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Maintenance Policies and Practices on Resilient Houses: Case Study from a Coastal Resilience Project in Vietnam

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Abstract: Vietnam is a country that experiences extreme climate conditions and annual accumulated damage due to typhoons and floods, which seriously destroy houses and cause many deaths. Approximately half a million people currently living within 200 m from the coastline live in unsafe houses. Therefore, the Coastal Resilience Project (the project) was implemented to build 4000 storm- and flood-resistant houses for five coastal provinces in Central Vietnam. The paper is carried out to review existing policies and practices related to the maintenance of resilient houses, as well as to propose feasible maintenance solutions for houses to ensure the sustainability of the project. The result shows that currently, there are no technical instructions or manuals on the maintenance and repair of individual houses in general, or the project houses in particular. Most of the households in the project also have very low and unstable incomes. In addition, as they lack knowledge of how construction works, they know little to nothing about the maintenance of a house. From these findings, the authors recommend several solutions for better maintenance policies and practices on the resilient houses of the project in Vietnam. The project provides several lessons in terms of the maintenance of the resilient houses of future projects in Vietnam and elsewhere, by reviewing existing policies and current practices, as well as proposing feasible measures to ensure the sustainability of the project. The findings in this paper provide valuable information for better maintenance policies and practices of resilient houses for other vulnerable coastal provinces in Vietnam and similar contexts elsewhere.

Keywords: houses; maintenance; project; resilience; Vietnam

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1. General Introduction

Vietnam is one of 30 countries at "extreme risk" due to climate change. Over the past 50 years, Vietnam has witnessed an increase in temperature of more than 0.5 °C and a 20 cm rise in sea level. As a result, the annual accumulated damage in Vietnam due to typhoons reaches 1.3% of GDP, with a total of 96,000 destroyed houses and almost 500 deaths within 22 years (from 1990 to 2012). The country has a vast coastline that is more than 2000 km in length. There are about half a million people living within 200 m from the coastline. Many of them are currently living in unsafe houses along the coastline, which are typically directly impacted by typhoons and floods. For these reasons, the project "Improving the resilience of vulnerable coastal communities to climate change-related impacts in Vietnam" (hereafter referred to as "the project") was implemented in coordination between the government, project donor and implementor, and local beneficiaries [1]. The project document was issued as an attachment to Decision No. 3637/QĐ-BNN-HTQT, dated 7 September 2017 of the Ministry of Agriculture and Rural Development (MARD) [2]. The main objective of the project is to increase the resilience of vulnerable coastal communities to climate change-related impacts in Vietnam. The project comprises a component to build storm- and flood-resistant houses (resilient houses). Since 2017, the resilience housing component has been implemented in the five coastal provinces of Vietnam: Thanh Hoa, Quang Binh, Thua

Thien-Hue, Quang Nam, and Quang Ngai (Figure 1). Building on an existing protection program to provide safe housing for the poor and marginalized (Decision No. 48/2014/QĐ-TTg issued by the Prime Minister dated 28 August 2014) [3], the project aims to strengthen storm/flood resilient design features in 4000 new resilient houses for poor and highly disaster-exposed people in coastal areas.

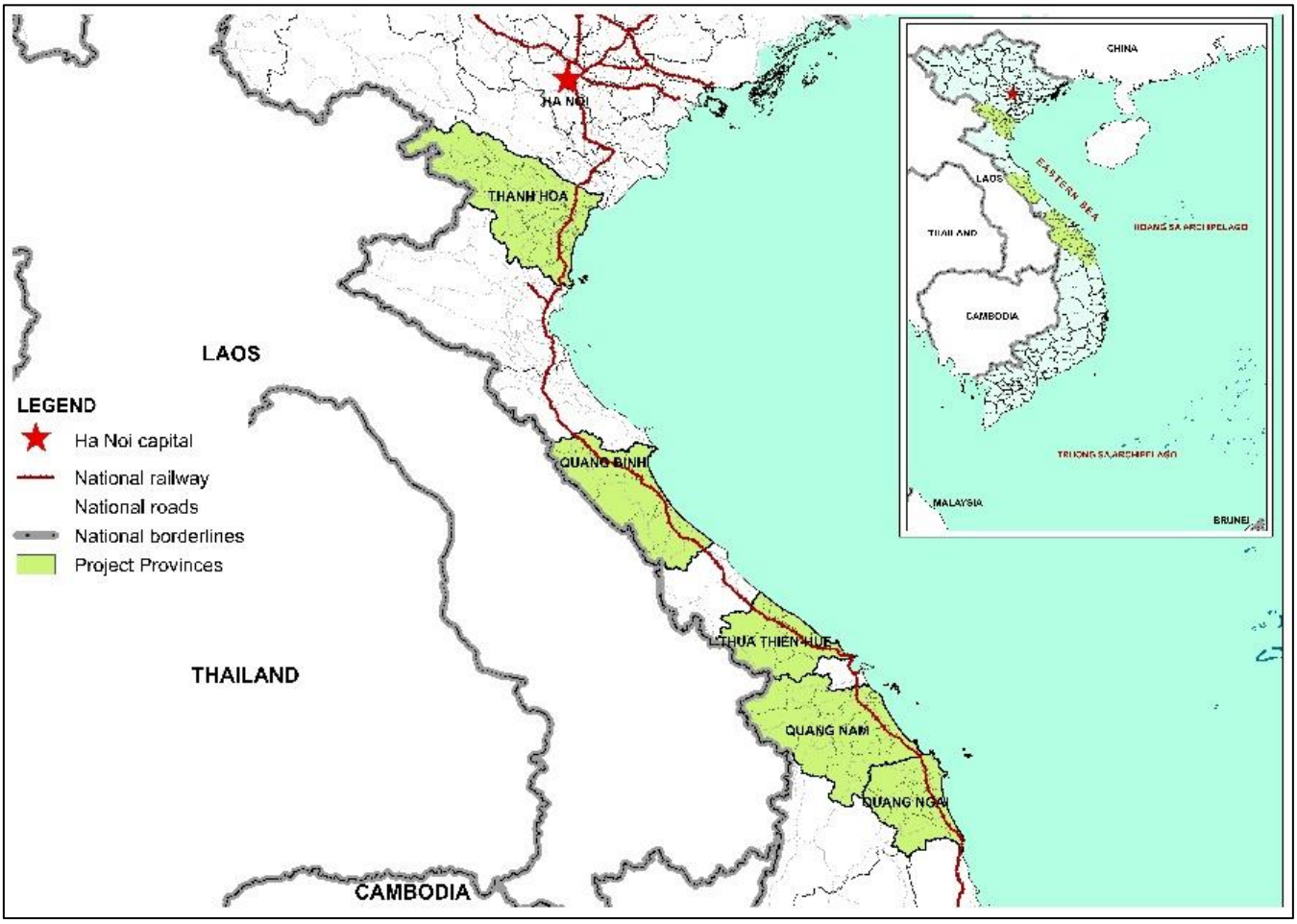

Figure 1. Local Map of Five Coastal Provinces Belonging to the Project.

The maintenance policies for resilient houses involve a comprehensive approach to maintaining the structure and components of a building to ensure it can withstand various hazards and natural disasters. The maintenance of a living house is an important task with the aim of prolonging the service life of the house and ensuring the safety of the people living in it. In order to have feasible maintenance schemes for flood- and storm-resilient safe houses in the five project provinces, the authors focused on reviews of existing policies and practices related to the maintenance of resilient houses, together with understanding, throughout field surveys, the context and difficulties relating to the maintenance of the project houses, both from a project and local authority point of view. This was carried out to help propose feasible maintenance solutions for resilient houses and ensure the sustainability of the project. In order to fulfill the mentioned objectives, some key research questions were considered in the research orientation, including: What are the government's regulations for maintenance related to housing in general and for flood- and storm-resilient houses in particular? Are they suitable for the project and why or why not?; How is the maintenance of individual houses implemented in the study areas? What are the difficulties, obstacles, and solutions?; What are the most suitable and feasible solutions for the maintenance of existing storm- and flood-resilient houses?; What

are the funding sources for storm- and flood-resilient houses, and what are some of their associated challenges and solutions?; and What types of insurance products are available for homeowners to consider, including for potential damages by various events?

2. Literature Reviews

Housing usually represents the highest losses due to natural disasters. In developing countries, despite national governments and humanitarian agencies' efforts to carry out plenty of recovery actions, most affected households still receive limited assistance (Suarez et al., 2008) [4]. Resilient houses are designed to withstand and recover from natural disasters, such as hurricanes, earthquakes, floods, and wildfires. However, maintenance policies for resilient houses are critical to ensure that homes can withstand various hazards, remain safe and functional, and reduce the impact on the environment. It requires attention to several issues, including construction quality, maintenance, sustainability issues, technical issues, financial issues, and insurance. "Hazard Resilient Housing Construction Manual", a report by the National Building Research Organization, provides guidelines for designing, constructing, and maintaining resilient houses [5]. The report covers issues such as site selection, foundation design, structural systems, and energy efficiency. Saira Enam (2015) [6] examines the challenges of managing resilient housing in disaster-prone areas. The research discusses issues such as community engagement, stakeholder collaboration, and regulatory frameworks. The Build Change (2021) [7] provides guidance for building disaster-resilient homes in vulnerable communities. The report covers issues such as community participation, building codes and regulations, and sustainable design. These types of research provide valuable insights into the management issues associated with resilient houses, and can help homeowners, policymakers, and building professionals develop effective strategies for promoting resilience in the built environment.

Maintaining resilient houses requires addressing technical issues related to building materials, construction methods, and energy efficiency. Charlesworth and Ahmed (2015) [8] provide information and guidance for designing and building resilient houses. They cover a range of technical issues related to building materials, construction methods, and energy efficiency. The United Nations (2020) [9] discusses the importance of integrating technical and social solutions for building resilience. It highlights the need for a holistic approach to building resilience, which includes both technical and social aspects.

Moreover, sustainability is an essential aspect of maintenance policies for resilient houses. Sustainable maintenance policies help to ensure that the resilience of the houses is maintained over the long term without compromising the environment. The use of sustainable building materials in the construction and maintenance of resilient houses can help to reduce the environmental impact of the buildings (Suhamad and Martana, 2020) [10]. O'Brien et al. (2012) [11] provide guidance for designing and building sustainable and resilient homes. They cover a range of sustainability issues, including building materials, energy efficiency, and social equity. These studies highlight the importance of incorporating sustainability considerations into building design and maintenance.

In addition, maintaining resilient houses requires significant investments, and financial issues are a critical aspect of any maintenance policy. Brugmann (2012) [12] explores the financial tools and strategies that can be used to build resilience in cities, including financing mechanisms for resilient housing. This study underscores the importance of engaging private sector investors and using data-driven approaches to identify and prioritize resilience investments. UNEP (2022) [13] discusses the demand-side perspective of financing resilience in cities, including financing mechanisms for resilient housing. It highlights the importance of involving local communities and using participatory processes to identify and prioritize resilience investments. It emphasizes the need for innovative financing mechanisms, the engagement of private sector investors, and participatory processes for identifying and prioritizing resilience investments.

Furthermore, there is a growing interest in resilient houses and their maintenance policies, particularly in the context of climate change and natural disasters. Insurance is an

important aspect of these policies, as it can provide financial protection for homeowners and incentivize them to invest in resilience measures. Carolyn and Helen (2020) [14] discuss the role of insurance in building resilient communities. The authors argue that insurance can be a powerful tool for incentivizing homeowners to invest in resilience measures, but that it must be combined with other policy tools, such as building codes and land-use planning, to effectively reduce risk. Idan et al. (2012) [15] discuss the role of the insurance industry in disaster risk reduction and resilience building. Their research highlights the potential of insurance to incentivize risk reduction measures, but also notes that insurance alone cannot address all of the challenges associated with building resilience. These studies highlight the need for a comprehensive approach to risk reduction that combines insurance with other policy tools and social initiatives.

Several studies have been carried out on the resilience of vulnerable coastal communities to climate change-related impacts in Vietnam. Tran et al. (2012) [16] reviewed housing vulnerability in the central area of Vietnam that imply for climate resilient houses with the conclusion of several typical design and construction for resilient houses against natural disasters. There is a relationship between climate change and housing, specifically in developing countries where housing is regarded as one of the most valuable assets of residents (Ahmed, 2011 [17]; Luu, 2013 [18]; Tran, et al., 2014 [19]). Lee and Lee (2017) [20] studied the disaster resilience of low-cost houses located in a central province of Vietnam. In this study, the design and construction of individual houses are normally carried out by homeowners or their relatives, using their own experiences from observing their neighborhood houses. Moreover, they try to utilize local materials that are available in their vicinity at a low cost, such as bamboo, wood, or stone, in order to reduce the construction costs as much as possible. However, these low-quality resilient houses cannot survive severe typhoons and floods. In the field of houses' maintenance, several studies have been carried out to show the current status and propose maintenance plans. Hai (2009) [21] identified several defects occurring on resident apartments and proposed maintenance solutions such as priority maintenance method, site inspection, and maintenance database. Harun-Or-Rashid (2022) [22] proposed features of resilient houses in Bangladesh that can sustain themselves against natural hazards and remain durable without much maintenance.

3. Research Methodology

Based on the research objectives and questions, specific tasks (as shown on Figure 2) were developed into three groups: desk review/study, site surveys, and writing the paper. Based on the requirement and literature reviews, the survey forms for local authorities and households were developed. They consist of several parts for data collection: Introduction, Understanding the maintenance works, Maintenance works in reality, Budget for the maintenance works, House insurance, and personal Opinion on House Maintenance.

The project was started by reviewing project documents, the existing policies on maintenance in general and individual house in particular, as well as lessons from the best practices failures related to the maintenance of resilient houses in order to design survey forms (Step 1). After the survey forms were completed by the authors (Step 2), site surveys (Step 3 and Step 4) were carried out in all five provinces (Thanh Hoa, Quang Binh, and Thua Thien Hue, as well as Quang Nam and Quang Ngai). In-depth interviews and discussions with local authorities (PPMUs, DoCs, DPCs, and CPCs) were conducted to understand the project's context and the difficulties in terms of the technical and financial issues relating to the maintenance of resilient houses. Household interviews were also conducted with randomly selected houseowners in the five provinces of the project to understand the reality and difficulties from a household's point of view relating to maintenance works of the resilient houses. About 15–20 households in each province were selected for interviews. Before interview implementation, the author had obtained ethical approval by the project. In addition, written informed consent was obtained from all participants in this study with the support from the project. In addition, meetings with insurance firms and other related stakeholders were also held to collect more information relating to insurance policies and

insurance for construction and maintenance works. Before interview implementation, the authors had obtained ethical approval from the project. In addition, written informed consent was obtained from all participants in this study with the support from the project.

A consultation workshop (Step 7) for the draft paper is held with the participation of the project's donor, implementor, MoC, PMU, and PPMUs. All comments and feedback from the participants in the workshop will be collected and reviewed for finalizing and completing the paper.

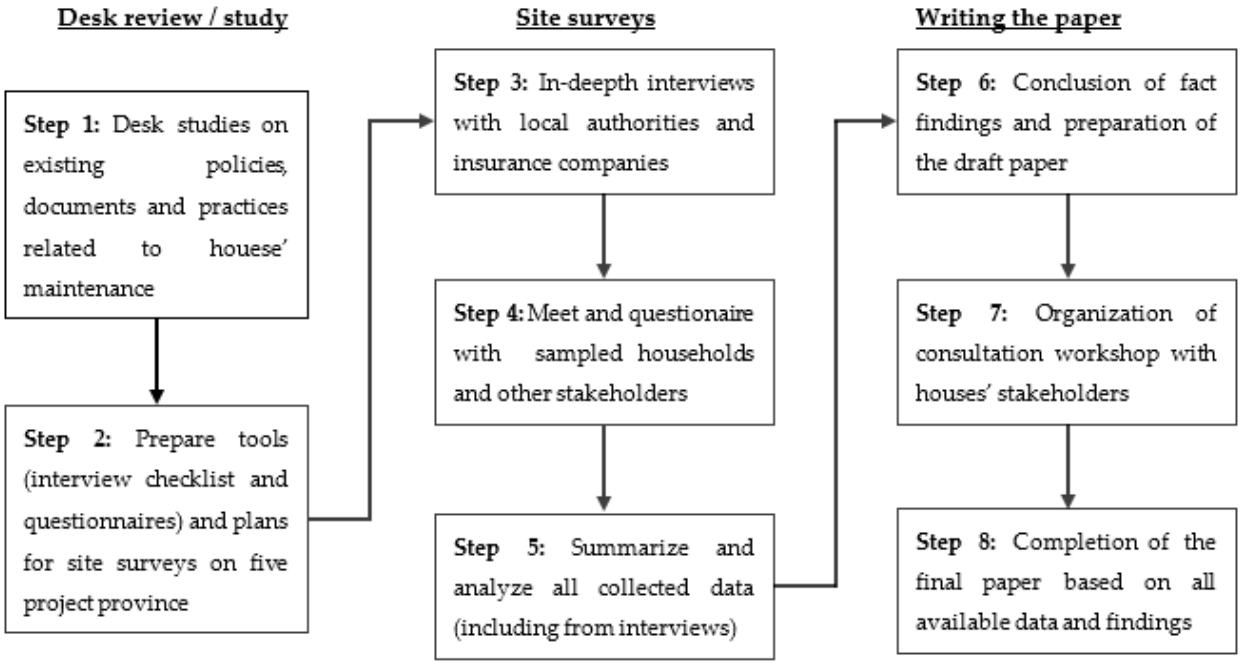

Figure 2. Research Steps to be Implemented.

4. Project Descriptions

The project started in 2017 and by December 2021, all 4000 resilient houses were completed, as shown in Figure 3.

4.1. Main Structural Design of the Resilient Houses

In total, 34 innovative storm- and flood-resilient housing designs were selected and officially used in the project for the five project provinces. A typical design of resilient houses is shown in Figures 4 and 5. The main structure of the resilient houses includes:

1. Number of floors: one base floor and a mezzanine for flood and typhoon shelter;
2. Main structures (including column, pier, and mezzanine): made of reinforced concrete with grade 200#;
3. Foundation: simple foundation made of masonry stone with grade 50# or of reinforced concrete with grade 200# for independent foundation structure;
4. Floor area: (i) ground floor: the floor construction area is 12 m^2 at a minimum; and (ii) mezzanine: the area is 10 m^2 at a minimum and at least 1.5 m higher than the highest flooding level recorded in the locality;
5. Walls: made of brick with a thickness of 110–220 mm;
6. Doors and windows are reinforced with firm doorknobs, latches, fasteners, or locks in order to protect against strong winds;
7. Roofs: there are three options: (i) option 1: reinforced concrete; (ii) option 2: terracotta or cement tiles with wood structure reinforced by a concrete bar along the roof to protect against strong winds; or (iii) option 3: wavy corrugated iron with a thickness of 0.4 mm, reinforced by steel bar V30 × 30 × 3 mm along the roof to protect against strong winds.

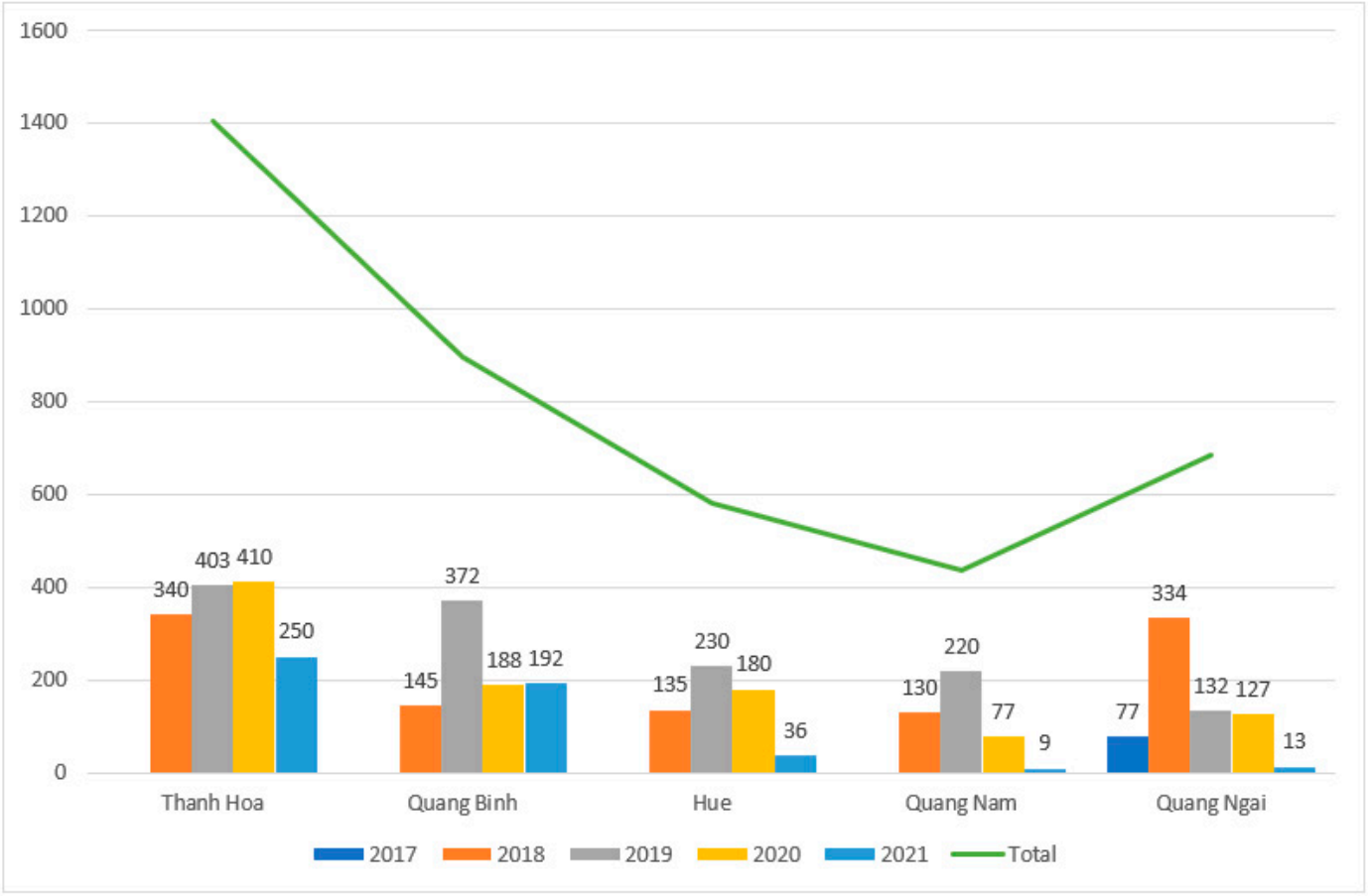

Figure 3. Resilient Houses Completed by the End of 2021.

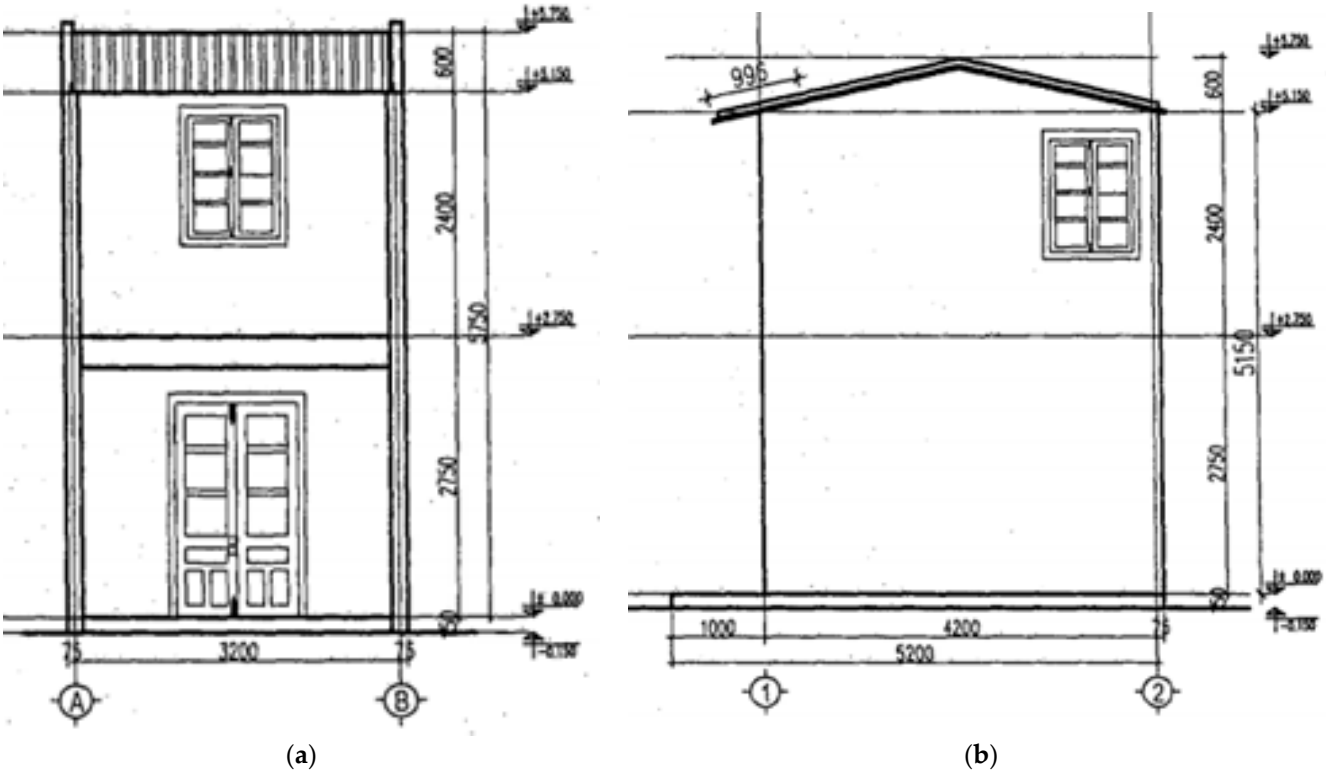

Figure 4. Typical Design of Resilient Houses. (**a**) Elevation A; (**b**) Elevation 1–2.

Figure 5. Typical Project Houses. (**a**) Thanh Hoa province; (**b**) Quang Nam province; (**c**) Quang Binh province; (**d**) Thua Thien Hue province.

All designs used in the project were based on the typical designs suggested in the decision No. 48/2014/QĐ-TTg, dated 28 August 2014 by the Prime Minister [3], on the policy for poor households to build houses against typhoons and floods in the coastal areas. The above resilient features aim to ensure that housing, the most valuable asset of the people in the project areas, is built in a safe location and can withstand not only the impacts of the current adverse climate conditions and disasters, but also the expected extreme conditions for many years to come.

4.2. Partners Involved

The parties involved in the project (specifically, the resilient housing construction component) are shown on Figure 6. Their key roles and responsibilities are as follows:

1. Households: The beneficiaries of the project. Homeowners also play the roles of the investor and main supervisor during the construction period. In cases with elderly homeowners, female-headed households, illness, or other instances in which there is limited knowledge and experience in the supervision of construction works, support is provided by PPMU engineers and communes to monitor.

2. Donor/Implementor: Co-finance and provide other supports.
3. Provincial Project Management Unit (PPMU): Make plans, manage, and supervise the project, and make reports to the Government (MARD, MoC, and UNDP). PPMU plays a role as the coordinator between households, UNDP, and other partners.
4. Project Management Unit (PMU) Component 1-MoC and DoC in the project provinces: Provide technical support such as typical design, supervision, issue guiding documents on the project implementation, and other technical supports.
5. Districts, communes: Support homeowners with limited knowledge and experience (including the elderly, female-headed households, or those with illnesses) by checking construction quality and supervising the construction works.
6. Third parties: Including construction team (contractor), local communities, and organizations such as youth and women's unions, the fatherland front committee, trade unions, Social and Policy Bank, etc., who can provide support during construction and in case of damages due to disasters.

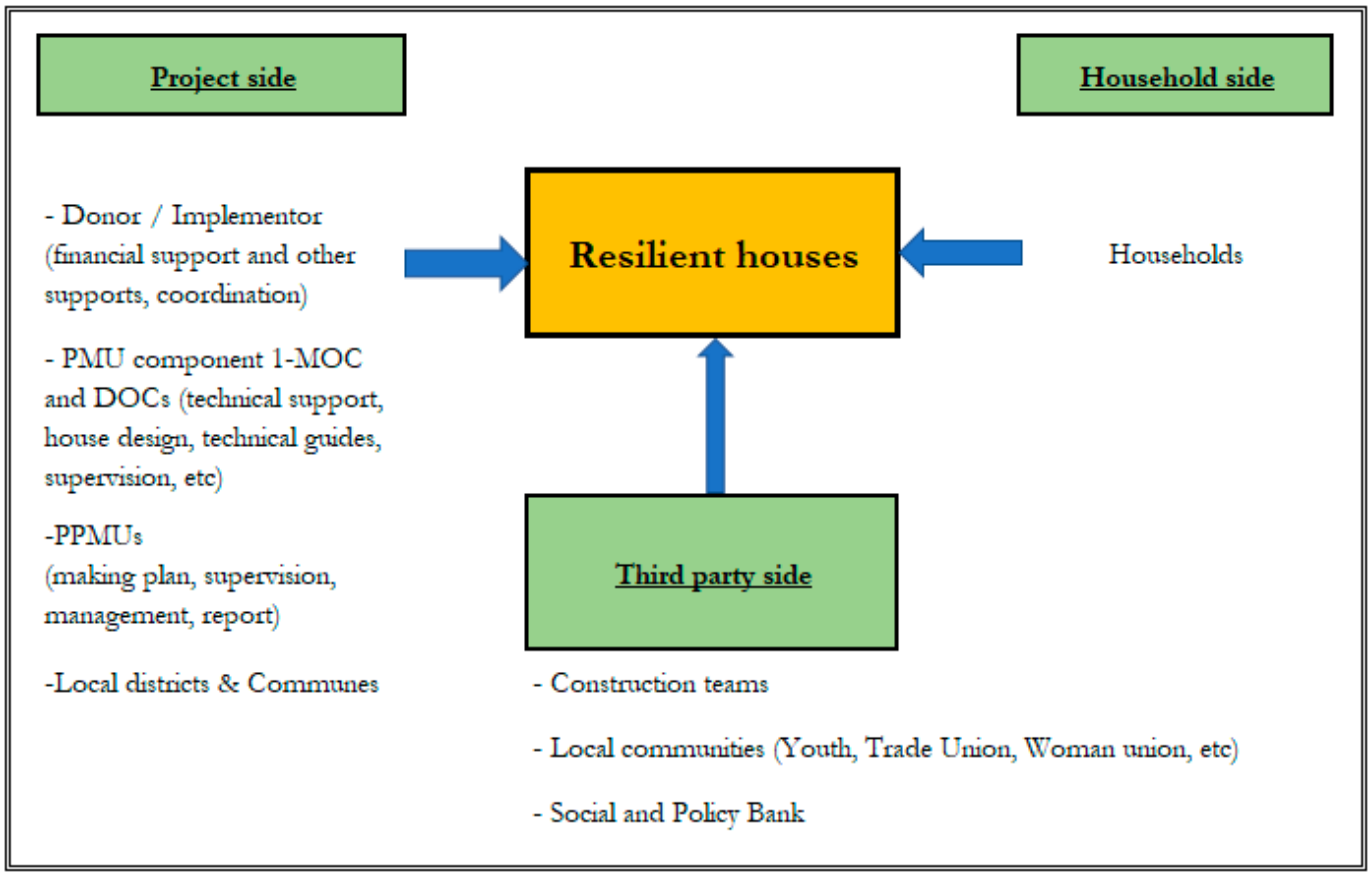

Figure 6. Partners involved in the project.

4.3. Financial Supports

The total construction cost of a resilient house ranges from 55 to 135 million VND, depending on the design of the house and the province. On average, the donor supports 37–39 million VND (equal to approximately 1700 US$ per house, including 900 US$ for a roof with strengthened bracings and fittings, 400 US$ for reinforced windows, doors, and ceilings, and 400 US$ for drainage, siting, and raising plinths), which accounts for about 25–50% of the total construction cost. In addition, each household can receive approximately 12–16 million VND in support from the government (according to the decision 48/2014/QD-TTg, dated 28 August 2014 [3]) and 15 million VND from the Social and Policy Bank's preferential loan. In total, a household can receive a maximum support

of 70 million VND to build a resilient house from three sources—the donor, the government, and the Social and Policy Bank.

The budget from the donor is mainly used for the reinforced features of safety as mentioned above, and the rest is paid by the government, the bank, and the homeowners directly. Some households experiencing extremely difficult circumstances, such as those with elderly inhabitants or disabled people, will have access to additional support from the local authorities. This includes manpower from trade unions and youth in order to reduce construction costs. All the households that received support from the project are the poor, near-poor, and low-income families that met the criteria set out in the decision No. 48/2014/QĐ-TTg, dated 28 August 2014 by the Prime Minister [3]. The budget covers part of the construction costs to support the reinforced features against typhoons and floods, but does not cover costs for maintenance and repair or construction insurance.

5. Legal Documents Relating to House Maintenance in Vietnam

Maintenance is considered one of the most important steps to ensuring quality, enhancing the durability of the works, and reducing operating costs. Aware of the importance of maintenance to the construction works in general, the National Assembly of Vietnam has issued legal documents to include: the Law of Construction No. 50/2014/QH13 [23], the Law of Living House 65/2014/QH13 [24], the Law of Insurance Business No. 08/2022/QH15 [25], and the Law of Fire Prevention and Fighting No. 40/2013/QH2013 [26]. In addition, there are several sub-law documents that have also been issued by the Government of Vietnam to include decrees, circulars, decisions, technical regulations and standards, guidelines, and so on. They have formed a comprehensive set of legal documents on the maintenance of construction works in general. These documents form the legal basis for the maintenance of construction works in general, in order to ensure and maintain the safe operation of structures and works according to design during the exploitation and use stages.

5.1. Life Cycle of a Construction Work and the Role of Maintenance Work

The life cycle of a construction work in general (Figure 7) comprises three main periods: (i) Construction period; (ii) Operation or exploitation period; and (iii) Decline or collapse period. Physically, during operation/exploitation, the quality of the work degrades quickly. To ensure that the construction work is of good quality and within the expected service life, adequate maintenance is imperative.

Each part of the work has its own function and impacts the other components of the construction work. In case a part of the work does not function well or is degraded or broken, the whole construction work may collapse earlier than expected. Therefore, all parts of the work should be examined regularly, and repaired or replaced at the right time. Maintenance work plays an important role in upholding the quality and prolonging the service life of a construction work if it is completed at the right time and place. To do that, the designer or homeowner should prepare the procedures and technical instructions for the users to identify which structures should be maintained, as well as when and how to maintain them.

5.2. Classification of Construction Works and Maintenance

According to the Decree 06/2021/NĐ-CP [27], construction works can be classified into six main groups: (i) Civil works; (ii) Industrial works; (iii) Transportation works; (iv) Agriculture and rural development works; (v) Infrastructure works; or (vi) Security and defense works. Several legal regulations such as the Circular 12/2012/TT-BXD [28], the Construction Law No. 50/2014/QH13 [23], and the Law of Living House No. 65/2014/QH13 [24], civil works are further broken down into (i) resident house and (ii) public works. The resident house category comprises two classes: (i) apartment and (ii) individual house—the construction work that is built on a land area that belongs to a household or a person officially defined by law. According to this classification system, a resilient house belongs to the individual house category under the civil works group.

Therefore, this report will focus exclusively on reviewing policies relating to this type of construction work. In addition, the resilient house model used in the GCF Project is characterized by the following key features: (i) it was built according to pre-designed options offered by the project; (ii) simple structure with two floors at most, in which the second floor is mainly used as a shelter or storage in the case of a typhoon or flood; (iii) low cost of construction; and (iv) with some reinforced features that can protect against severe flood and typhoon conditions which are typical in the coastal areas of Vietnam.

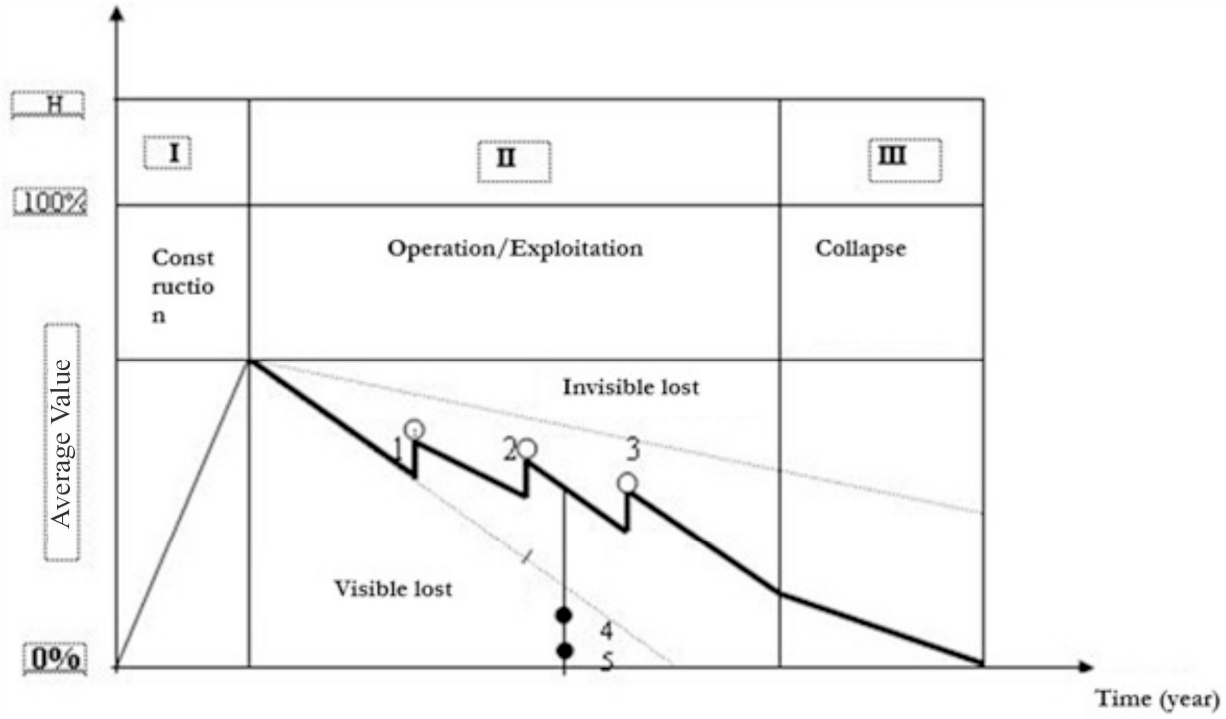

Figure 7. Life cycle of a construction work.

The maintenance of a construction work begins after the construction is completed, and it can be divided into three main streams, depending on the period of service life of the construction work:

(i) Construction warranty: This is normally the responsibility of the construction team (contractor) to repair or replace the damages that result from construction activities. There is not a clear regulation on the period of warranty for individual houses in all legal documents. Although it is suggested that the warranty period for a construction work should not be less than 12 months, except for the work at grade special or level one, the duration of warranty is typically an agreement between the homeowner and contractor that is defined in the contract before starting the construction.
(ii) Regular maintenance: This is the responsibility of homeowners.
(iii) Minor and medium repair: This is also the responsibility of homeowners.

In rural areas of Vietnam, the warranty is usually ignored in the contract and there is not even a written contract (legal document) between the homeowner and the construction team. The main reasons are that: (i) the total cost of construction is much higher when the warranty condition is included; (ii) homeowners do not know or do not believe that warranty is important and necessary, or that it should be mentioned in the written contract with the construction team/contractor; and (iii) most of the construction team/contractor has direct or indirect relations with homeowners through relatives or friends. Therefore, if and when there are any faults caused by contractors or construction workers, the homeowner typically asks them to do the necessary repairs. This in itself is, in fact, a kind of warranty. The Law of Living House 2014 [24] defines housing maintenance as the peri-

odic works of the maintenance and repair of houses and repairs when there is damage in order to maintain the quality of the house. In fact, house maintenance includes some technical techniques: (i) recognizing defects and damages (including safety issues) that require technical guidelines/instructions, and examining plans and management documents; (ii) maintenance activities (repair works) that normally require professional workers; and (iii) documentation and filing.

All three of the above requirements are based on knowledge and experience for most households in the project, while the dổn/implementor as well as local authorities do not have any technical guidelines/instructions for maintenance works thus far. In addition, all the selected households in the project are poor. Their annual income is not even sufficient to maintain normal standards of living, therefore it is quite difficult for them to save money for maintenance and repair works. As a result, the quality of the houses might be degraded quickly after some years (likely after 5–7 years) and the benefits gained through the project will likely be lost. In addition, the impacts from severe risks and climate change such as storms, floods, typhoons, strong winds, and high temperatures will cause certain deterioration to residents' houses.

5.3. General Procedures of a Maintenance Work

Maintenance procedures of a construction work in general are clearly mentioned in the Decree 06/2021 [27], including three technical aspects:

1. Prepare and approve the maintenance procedures, including: (i) identify important work items/structures that are objects of maintenance; (ii) methodology and techniques to be applied, and tools to be used; (iii) list of actions to be done and a schedule of actions.
2. Prepare maintenance plan, including the action plan, budget, and personnel (to be completed by the homeowner/user or a hired professional team).
3. Documenting works.

Furthermore, maintenance actions can be divided into three groups: (i) routine maintenance; (ii) periodic maintenance; and (iii) ad hoc maintenance. These procedures are highly professional. Though recognized as important and necessary for large and important structures, they are generally not considered particularly relevant to individual houses, since most local homeowners do not have the knowledge and experience needed for these kinds of technical issues. Moreover, the maintenance budget is also another problem. In reality, the warranty and maintenance are usually ignored in the case of individual houses. Therefore, it is also not exceptional for resilient houses in the project.

5.4. Insurance Issues

Insurance is an important issue for a construction work in general. It is even more important for resilient houses over the course of the GCF Project implementation, since they are more likely to be subject to risks and adverse climate change-related impacts such as typhoons and floods. Insurance is mentioned in some legal documents such as the Law of Construction [23], the Law of Living House [24], and the Law on Insurance Business [24]. Relating to construction works, there are various kinds of insurance, such as insurance for equipment, materials used and labors at site, civil liability insurance for third parties, and insurance of the construction quality, including insurance of professional liability for construction investment consulting, insurance for construction work during construction time, and insurance for construction warranty.

This paper focuses on insurance for construction warranty, after the construction is completed. According to the Law of Construction [23], insurance is compulsory for the following cases: (i) for laborers working at sites; (ii) professional liability for construction investment consulting services; and (iii) construction works that have impacts on the safety of local communities or the environment, and that require special construction techniques under complex construction conditions. Unfortunately, insurance is not compulsory for individual houses or for the operation period yet. Therefore, there is no legal document on

insurance for resilient houses that can be applied for individual houses in general, and by extension, the project houses.

6. Key Findings from Site Inspection

Due to the situation of COVID-19 in 2020 and 2021, the field trips in the five project provinces were organized in different times: Quang Binh (14–17 November 2021), Quang Ngai (1–4 December 2021), and Thanh Hoa (2–5 January 2022), Thua Thien Hue (18–20 February 2022), and Quang Nam (1–3 March 2022). The authors met and discussed the project implementation status with members of the project management board, local authorities, and beneficiaries in order to: (i) directly observe, exchange, and evaluate the implementation results of the project and (ii) capture the local people's feedback on the effectiveness of the project, damages, and maintenance, as well as issues relating to the insurance of the house. In addition, the authors also met and discussed with the Red Cross and local insurance agencies to learn about similar models and information related to the budget for the maintenance and repair of the project houses. The results of the field visits are presented below.

6.1. Effectiveness of the Project Houses

After the severe floods and typhoons in September and October of 2020 in the central region of Vietnam, the effectiveness of the project houses has been recognized by the local people and authorities. The local governments in the Quang Binh, Thua Thien Hue, and Quang Nam provinces have asserted that, without the project houses, thousands of people would have died due to the level of floodwater that rose very quickly to about 1.5 m, higher than the expected annual level. The project houses not only saved the lives of beneficiary households' family members, but also saved the lives of neighboring families. In Quang Binh province (Hong Thuy commune, Le Thuy district), the model of the project houses was copied and multiplied by the local residents themselves (Figure 8). It is the most valuable evidence of the effectiveness of the project houses.

Figure 8. The model of the project house has been copied and multiplied by many households in Hong Thuy commune, Le Thuy district, Quang Binh province, when building their own new houses.

6.2. The Use of Space of the Project Houses

Generally, the project houses are used effectively for both daily living and resilient shelter purposes. However, the use of the mezzanine may differ between different groups, as described below:

1. For the elderly, lonely, and disabled households, the mezzanine is mainly used as a safe shelter during flooding events, especially in the Quang Binh, Hue, and Quang Nam provinces, where severe floods with high-water levels are likely to occur in a given year.
2. For large-size households and others, the mezzanine is used both for living space and safe shelter when floods occur.
3. The kitchen and toilet are not covered in the project houses. People use the existing ones or build new ones next to the project houses.

6.3. Quality of the Project Houses

The project houses have been built with good quality. The authors have directly observed and evaluated the quality of some of the project houses that have been completed since 2018. After four years of being exposed to severe natural hazards in the central region of Vietnam (including high floods, extremely high temperatures, and strong typhoons), they are still in good condition, and no serious damage has been recognized. Moreover, the construction quality is even better than required, primarily because: (i) people build their own houses, so they try to do the best that they can within their limited financial resources. If possible, they try to increase the quality of the house by using better materials and increasing the size of girders, columns, and floors, etc.; (ii) the householder asks their relatives who have experience and knowledge of construction to participate in the construction, or directly manage and supervise the construction process, so that the quality is ensured; and (iii) the construction works are strictly supervised and managed by project staff from the very beginning.

However, some minor defects have been observed in a few houses, such as permeable walls and leaks from the roof (Figure 9). These issues tend to happen when the head of the household is an elderly person, someone with no experience or knowledge of construction techniques, or someone who does not have descendants/brothers to support them. In such cases, the construction quality is entirely dependent on the construction team. Financing, or lack thereof, is another contributing factor to such issues. For example, some households do not have enough money to paint the walls on both the inside and outside of the house, worsening the permeability of the walls and leading to wall damage and the need for sooner maintenance and repair. The overall quality of the project houses is assessed in Table 1.

(**a**) (**b**)

Figure 9. The project houses in Quang Binh province. (**a**) Permeable walls and narrow steps of ladder; (**b**) Side cover of the roof is missing.

Table 1. Evaluation of GCF houses.

TT	Structure	Description	Overall Evaluation
1	Foundation	No cracks or subsidence is observed.	Good quality
2	Main structure (girder, column, and floor)	The main structure of the house is solid, there is no tilting or falling phenomenon.	Good quality
3	Brick wall	Permeable walls are observed in some houses.	Still in good condition
4	Mezzanine	In good condition.	Good quality
5	Roof	The system of bracing and beams supporting the roof is firm and reinforced to ensure that it can withstand strong winds and storms. The roof has two types: tile roof and corrugated iron roof, both of which are firmly reinforced. Some houses leak due to misaligned screws, which can be repaired.	Good quality
6	Door and windows	Using stainless steel material, firmly reinforced, with bolts, ensuring resistance to storms.	Good quality
7	Ladder to mezzanine/flood shelter	The width of steps is quite small and on a slope, making it difficult to carry heavy objects to the second floor in case a flood comes. In some houses, no guard rail for safety is observed.	Acceptable quality

6.4. Maintenance of the Project House

All households and local authorities believe that because the project houses have been built with good quality materials and high standards, they can be used normally for about five years before any damages appear, and maintenance is required. The interview at sites show that households did not properly understand the importance and necessity of maintenance work. In addition, most of the project beneficiaries are poor. They have no income or have a precarious income. Many households borrow loans from the bank for Social Policies with an interest rate of just 3%/year but are also struggling to pay bank interest. Therefore, it is very difficult for households to spend any extra amount of money on annual house maintenance and repair. However, preventive maintenance is still needed in all cases. For example, it is necessary to clean the leaves on the roof to secure the iron sheet, etc.

Currently, neither the project side nor the local authorities have technical guidance/instructions for the beneficiaries on the maintenance and repair of GCF houses. The households themselves also do not have experience and knowledge of the maintenance and repair of the houses and structures. Moreover, there is no coordination mechanism between the project side, local authorities, and households for the management, maintenance, and repair of the project houses in the exploitation phase, after construction is completed.

6.5. Insurance of the Project Houses

The authors met with local insurance companies to discuss the insurance of residential buildings in general, with a specific focus on the project houses. It was confirmed that although insurance companies have some insurance products for individual houses, thus far no one has purchased them in rural areas. There are two insurance companies (Bao Viet and ABIC—the insurance company of the Agriculture Bank) showing interest in the insurance for the project houses. ABIC offers a more attractive and suitable insurance policy than Bao Viet. ABIC offers an insurance package of 142,000 VND/household/year (approximately 12,000 VND/household/month) for damages caused by incidents and disasters such as storms and floods, and damages to furniture due to floods, fires, and explosions. This premium is not high and is quite suitable for rural households, both in general and for the project area specifically. However, there are still some obstacles to purchasing insurance for GCF houses, including:

1. Buying insurance for individual residential houses in Vietnam in general and in rural areas has not been popularized yet. In the event of severe damages due to storms or floods, buying insurance is contingent upon support from local authorities, communities, and relatives.
2. Local people do not understand the meaning and necessity of insurance, and they are not yet ready to buy insurance for the project houses.
3. Most households participating in the project are very poor, with no or low regular income, especially the single families or those with disabled people. Many households only rely on income from selling vegetables from their small gardens, with about 200,000–300,000 VND/month in income, and this already small income is highly contingent on nature. Moreover, they are currently bearing the loan from the bank for Social and Policies. Each month, they must pay an interest of 38,000 VND, which already accounts for 20 ± 5% of their total income. Any further payments, even if they are not necessarily what most would consider large sums of money, would be burdensome for these low-income households.
4. There is no allocated budget from the local government to buy insurance for the project houses.

6.6. Advantages and Disadvantages of the Project Houses in Comparison with Other Models

The authors had also met with other organizations such as the Red Cross, the Asian Development Bank (ADB), and the Vietnamese Fatherland Front Committee to exchange ideas and directly observe other models of resilient houses funded by these organizations. After reviewing these models and comparing them with the project houses, the authors made the following assessments:

a. The project houses are more effective against floods and storms due to the high second floor and stronger reinforced roofs and windows.
b. The project houses' design options pay more attention to the poor, elderly, lonely, and low-income households whose need for living space is not high, as well as those who still use their previous house for daily activities, and just use the project house as shelter during flooding events. Other models for families who require more space for living activities have higher financial support (up to 70–250 million). This also means that the number of beneficiaries in other projects is limited and less than the project.
c. The project houses, as well as all other models of resilient houses, do not have: (i) technical guidance/manual for maintenance and repair of the houses; and (ii) funds for buying insurance for the period of exploitation or funds for the maintenance and repair of the house.
d. As compared with other projects, the project house does not have a sanitary system or a clean water supply system inside the house, because the main purpose of the project house is to function as a flood- and storm-resilient shelter, rather than as a place for daily living activities, given budgetary constraints.
e. Due to the relatively low budget of most the project's beneficiary households, there are no funds available to paint the walls of the house on both the inside and outside. This results in the house wall being waterlogged, which can cause significant damage and degrade the quality of the structure quickly in some cases.
f. There is no flood shelter for animals. In the flood of 2020, most of the livestock drowned, causing the households to face further difficulties. The Red Cross, by comparison, has a number of designs with flood decks and outdoor stairs for pets and livestock (Figure 10).
g. In some houses, the narrow width of steps of the ladder leading to the mezzanine (just 4–5 cm in width) makes it difficult to carry heavy objects or furniture to a safer place during high floods.
h. GCF houses are quite hot in the summer due to the corrugated iron roof. This is the same material used in other projects.
i. The advantages and disadvantages of GCF houses are summarized in Table 2.

Table 2. Advantages and disadvantages of the project house as compared with other models of resilient house.

Issue	The Resilient Houses Funded by the Project	Other Models Funded by the Red Cross, ADB, and the Vietnamese Fatherland Front Committee
Project effectiveness	Focusing on the functions against floods and storms with the high second floor and stronger reinforced roofs and windows, the GCF house is very effective as compared to other models. The number of beneficiaries of the GCF Project is much higher than other models since the construction cost of the GCF house is much cheaper. The reason is that UNDP's design options pay more attention to resilient function and the beneficiaries are the poor, elderly, lonely, and low-income households who still use their previous house for daily activities, and their need for living space is not high.	These models focus on living functions rather than resilient ones; therefore, these houses have more living space than the GCF house. However, the roofs and doors are not as strongly reinforced as those in GCF houses. These houses cannot be used as safe shelter in the case of severe typhoons and/or high floods, except for houses funded by the ADB. The number of beneficiaries is very limited, with only one or two houses per commune.
Use of space	The project houses are used effectively for both daily living and resilient shelter purposes, in which the mezzanine is used as a safe shelter in the case of floods as the main function rather than as a living space.	Other houses are intended to be used as the main living space rather than as a safe shelter.
Maintenance	Do not have technical guidance/manual for the maintenance and repair of the houses, or funds for the maintenance and repair of the houses. The donor/implementor is conducting this research to identify issues and solutions for the maintenance of the project houses.	Do not have technical guidance/manual for the maintenance and repair of the houses, or funds for the maintenance and repair of the houses. Maintenance work is the responsibility of the homeowner.
Insurance	Do not have funds for buying insurance for the period of exploitation. The donor/implementor is also conducting this research to identify issues and solutions for insurance of the project houses.	Do not have funds for buying insurance for the period of exploitation.
Other technical issues	Designs do not have a sanitary system as well as a clean water supply system (not only on the second floor but also on the first floor) for most of the houses in the Quang Binh, Hue, and Quang Nam provinces. There are no flood shelters for animals. They are quite hot in the summer due to corrugated iron roofs.	These models have sanitation (clean water and toilet) on the first floor. These models also do not have flood shelters for animals. All houses with corrugated iron roofs are also very hot in the summer.

Figure 10. Resilient house funded by the Red Cross in Quang Binh province.

7. Discussion on Solutions for Better Maintenance on Resilient Houses

7.1. Technical Guidelines for the Maintenance of the Project Houses

Until now, there is no official technical guide or specification for the maintenance and repair of individual houses in the legal document system of Vietnam. In fact, there are some legal documents relating to the maintenance of a construction work in general, however these procedures are professional ones for large and important structures, rather than for individual houses. In addition, these procedures and regulations are very complex and cannot be applied to the project houses, since most local homeowners do not have knowledge of or experience with construction works. None of the projects of resilient houses funded by other organizations and the project have technical manuals/instructions for the maintenance and repair of resilient houses. There is also no technical guide that can be used for reference.

Currently, the project houses have been completed and operational for a few years (since 2018 as the first ones). So far, no serious damage has been observed. However, in the next 5–10 years, there will definitely be damages and deteriorations in terms of quality. As such, a technical guide for the maintenance and repair of the project houses is imperative. It is necessary to develop a technical guide/manual for the maintenance of the project houses with financial support from the donor/implementor. The main contents of the technical manual on the maintenance and repair of the project houses should include the following items:

1. Roof maintenance: The roof is one of the most important parts of the house that protects it from natural disasters. Technical guidelines for roof maintenance can include regular inspection for any damage or leaks, clearing debris, replacing damaged tiles or corrugated iron roof, and paying attention to the screws and the beam system and any other connections to ensure resistance to wind and storms, and to avoid the roof being blown away.
2. Windows and doors maintenance: Windows and doors are essential components of any resilient house, and their proper maintenance is crucial to ensuring the longevity and durability of the house. Windows and doors should be cleaned regularly to remove dirt, dust, and other debris that can accumulate on the surface of the windows and doors, which can cause them to deteriorate over time. The hinges, locks, and other moving parts of windows and doors should be lubricated regularly to ensure they operate smoothly. Regular inspections should be conducted to check for signs of wear and tear, damage, or other issues. Any repairs needed should be carried out as soon as possible to prevent further damage and ensure the windows and doors continue to function as intended.
3. Electrical maintenance: Electrical systems are essential to the functioning of the house, and any malfunction can be dangerous. Technical guidelines for electrical maintenance can include the regular inspection of the system, replacing any damaged wiring or electrical components, and ensuring proper grounding and surge protection.
4. Walls maintenance: Walls should be properly waterproofed to prevent water infiltration, which can cause damage to the walls and other components of the house. Any repairs needed should be carried out as soon as possible to prevent further damage and ensure the walls continue to provide adequate structural support. This includes repairing cracks, holes, or other damage to the surface of the walls.
5. Foundation maintenance: The foundation provides stability and support to the house, and any damage to it can compromise the entire structure. Technical guidelines for foundation maintenance can include regular inspections for any cracks, settling, or shifting, repairing any damage promptly, and ensuring proper drainage around the foundation.
6. Mezzanine maintenance: Proper use of the mezzanine is also essential to its maintenance. The mezzanine should only be used for its intended purpose and should not be overloaded with too much weight. Safety measures should be in place to ensure the safety of those using the mezzanine. This can include installing guardrails or safety barriers, ensuring proper lighting, and maintaining a clear and unobstructed

path to and from the mezzanine. Regular inspections should be conducted to check for signs of damage or deterioration.

Technical documentation should cover how to detect damage and assess the level of damage, and provide guidance for repair and replacement, inspection plans, replacement plans, and the estimated cost of maintenance. It is noted that in the central provinces (such as Quang Binh and Thua Thien Hue), characteristics against both floods and typhoons should be given more attention, while in the southern provinces (such as Quang Nam and Quang Ngai), features against typhoons are more important than those against floods. The northern provinces (for example, Thanh Hoa) experience less severe typhoons and floods than the central and southern provinces of Vietnam. Therefore, the technical guide should also take these distinct characteristics into consideration.

7.2. Budget for the Maintenance of the Project Houses

In the coming years, perhaps after 5–10 years, there will almost certainly be some damages and deterioration, including but not limited to wall penetration, leaks in the roof, and damage to roof reinforcements that lead to damages to the roof itself. The houses will definitely degrade rapidly if the maintenance scheme is not well-designed or not implemented correctly (Table 3).

Table 3. Estimated damages for the maintenance of the project houses (estimated by the authors based on expertise and personal experience).

No.	Damages	Percentage of Houses (%)			
		After 5 Years	**After 10 Years**	**After 15 Years**	**After 20 Years**
1	Permeable podium wall	5%	15%	30%	≥50%
2	Rust of the roof reinforcement	2%	5%	10%	≥20%
3	Roof blown away	2%	5%	10%	≥20%
4	Broken windows and/or doors	2%	5%	10%	≥20%
5	Broken mezzanine	-	0.5%	2%	≥5%
6	Broken ladder, guard rail	-	0.5%	2%	≥5%
7	Broken rain-water drainage system	-	2%	5%	≥10%
8	Entire house structure is broken or collapsed due to typhoon or flood	-	0.5%	2%	≥5%

The maintenance of the resilient houses in this project is crucial to ensuring the safety and well-being of its citizens, especially in the face of natural disasters and climate change. There are several factors that need to be taken into consideration when discussing the budget for the maintenance of the resilient houses in this project. These factors include the number of resilient houses that need to be maintained, the extent of maintenance required, and the availability of the resources to carry out the maintenance work. The extent of the maintenance required also plays a critical role in determining the budget required. Resilient houses require regular maintenance, such as repairing roofs, strengthening foundations, and reinforcing walls. The extent of the damage caused by natural disasters also determines the amount of maintenance required. Therefore, the budget for maintenance must be flexible enough to cover both routine maintenance and repair work caused by natural disasters.

Another factor to consider is the availability of the resources to carry out the maintenance work. This includes the availability of skilled labor, materials, and equipment. The budget must be sufficient to procure these resources and ensure that the maintenance work is carried out to a high standard. It is also essential to consider the long-term sustainability of the resilient houses. The budget should be structured in a way that ensures that the houses remain resilient for an extended period.

For maintenance-related financial issues, the following recommendations are made:

1. For small damages, as is the case in other resilient housing projects, after handing over houses to beneficiaries, the responsibility for the maintenance and repair of damages falls to the householders. The homeowners must maintain the quality of their houses after completion. To do so, they must allocate their own money to the maintenance and repair of small damages to their houses.
2. In instances of severe damages caused by disasters such as typhoons or floods, local governments are responsible for mobilizing all possible resources from local communities, other organizations (such as youth, trade unions, veterans, charities, NGOs, etc.), and enterprises, as well as contributions from philanthropists within and outside the province, to help people whose houses have been damaged. Poor, elderly, lonely, and disabled people are prioritized, as well as households with special difficulty circumstances. This issue was already discussed with local authorities during site visits. In addition, households can also receive support from insurance companies if the project has a contract with them. To maintain the overall quality of the project houses for long-term purposes, it is recommended that the donor/implementor should periodically evaluate their quality after five, 10, 15, and 20 years of use, and have a budget allocated towards the maintenance and repair of any damages that arise. The budget for maintenance will depend on the results of the evaluation every five years. This is a more active form of maintenance.

7.3. Management of the Maintenance of Resilient Houses

The donor/implementor should issue technical guidance for resilient house maintenance. At the same time, a periodic quality assessment every five years should also be conducted to assess the level of damage in order to have a plan to support affected households, if necessary. The evaluation results should be compiled and stored as a reference for future projects. These works should be carried out by a local individual consultant or firm. The donor/implementor should sign a long-term contract with the selected consultant or firm to ensure the consistency and systematic results of the quality of evaluation as well as the database for future use (Table 4).

Table 4. Estimated cost of insurance for the project houses.

No.	Object	Total Budget for Maintenance/Year	Contribution by Project Donors (50%)	Contribution by Households (50%)
1	Household insurance	142,000 VND/year	71,000 VND/year	71,000 VND/year
2	Total project budget (for 4000 GCF houses)	568 million VND/year	284 million VND/year	284 million VND/year

Local authorities are responsible for supporting the donor/implementor in classifying households into groups for distributing the supportive budget more effectively. These groups may include: (i) families who have no income and no financial support from other supports (close relatives, enterprises, social community, etc.); (ii) families who have no income but can receive financial support from other supports; (iii) families who have income but no financial support from other supports; and (iv) families who have income and financial support from other supports. In addition, for the dead single households, the local government needs to review the list and have a mechanism to manage and use the house in the long run to avoid the house being degraded due to no one maintaining the houses and to ensure the project's effectiveness of construction investment. Moreover, effective management requires a comprehensive approach that covers various aspects of the maintenance process, including planning, execution, and monitoring.

1. Planning: Planning is a critical aspect of the management of maintenance. The planning process should be based on the assessment of the current condition of

the resilient houses, which can identify the areas that require immediate attention. Planning should also consider the availability of resources and the timeline for the maintenance work. A well-planned maintenance program can reduce costs, minimize disruptions, and ensure that the work is completed on time.

2. Execution: The execution phase involves carrying out the maintenance work as per the plan. This phase requires skilled labor, adequate materials, and equipment. The work should be carried out following the standard procedures and using high-quality materials. Quality control should be maintained throughout the process, and any deviations from the plan should be immediately addressed.
3. Monitoring: Monitoring the maintenance work is essential to ensuring that it is carried out as per the plan and meets the required standards. Regular inspections should be carried out to assess the progress and quality of the work. Any issues should be immediately reported, and corrective action should be taken.
4. Record-keeping: It is crucial to maintain proper records of the maintenance work. This includes records of the maintenance plan, work carried out, and any issues that arose during the process. Proper record-keeping ensures that the maintenance work is carried out consistently and can serve as a reference for future maintenance work.
5. Training and capacity building: Training and capacity building of the personnel involved in maintenance work are essential to ensuring that they have the necessary skills and knowledge to carry out the work effectively. Regular training sessions can help update the skills of the workforce and ensure that they are aware of the latest techniques and materials used in maintenance work.

In conclusion, the effective management of the maintenance of resilient houses in this project requires a comprehensive approach that covers all aspects of the maintenance process. This includes planning, execution, monitoring, record-keeping, and training and capacity building.

7.4. Insurance of the Project Houses

Insurance of the maintenance of resilient houses in Vietnam is an essential aspect that can provide financial security to homeowners and reduce the economic impact of natural disasters. Insurance can cover the cost of repairs and replacements of damaged houses, and also encourage homeowners to invest in the maintenance of their houses. The cost of insurance policies for the maintenance of resilient houses can vary depending on several factors, such as the location of the house, the type of policy, and the level of coverage. Homeowners should carefully assess their insurance needs and choose policies that offer adequate coverage at a reasonable cost. Insurance policies can offer incentives to homeowners who invest in the maintenance of their houses. For example, some policies offer discounts to homeowners who regularly maintain their houses or use high-quality building materials. These incentives can encourage homeowners to invest in the maintenance of their houses and reduce the economic impact of natural disasters. The claims process for insurance policies covering the maintenance of resilient houses should be transparent and straightforward. Homeowners should be able to file claims easily and receive prompt and fair compensation for damages. The claims process should be communicated clearly in the insurance policy, and homeowners should have access to support and guidance during the process.

However, the insurance policy offered by ABIC only covers expenses for damages and losses caused by incidents such as storms, floods, and fires, and so it excludes damages caused during exploitation (maintenance and repair costs). Therefore, the cost for insurance is completely separated from the cost of maintenance and repair during the operation. If possible, the donor/implementor can arrange a budget to support purchasing ABIC insurance for GCF houses, with 50% being subsidized by the donor/implementor and 50% contributed by the households.

7.5. Media Campaign

Education and awareness campaigns can help homeowners understand the benefits of insurance and the importance of maintenance for resilient houses. These campaigns can also inform homeowners about the different types of insurance policies available and the coverage they offer. In order to convince beneficiaries to carry out maintenance and purchase insurance for their project houses, the local government needs to coordinate with the donor/implementor to promote a media campaign that increases awareness of the necessity and importance of maintenance and buying insurance. Since maintenance and insurance for individual houses is not mainstream in Vietnam and across project sites, it may take time to propagate the idea, and for people to understand and volunteer to participate for their own best interest.

8. Conclusions

The paper is carried out to review existing policies and current practices related to the maintenance of resilient houses as well as to propose feasible maintenance solutions for houses to ensure the sustainability of the project. The finding is that currently, there are no technical instructions or manuals on the maintenance and repair of individual houses in general, or the project houses in particular. Most of the households in the project themselves also have very low and unstable incomes. Moreover, they do not have knowledge of construction works and know little to nothing about the maintenance of the house. As a result, the households are not concerned about the plan and budget for the maintenance and repair of the houses yet. Another finding is that in Vietnam, there is no legal regulation on buying insurance for individual houses, or the project houses in particular. On the other side, purchasing insurance for individual residential houses in Vietnam in general, and in rural areas, has not been popularized yet, and there is no precedent for buying house insurance so far. Most of the households participating in the project are very poor, with no or low regular income, especially the single families or those with disabled people. They do not understand the meaning and necessity of insurance and they are not prepared to buy insurance for the project houses yet. In the project areas, there are also some models of resilient houses funded by other organizations with different scales and formats. However, all these projects have the same issues; they do not have the technical manuals on the maintenance and repair of resilient houses and/or the funds available for the insurance and maintenance of the house.

In order to improve existing policies and current practices related to the maintenance of resilient houses for the future, the authors recommend all stakeholders to consider the following:

8.1. Technical Issues

1. A technical guide for maintenance should be officially issued. In addition, a short training course should also be organized for homeowners in the beginning in order to raise their awareness of the importance of maintenance in the early stages, and allow for the transfer of some basic techniques of maintenance works to the homeowners.
2. For flooded-zone areas (such as Quang Binh, Hue, Quang Nam provinces, etc.), it is necessary to have a ready sanitation system in the design that includes a clean water tank, a rain harvesting system, and a backup WC in the mezzanine in case of high floods, in order to prevent the direct emission of waste into the environment by residents.
3. The steps of ladders to the safe shelter on the mezzanine should be designed with a minimum width of 7–10 cm, in order for households to be able to easily move heavy belongings when high floods come.
4. It is recommended to use a tiled roof instead of a corrugated iron roof because it is cooler in the summer, and it is easier to remove tiles to escape in cases of abnormally high floods. If a corrugated iron roof is used, extra solutions to reduce heat in the summer should be applied, such as XPS heat prevention panels, heat resistant sheets, etc.

5. In order to reduce the maintenance cost at the exploitation stage, the project should focus on improving the quality of the houses at both the design and construction stages, such as by: using high quality materials, using reinforced concrete roofs instead of corrugated iron roofs, handling joints, thoroughly waterproofing the junctions between the roof and walls, adding waterproofing paint on both inside and outside walls, etc. This is a proactive maintenance measure, helping to reduce maintenance costs during the operation and prolong the service life of the houses. An extended floor for animals can also be considered in the design, if it is required by the homeowners.
6. The project should coordinate with provinces in promoting the development of the maintenance service for individual houses (encouraging local construction companies to pay more attention to maintenance services) to ensure the quality and professional service for the maintenance of the houses in the project.
7. More in-depth research that focuses on maintenance procedures and insurance policies, and periodic quality assessments of every 5–10 years, are needed.

8.2. Financial Issues

1. The supportive budget from the project should exceed 1700 US$/household to ensure that the design can cover basic needs such as a kitchen, a toilet on the first floor (in cases where the house is used as the main living space), and a sanitation system in the mezzanine for high flooded zone areas.
2. A small budget for insurance for damages caused by accidents and disasters, as well as for the regular maintenance of houses. Insurance offered by ABIC should be taken into consideration. Fifty percent should be subsidized by the project, and 50% should be contributed by the households.
3. For maintenance of the house, it is recommended as follows: (i) Houseowners are responsible for carrying out repairs in the case of small damages; (ii) In instances of severe damage caused by disasters such as typhoons or floods, local governments are responsible for mobilizing all possible resources from local communities, other organizations (such as youth, trade unions, veterans, charities, NGOs, etc.), and enterprises, as well as contributions from philanthropists within and outside the province, to help people whose houses have been damaged. Insurance companies may also be involved in cases where project/houseowners buy insurance; and (iii) To maintain the overall quality of resilient houses for long-term purposes, it is recommended that the project should have a budget for periodic maintenance after five, 10, 15, and 20 years of use.
4. The budget for purchasing insurance and for maintenance works should be included in the project document and mentioned in the contract/agreement with the household.

8.3. Management Issues

1. A long-term contract with a local individual consultant or firm should be arranged for periodic evaluation (every five years) of the quality of the houses, to ensure the consistency and systematic results of the quality of evaluation. The evaluation results should be compiled and stored as a reference for future projects.
2. Local authorities should take responsibility to support the project in classifying households into priority groups for the effective distribution of the budget, such as elderly and lonely persons who have no or limited support from relatives, households with disabled people with a limited income, households that have income, and so on.
3. The project should have some approaches at higher levels in order for the housing maintenance issue to be legalized and applied in reality.

8.4. Other Issues

A long-term media campaign should be implemented to raise beneficiaries' awareness about the necessity and importance of performing maintenance in the early stages and buying insurance for their resilient houses.

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