnerable to extreme events due to their low adaptive capacity and suffered the same damages every year. The research documents existing conditions of low income houses in the Thua Thien Hue province and identifies leading causes of the building failure from the natural disasters. The quality of construction and repairs are assessed based on Coastal Construction Manual and by Federal Emergency Management Agency. In order to examine people's perception toward housing reinforcement as a coping strategy as well as to identify problems and issues associated with achieving stronger and safer housing, focus group and individual interviews were conducted with local residents from four different flood and typhoon-prone communities. The research found that many households in the affected areas now realize the importance of improving housing structures as a coping strategy to resist the impacts of floods and typhoons, however due to low income and a lack of professional instruction and technical guidance in the area, many households still reside in weak and fragile housing conditions that cannot withstand climate related risks. In particular, low-income households spend a considerable amount of their income on housing repair every year. Consultation and communication with professionals about building a resilient housing is lacking. Given that the major immediate recovery action taken by the local people tends to focus on repairing damaged houses, providing proper and applicable construction practices is crucial to improve the housing condition, but also to contribute to reduce poverty in Vietnam.

Keywords Disaster Coping Mechanism, Housing

Welfare, Low-income Housing, Recovery Reduction

1. Introduction

Along with Philippines and Cambodia, Vietnam is one of the most disaster-prone countries in the world. The World Bank [2] has indicated that Vietnam is among the top ten countries that will bear the worst damages brought about by climate change. In 2010, sea levels in Vietnam rose 100cm above normalized 1980-1999 levels, and by 2050, it is expected to rise an additional 28-33cm. With sea levels rising, the flood-prone areas in Vietnam will expand every year. In addition to rising sea levels the Central Committee for Flood and Storm Control in Vietnam [3] reports that there are about twelve tropical cyclones occurring in the South China Sea annually, and six to eight storms and tropical depressions affect the territory of Vietnam.

As a consequence of climate change, coastal areas of Vietnam are now prone to flooding from monsoon rains and typhoon storms. Inland areas of the country are at high risk of flash flooding. Flooding is becoming an annual event resulting in the loss of lives, the displacement of vulnerable people, the destruction of key infrastructure, property damage, and loss of food stocks and livestock. The repeated and extensive damages are more likely to have a direct impact on the capacity of the family and the community to develop and move beyond poverty.

In light of the frequent floods and resulting damage, development needs, such as the provision of housing, water supplies and the planning of infrastructure, is essential in order to build resilience. The government of Vietnam responds relatively quickly providing immediate disaster relief. However, its reconstruction efforts focus on strengthening large infrastructure, such as highways, dams, and dykes. When the government does offer financial help to affected families, it is rarely enough for them to rebuild their homes [5].

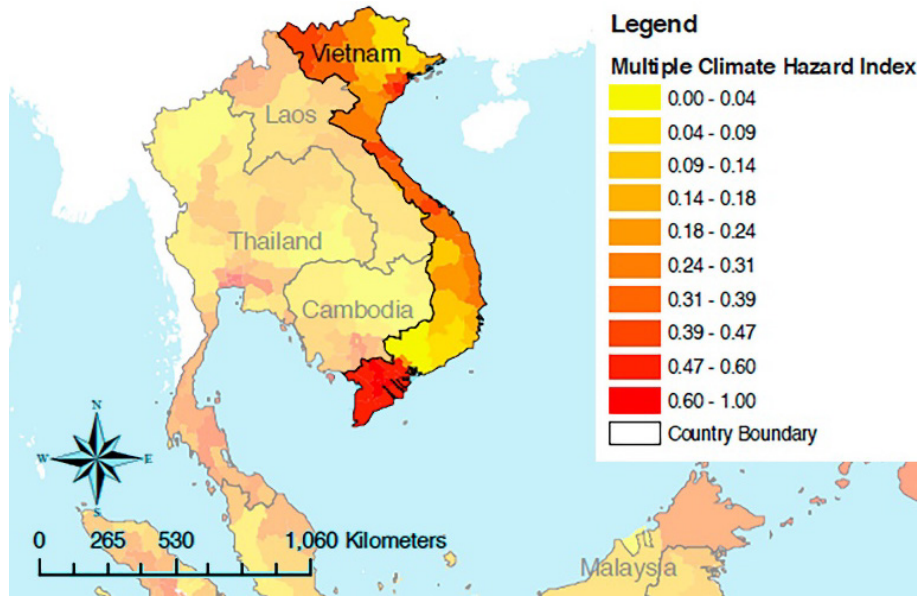


Figure 1. Vietnam - Climate Hazard Index [4]

Despite many efforts are being made to rehabilitate and mitigate impacts from these natural disasters, people outside of the affected regions are still not familiar with these efforts nor its nature of almost annually reoccurring damages in Vietnam. After Typhoon Nari and Typhoon Haiyan in 2013, several cities frequently appeared in the news. News reports seldom mentioned Thua Thien Hue Province which has suffered the most from dual impacts of both typhoons. Housing in Thua Thien Hue Province, the most frequently affected and susceptible area in Vietnam is poorly adapted to intensifying hazards [6].

While the poor are particularly vulnerable, much of the more costly, 'modernized' housing enjoyed by wealthier households are also highly vulnerable to typhoons and floods [6]. In addition, most residential houses in the Central Vietnam have been built without technical guidance or instruction from construction professionals. Many of these structures lack disaster resistance [7]. Studies confirm that 70% of recently built low income housing has weak structures that are prone to damage [8]. When disasters strike, many of the low income households use their own financial resources to build their homes in the same manner as the previous unsafe ones [9]. In fact, their investment will likely be lost again when a major typhoon or flood damages this area. So paradoxically, families have become more vulnerable to these disasters that result in a spiral of declining poverty.

This research is particularly concerned with building adaptive capacity for natural hazards. Indeed, it is about promoting a climate-resilient community through incorporating climate change adaptation to housing design and construction. Building a safe and resistant shelter for poor and vulnerable families can be a solution that offers effective means of managing climate-related risks and improving their capacity to respond to climate change. This framework will help bring national initiatives for safe

construction in flood and storm areas, taking account of recurrent damages to home.

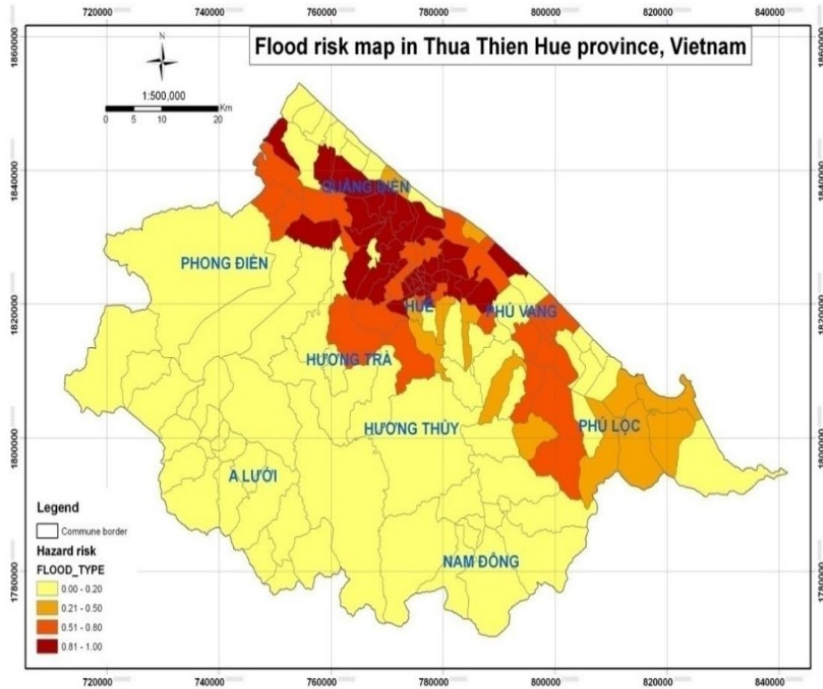
2. Research Method

A fieldtrip was held throughout Thua Thien Hue province, the North Central Region of Vietnam from August to December, 2015. The main objective of this field trip was to acquire first-hand knowledge on the effects of floods and storms on both households and communities, and photograph existing housing conditions post recent flood events. Thua Thien Hue province is in a coastal area with the largest lagoon system in Southeast Asia which has been affected by natural disasters such as floods, storms and droughts. The study covers 4 communes: Quang Thai, Quang An, Huong Phong, and Huong Giang in Thua Thien Hue province. As a large proportion of people in this province are involved on agricultural production, the land is considered as an important resource for people in this area. The province has over 128 km of coastline that provides a for a seafood industry that produces over 40,000 tonnes/year consisting of over 500 species of fish [10]. The province also accommodates Tam Giang - Cau Hai Lagoon, the largest lagoon in South-East Asia, which has 68 km in length with 22,000ha of water surface. Exotic Fruits such as coconut, rambutan, jackfruit, lychee, star fruit, mangosteen, kumquat, durian, dao, dragon fruit, and golden apple are grown in this area due to sufficient amount of rainfall every year [11]. As many people in this area largely rely on natural resources, it is important to note that these people, in turn, can be more severely affected by floods and typhoons than elsewhere.

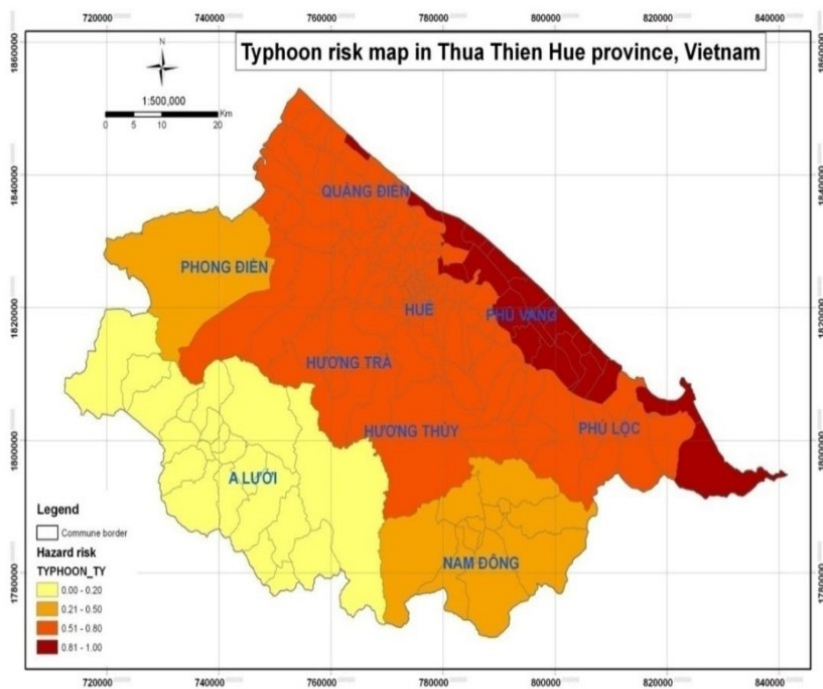
The region is characterized by high variation in terms of topography, climate and biodiversity, and thus can be divided into four zones: (i) mountainous area, (ii) hills, (iii) plains and (iv) lagoons separated from the sea by sandbanks

[12]. The region has tropical monsoon climate and the seasons are divided into four distinct seasons: fresh spring, very hot summer, mild autumn, and windy and cold winter. The dry season, characterized by hot climate starts from March to August while the rainy season usually starts from September to February. The rainy season is quite cold with average temperature is 19.7°C , but sometime down to 8.8°C

[12]. In this time, it rains a lost, sometime lasts all day - about 70 percent of the precipitation occurring in those months. The annual precipitation in the province is 3200 mm, but depending on the year, the annual average may be 2500 to 3500 mm in the plains and 3000 to 4500 mm in the mountains. The below map show the levels of risk caused by floods and typhoons across the province.



(2a)



(2b)

Figure 2a: Flood Risk (left) and 2b: Typhoon Risk (right) Map of Thua Thien Hue province, Vietnam [13]

Given the province's topography, in order to ensure sampled households are a good representative of the population, in the first stage, selected communes were clustered according to topographical features. In the second stage, from each topographical area, communes that are located close to the commune center and roads are selected in consultation with local government officials. The selected communes are Huong Giang in Nam Dong district (upland), Quang An in Quang Dien district (lowland), Quang Thai in Quang Dien district (lagoon) and Huong Phong in Huong Tra district (coastal). The location of four communes are marked with stars in the below map.

Interviews with Four Local Communes

Focus group methodology is considered to be an appropriate method for data collection for qualitative studies. It is described as a time-efficient mean to collect information that could be used to inform and validate the study design [16]. The group discussion provides an avenue to gain information on participant's view, attitudes, beliefs,

responses, motivations and perceptions on a defined topic so it increases the researcher's understanding of ongoing aspects of participant's experiences [17]. In this study, with support from the community staff, about six to ten households were selected and women were encouraged to participate in the discussion as a household representative. In order to prevent any potential political influence on discussions or views of the regular participants, local authorities were excluded from the recruitment process. After discussions, in order to crosscheck, complement and deepen the information discussed in the group setting, individual interviews were followed with the same 27 participants involved in group discussions. The individual interviews weighted more on personal information such as property values, financial status and social network, which may have made them uncomfortable and less truthful in a group setting. These results were later converted to numerical data. The use of both focus group and individual interview provided an opportunity to validate responses and gain greater depth of reality.



Figure 3. Map of Hue Province by Districts

Table 1. Population of Study Sites by district [14]

District	Population	Population Density (person/km ²)	Population per commune
Quang Dien	83,844	514	7622
Huong Tra	112,518	216	7032
Nam Dong	22,538	34	2049

After some opening questions designed to place participants at ease, a number of key questions, the central focus of the study, were asked. Participants were asked what they have done over the past few years at the household and community level to respond to challenge of flooding and storm events. Specifically, interviews addressed the natural disaster risks and vulnerability, and availability of management plan and aid for recovery in the province and discussed about the availability of inter-household adaptation and collective action (e.g. how effective community-based disaster risk management is in obtaining foods and shelter, housing and property repair assistance, livelihood opportunities, other emergency aids, etc.). Inquiries in respect to local residents' efforts to protect their home from flooding and storm damages, and knowledge on common construction materials were also made. The FGDs provided more insight on how potential risk factors affect their daily life as well as how the relevant authorities work together on community prevention to minimize damages. After interviews, the research validated the literature review; identified the types of people who are likely to be most vulnerable to future flood events; and derived future adaptation strategies and pathways, with a particular emphasis on how vulnerability might be reduced and future adaptive capacity built up. Recovery efforts and progress made since the last floods and typhoon were analyzed based on flood resistant materials, conditions of connections such as hurricane ties and clips that were photographed so as to draw policy insights and recommendations to improve protection measures and adaptive managements for households and local governments to floods and typhoons.

Analysis of Housing Repairs

The quality of construction and repairs were examined in reference to the Coastal Construction Manual and maintenance inspection checklist [1] by Federal Emergency Management Agency. Although Vietnamese common methods of residential construction, especially in the rural area are differ from how residential construction is typically done in the U.S., the fundamentals of flood and hurricane prevention, and recommended materials were similar.

3. Research Result

Comments from Local Residents

With support from community officials, about six to eight villagers from poor, non-poor and better-off households participated in the discussion, and members of common interest groups such as Women's Union and Youth Union were also involved in the discussion. These discussions were organized to ensure the active participation of village heads and women in selected communes.

Table 2. Number of Participants by Districts and Communes

Districts	Communes	No. of participants
Quang Dien	Quang Thai	8
	Quang An	6
Huong Tra	Huong Phong	6
Nam Dong	Huong Giang	7
TOTAL		27

This research discovered that perception towards floods and typhoons varies from person to person depends on where they live. Most participants were almost certain that there will be another flood or typhoon in the future, reflecting the fact there have been floods or typhoons every year. Although they suffer from economic loss, and their lives get harder after each disaster, they continuously live with the risk of being flooded almost every year. Many participants stated that they have learned to accept some degree of the risks through many years of experiences and be rational about future risks. Also, they become smarter and clever about how to survive nature.

There have been no major disasters in Thua Thien Hue as a whole since the catastrophic 1999 flood and the Typhoon Xangsane in 2006. However, this did not mean that natural hazards no longer concern them. All participants agreed that floods have become very serious in the last decades, and believed that floods would continue to be a serious issue over the coming decades. In other words, everyone is fully aware that floods can affect the area occurring annually and it is unavoidable. They showed concern about the safety and well-being of their family because a disaster can drive people into poverty anytime.

- [1] Participants explained that they make additional spending for materials and labor when preparing for and recovering from floods. These costs are consuming a significant portion of household income. When they were asked if they ever had to cut down on expenses for food, health care or children's education due to financial loss caused by floods, many of them said "yes". Fortunately, no one in the study group had an extreme case to drop their children out of school. *"My allowance money needs to be reduced, for example, before the disaster I spend 100 thousand VND but after the disasters taking place, I only spend 70 thousand VND, saving 30 thousand VND to prepare for future disasters"* (Anonymous, personal communication, October 22, 2015)

In the aftermath of climate disaster, while a large proportion of houses get collapsed or totally destroyed, the same household tends to lose their homes, assets and livelihoods, increasing their vulnerability to the next disaster event. Indeed, the poor who lack the capacity to prepare and recover from a disaster, increase the risk of disasters.

“The poor is more vulnerable to floods because their houses are temporary type. They are easily blown away or destroyed. Houses that are not normally damaged as others are strong and stable built with strong materials. Therefore those who are almost not affected have a stronger house and better economy” (Anomynous, personal communication, October 22, 2015)

In most disaster-prone country like Vietnam, shelter is considered as the most valuable, but the most vulnerable asset for the local households. Therefore, people are aware of the importance of improving housing conditions as one of the key coping strategies that withstand floods and typhoons. It makes housing and community more resilient to future events. Coping strategies including raising the base of their homes, constructing the roof and walls with sturdy materials such as concrete and bricks, and moving furnitures, foods, and livestock to higher places are embraced for all new constructions.

Social capital is evident in the focus groups, with all participants stating that in their village, everyone knows everyone else and they are willing to help each other in an emergency. The village and commune organizations, such as Youth Union and Women’s Union also attempt to mobilize people and organize mutual support such as helping the affected households to repair homes and maintain livelihoods.

Each participant was asked to choose all sources of support they received during the last disaster events. The highest number of participants chose local government (22.22%) and relatives inside the locality (21.37%), followed by NGOs (19.66%), relatives outside the community (12.82%), neighbor (12.82%), and religious leader (11.11%) for their sources of help. While the local government was chosen the most, many participants added that assistance they get from the government, NGOs or anyone else is insignificant. It is indeed such a little help. In most cases, they must get through difficulties on their own. Related to social capital, when the participants were asked what forms of support they received, they said “money” and “foods” most frequently as seen in Fig. 5. Usually, support from the governments and NGO’s are provided by a form of money, and mostly it is used to purchase materials to repair their houses, so they can be back to their normal state of lives. But it is their own responsibility as individual or community to repair what has been damaged. Next to tangible support, what the affected households most need is a large force of labor to repair damaged properties. Families and neighbors volunteer their unskilled labor to help reconstruct homes. As a matter of fact, the social capital, particularly the bond of relatives and neighbors in the locality plays very important role to the affected households especially the poor households to deal with the adverse effects of floods and typhoons.

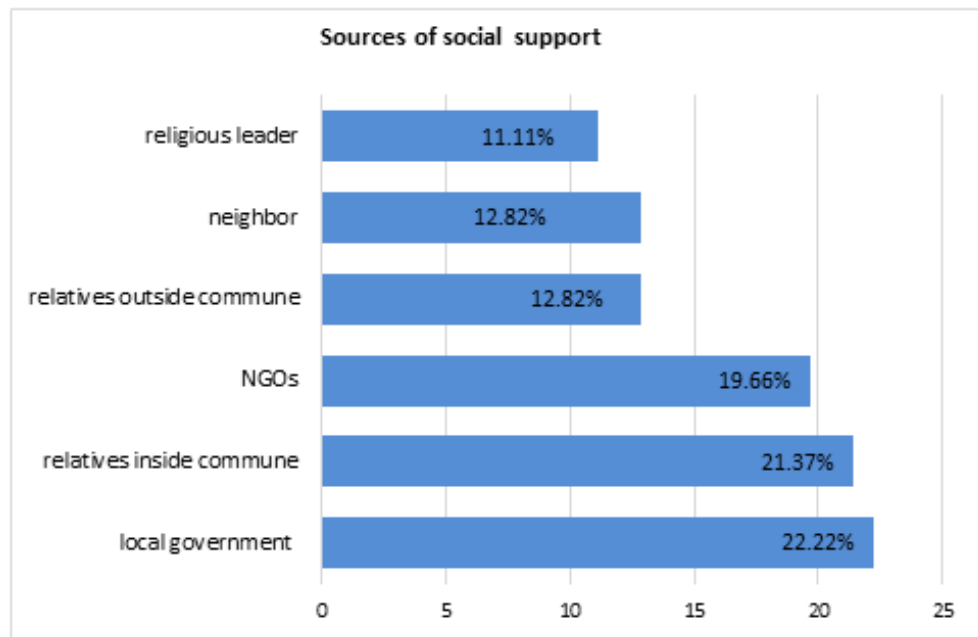


Figure 1. Sources of Social Supports provided after disasters

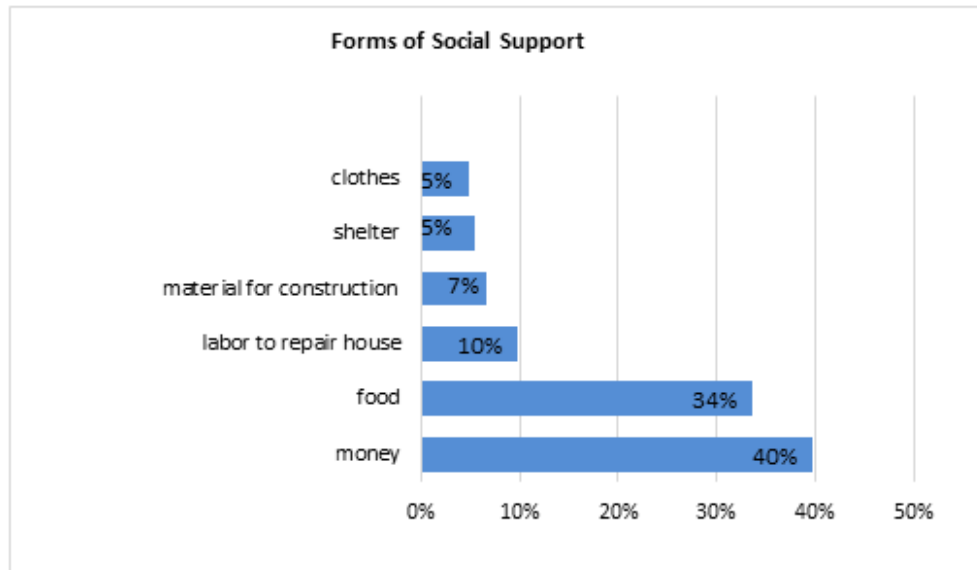


Figure 2. Forms of social support available in the area

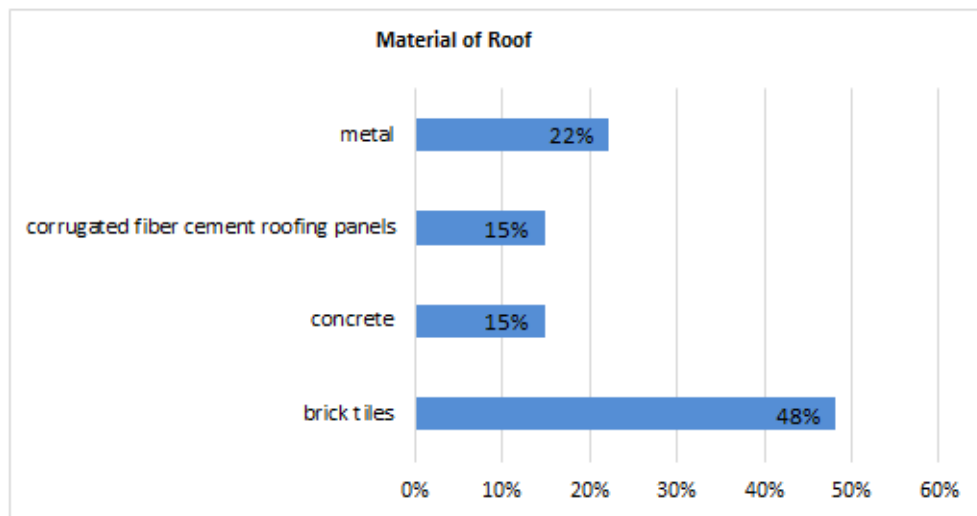


Figure 3. Local residents' response of types of roofing materials

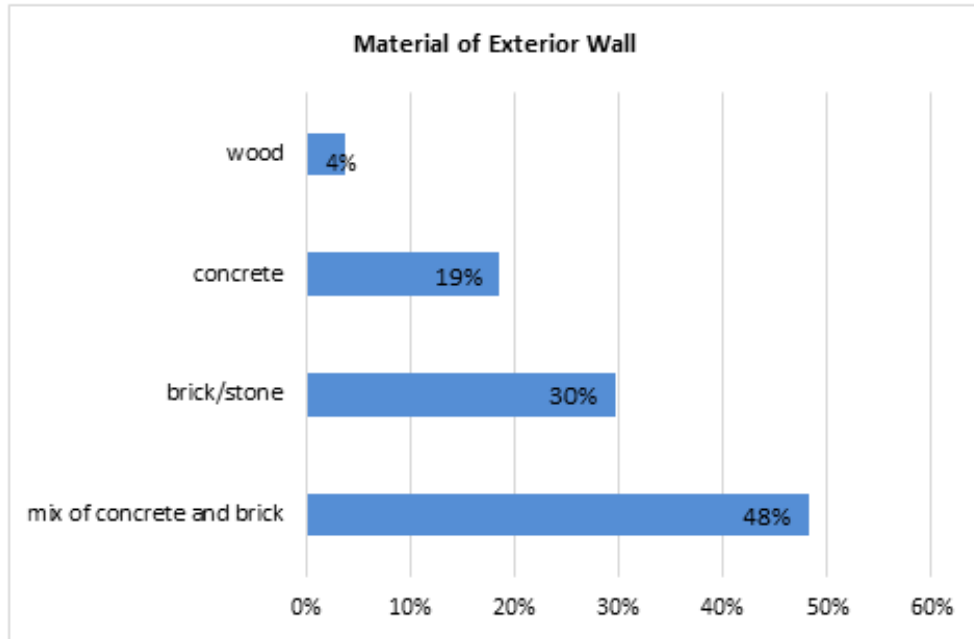


Figure 4. Local residents' response of typical exterior wall materials

Most of these residents are farmers or fisherman without much knowledge of construction. Technical construction guidance is provided by international non-profit organizations such as Save the Children, Development Work France, and Red Cross, but it is very limited since these organizations cover large areas in the county with limited manpower and resources. And when they do, that is all the professional construction consulting the locals receives to repair their damaged houses.

Common Residential Construction Materials

Based on the observations and responses from the local residents, most of the residential buildings in the area are constructed with limited selection of building materials. Slab on Grade is common foundation, and it is simply used as floor (unfinished) or ceramic tiles are laid on top of concrete for ease of care. Some houses appeared to utilize brick as underlayment and pour concrete on top as their floor, which causes floor cracks from ground settlement. Exterior wall is constructed with either cast-in-place concrete or mixture of concrete and hand laid bricks for more recent and new construction, while the older buildings still show wooden columns with wood paneling. Remainder of the structure including roof is framed with wood. The common types of Vietnamese vernacular roofing is using tiles, but corrugated metal roofing and corrugated fiber cement roofing are more common in less affluent neighborhoods.

Housing Repair Condition

Despite the increase of frequencies of natural disaster, most people repair damages using the same materials rather than making permanent reinforcement to prevent future risk.

As the locals testified, the local people did not fully understand the importance of reinforcing houses until recently. Most housing repairs are done by owners or through community effort with limited construction guidance. If damages were too severe to repair, structures were often abandoned, and the homeowners seek elsewhere for new home with the help of the community.

Most of the foundation or floor slab were not structurally reinforced and observed as in fair condition with less than ¼ inch cracks most due to water damage [1]. However, areas such as porch or entry where it is mostly exposed to weather, slab was in much poor condition left unrepaired.



Figure 5. Local resident's house with poor concrete slab at entrance

Due to the wet and humid weather, exterior walls and columns were often molded and cracked. While many cracks were patched, it still exposed the trace of repairs. It was very common to recognize previous level of flooding in the neighborhood, because of the trace of the water level was clearly visible on exterior walls and fences of the residences.

Rather than typical glass windows, most houses had shutters which would never be completely enclosed the space inside. Many observed glassed windows were broken and cracked, but the residents did not bother too much to repair them. Fortunately, they live in the moderate climate where the temperature does not change much.

Both wooden columns and concrete columns supporting the houses or canopy roofs were often observed to be rotten or molded on the bottom due to high humidity and flood damage. In addition, many of them were leaning from hurricane damage. No hurricane ties, clips, or special connection between horizontal and vertical structural members were found, completely exposing vulnerability of the entire framing of the houses.

Traditional roofing assembly in the area is to leave notches or holes on top of walls to lay wooden roof rafters through. Notches are often much larger to receive rafters and the gap between rafters and the notches are left open without fill or caulking. Wood purlin is nailed to rafters approximately 6" apart, then tiles are hand laid on top. There was no evidence of hurricane ties or clips [1] to enforce the connection between the roof and the concrete or brick wall. For corrugated fiber cement roofing panels and corrugated metal roofing, the panels were either screwed to metal purlins without any hurricane preventing connections or simply laid over wooden rafters or metal channels.

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4. Conclusions

With attempts by local governments and agencies to repair collapsed houses, there has been a remarkable improvement of the road and houses in the study areas. Many fragile and collapsed houses have been gradually replaced by semi-permanent and permanent houses [15]. However, there are many households still living in weak housing conditions without gaining access to the aid to repair and strengthen the houses. Even for those qualified for the financial aid, the support they get is very small. Therefore despite the large amount of investment in housing, 32% of housing stock is still classified as 'semi-permanent' houses, 19% as weak houses. In rural areas such as large part of Thua Thien Hue province, semi-permanent and permanent housing account for 31.7% and 49% respectively. Temporary and simple houses account for 9.8% and 2.6%. Ironically, accordingly to damage statistics for recent disasters such as typhoon Xangsane in 2006 and Ketsana in 2009, household living in semi-permanent housing have been worst affected with roofs and walls destroyed the most [9].



Figure 9. Local residents' home with broken windows and molded concrete wall



Figure 10. Installation of roofing tile at a new residential construction

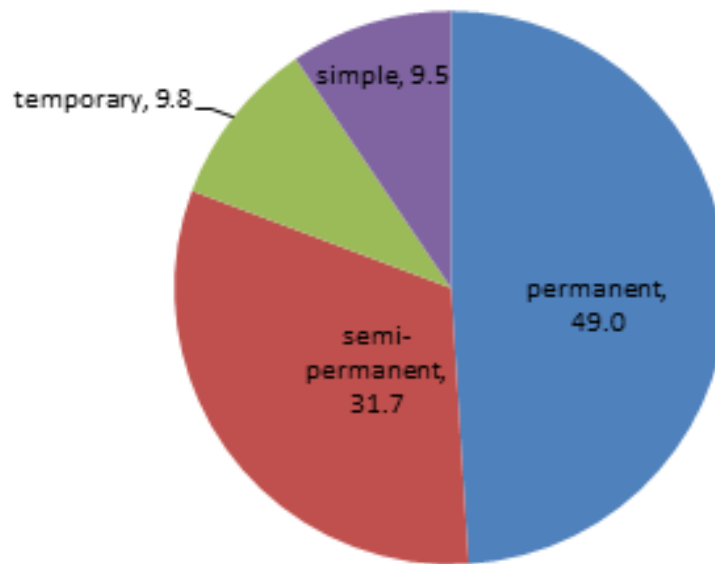


Figure 11. Percentages of Housing Type in Rural Area of Vietnam [15]

Vietnamese Housing Type Classifications are:

- i. Permanent: includes the villas, multi-story houses, apartments of multi-story buildings, multi-floor buildings assembled from pre-fabricated components, brick-constructed houses with flat concrete roof.
- ii. Semi-permanent: includes houses with walls made of brick/wood/wood frame and with roof made of tile/cement-mortar roofing/metal roofing etc. or houses constructed of equivalent materials.
- iii. House with durable frame and leaf-roof: houses with frame made from wood (all area of roof is propped up by durable pillars), with roof made of leaf/bamboo/oil-paper and its duration of use is more than 15 years.
- iv. Simple: includes all other houses, which do not belong to the above-mentioned types. These houses are with simple composition and primitive materials. Walls are usually made of dirt/leaves/woven sheets (not built of bricks or wooden frame) and roof of bamboo/leaf/oil-paper.

Most of the houses on research sites are categorized as semi-permanent houses, but the columns are normally made of bamboo or timbers which are easily broken by the strong force and flow of floods. Therefore, unless the damaged houses are remodeled to the permanent state, long-term solution to the damage is difficult to implement. People living in such houses do not have enough funding to remodel or reinforce the houses to fully resist next typhoon or hurricane rather they stay and live in the fear of next hurricane until it becomes unbearable to stay in the structure.

Then, it becomes an opportunity to rebuild and move onto the safer home.

Evidently, local people need affordable loans as well as technical support for housing reconstruction and reinforcement. The interviews revealed that people tend to repair their houses quickly after a disaster event and thus they desire to borrow money for house reconstruction. The problem is that their lack of construction techniques and knowledge does not necessarily improve the quality of housing. Indeed, in order to address recurrent structural damages, what could be really effective is providing loans using the conditional cash transfer (CCF) schemes which provide loans to only people who agree to take technical education and consultancy before they begin to repair their house. Learning about good examples of practices and successful experiences will be a useful guide for the local people to improve their capacity to respond to the challenges of climate change through resilient housing.

What we hear on the news as recovery effort by government and nonprofit organization does not have direct impact on long-term housing repairs from future hurricane or typhoon damages. However, with cultural and social setting of the community rebuilding effort, if more professional construction assist could be provided to educate and support them to repair their house with permanent solution, the condition after future disaster could be much alleviated. It is imperative to inform the local people of the key problems associated with disasters damages and teach them how to incorporate climate change adaptation into housing construction plans to improve their housing security.

Despite the increase in the frequency and magnitude of natural disasters in the Thua Thien Hue Province, the

response of local authorities to the impacts has been reactive rather than proactive. It is expected that this and future research will compel the government and relevant authorities to better understand the evolution and knowledge built on risk management in Vietnam so they can make better informed decisions that have lasting impacts. These studies must involve the local residents so that they can be fully aware of the potential dangers from natural disasters and work to ensure protection of their property and livelihoods.

It is expected that the study will contribute to a body of knowledge that will be available to the government, development practitioners and stakeholders for other flood/typhoon affected households throughout the country of Vietnam. The design of appropriate measures to manage and mitigate natural disasters requires an understanding of risk management, the exchange of experiences among household, and the development of knowledge and livelihood strategies that are supported by sustainable policy and interventions.

During the study it is also very important that the local people are informed that all people have opportunities to make their voices heard. It is important that they are a part of the process so they can feel that they are a part of the development of their future homes and communities. It is also important to give the people knowledge on new materials and educate them in new kinds of construction so they would understand and know what they can use and do. In addition, increasing awareness and preparedness against natural disaster and recognizing the existing structural failure would help alleviate the future risks as well.

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