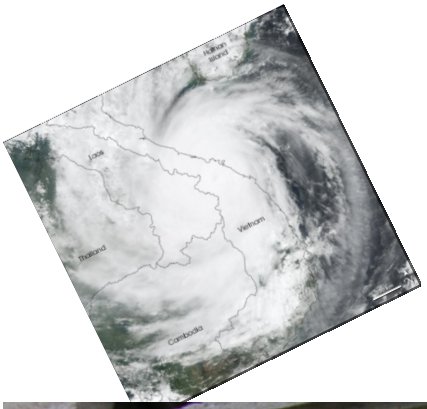
DỰ ÁN PHÒNG CHỐNG NHỮNG THIỆT HẠI VỀ NHÀ Ở DO BÃO GÂY RA Ở MIỀN TRUNG VIỆT NAM

PREVENTION DES DOMMAGES CAUSES A L'HABITAT PAR LES CYCLONES, CENTRE VIET NAM

PREVENT TYPHOON DAMAGE TO HOUSING, CENTRAL VIET NAM



IMPACT STUDY ON DEVELOPING LOCAL CAPACITY TO REDUCE VULNERABILITY AND POVERTY IN CENTRAL VIET NAM

Hue, November 2010

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This research has been funded
by a grant from Building and Social Housing Foundation (BSHF)
and financial participation from DWF.

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DWF, Hue - Viet Nam, November 2010

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FOREWORD

This impact study, undertaken in the first half of 2010, follows more than ten years of work by DWF and its local partners in Viet Nam to promote the adoption of preventive strengthening of houses and public buildings and the much wider integration of safe construction details in new construction.

The study shows that this effort has to a very great extent been a success, but that more needs to be done. In locations where the project has been present for a long time, there is a greater impact, and this suggests the need for continued promotion of safer construction in communes that only joined the project more recently. The Provincial Government of Thua Thien Hue province has done much in the past four years to support this process, through the formal recommendation that authorities and inhabitants should adopt the ten key principles of safe construction promoted by DWF.

The assessment of the project impact has not been easy on a limited budget. The subject and context is complex, with a very large number of physical, social, economic and practical variables. The sample of five communes in the study do not all display the same characteristics, and they have not been uniformly affected by floods, typhoons and whirlwinds during the project period. The consultants and the DWF Viet Nam team have made a considerable effort to address as many of the diverse parameters as possible in carrying out the study, and I am grateful to all concerned for the large amount of work carried out in a short period of time.

The study could not have taken place without the generous support of the Building and Social Housing Foundation based in the United Kingdom and we are most grateful for this support.

Bringing about changes in perception and practice of the ways in which housing vulnerability can be reduced amongst poor communities requires time. It remains to be hoped that this effort to reduce risk and vulnerability can and will continue, both in Central Viet Nam and in other regions.

Lauzerte, 18th November 2010.

John NORTON

DWF President

EXECUTIVE SUMMARY

This report presents findings of a study commissioned in 2010 by Development Workshop France (DWF) with support from the Building and Social Housing Foundation (UK) to assess the impact of the DWF project in Vietnam to promote the prevention of typhoon[1] damage to housing and public building since 2000. The study has been conducted in 5 selected communes, of which 4 in Thua Thien Hue Province (Vinh Xuan, Vinh Phu and Phu Da communes in Phu Vang District, Huong Phong Commune in Huong Tra District) and 1 in Quang Tri Province (Hai Hoa commune in Hai Lang district). For the purpose of this study, a mixed research method was used to collect data for the evaluation, including existing (secondary) Data Collection, Key Informant Interviews, Focus Group Discussions and Questionnaire Surveys of a sample of 50 households in each commune.

The results show that currently houses in the selected communities are vulnerable to extreme floods and typhoons. Over half of the households surveyed confirmed that their current house offered no protection at all or could only protect their family from minor floods and typhoons. These communities had suffered tremendous impacts of these extreme events, in which agricultural production, livestock raising and houses are the most severely damaged.

The study also revealed that there is significant difference in local awareness of the risks of typhoons and a difference in the materials and structure of contemporary houses in the five communes. Householders living in a commune with long-term experience of working with the DWF project (Phu Da commune) tend to build their houses with stronger materials and better structures for the roof, roof structure, door and windows, walls, and foundation when compared with those of householders living in the communes with medium and short-term experience of work in the DWF project (Vinh Phu, Vinh Xuan and Hai Hoa communes) and the one commune without any DWF intervention (Huong Phong).

The study also reveals that DWF typhoon resistant construction principles have, in general, been applied relatively widely in both public buildings and in houses. Provincial staff, local government staff in the People's Committees, local builders and beneficiary groups have generally evaluated these DWF typhoon resistant principles as effective measures to protect the local community from the impacts of typhoons.

Nevertheless, there are still various DWF safe construction principles and techniques - such as building houses with thin reinforced concrete ribs on tiled roofs or using cross bracing in the roof structure, and the use of U shaped brackets and L shaped steel bars to connect corrugated iron sheets to the purlin - which have been less adopted by some communities due to a lack of budget, social bias (people still like timber roof frames, which are now very costly), and the perception that some of the proposed principles or techniques are less important. The study nevertheless confirmed that local communities, both in communes with long-term experience of the DWF project and indeed with no direct experience of work with DWF, are willing to sacrifice a large amount of their yearly income, about 10% - 20%, to implement prevention measures in order to eliminate the adverse impacts of typhoons.

In general, DWF principles of safer construction have achieved social and official appropriation based on their effective mitigation of the impact of typhoons and this has led to widespread adoption.

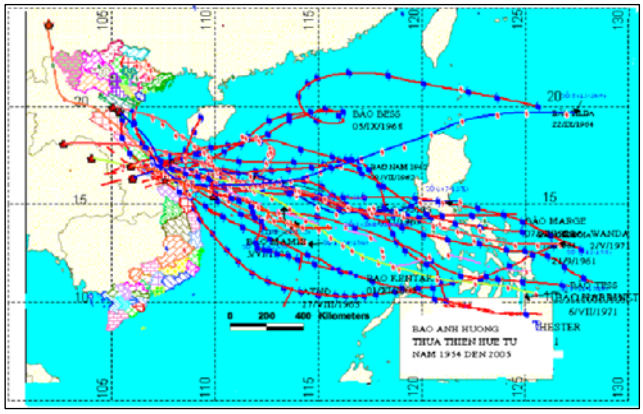
[1] *In this document the term **typhoon** has been used, but this refers equally to 'cyclone' or 'hurricane' as used in other contexts.*

I. BACKGROUND

1.1. Viet Nam and natural disasters

Settlements and climate have been changing. There has been significant alteration to precipitation and temperature patterns, and increasing frequency and intensity of natural hazards, widely felt in many countries in the world (see Appendix 1). Between 1980 and 2005, 85 per cent of all natural disasters occurred in Asia, and these caused 75 per cent of the economic losses in Asia. It is recognized that poor communities are the most vulnerable and most at risk to climate related hazards, as most of them are often settled in marginal and disaster prone areas. These include, in the central Viet Nam context, low lying coastal lagoons, fertile river basins and mountainous areas all prone to a variety of hazards – floods, typhoons, landslides. Here poor inhabitants are most exposed to the impact of climate related disasters compared to better off communities.
Located on the Indochina Peninsula in Southeast Asia, the "typhoon centre" of the South China Sea is one of the biggest in the world. Vietnam is rated as one of the ten countries most at risk from natural hazards, and within Vietnam the Central Region is known as the most disaster prone region in the country (see map).

Map : Cyclone tracks on central Viet Nam 1954-2005



This central region experiences 5 – 7 extreme disasters annually, particularly typhoons and associated floods (see Appendix 2). The situation is projected to be worse in the future - the profile of typhoon damage points to a considerable increase in the magnitude of disasters (EM-DAT, 2010). In this environment poor communities face life-threatening risks; the increased frequency and intensity of storms, floods and other climate related disasters will exacerbate these risks. These hazards bring the threat of damage to houses, and of loss of assets, livelihoods, environmental quality and future prosperity.

In response to this vulnerability, government, non-government organizations and other social actors have made great efforts over decades to prevent and mitigate the negative impacts of disasters, and much of this has taken place in the Central Region of Vietnam. Amongst these, the work of Development Workshop France (DWF) in central Vietnam is judged a significant example. Building on disaster risk reduction experience begun in 1989 in Central Viet Nam, since 2000 DWF has promoted the preventive strengthening of houses of the poor, the strengthening of public buildings, and the integration of safe construction techniques in new building so that they resist the impact of typhoons and floods. The achievements are considerable and recognized locally and internationally by the attribution of the World Habitat Award in 2008 and DWF work in disaster risk reduction globally has been recognized by the 2009 UNISDR-Sasakawa Award Certificate of Distinction. The DWF programme in Vietnam has most recently received a Special Mention in the 2010 Housing and Urban Development South-South Transfer Award designated by the UNDP Special Unit for South-South Cooperation, UN-Habitat and the BSHF

After a decade of work promoting the preventive strengthening of buildings to resist floods and typhoons in central Viet Nam, there is a need to assess the impact of the project in the project area and beyond. This study was commissioned to evaluate the direct and the indirect impacts of DWF project activities in Central Vietnam, consulting different stakeholders ranging from provincial leaders, to local communities and families, with particular focus on evaluating the impact of the DWF 10 key principles of typhoon resistant construction (see page 9).

1.2. Viet Nam and construction (houses and public buildings)

Before the introduction of the Viet Nam *Đổi mới* (renewal) policy in 1986, most people in rural areas of central Vietnam lived in temporary houses built with bamboo, thatch or mixed materials. Capital investment in the house was very low and materials were obtained locally and could often be gathered for free. Only a very few could afford houses with strong timber frames and tiled roofs that were able to resist floods and storms. When a flood or typhoon occurred houses were easily destroyed, but conversely could be equally easily rebuilt at very low cost with help from neighbours in a few days. Whilst short-term hardship might be high, the economic consequences of losing a home were low.

Figure 1: Temporary house

After 1986 when Viet Nam started its new policy there was remarkable development in road networks, public buildings and private housing, which moved Viet Nam from centralised decision making to a more localised market economy. However, there were still many households living in weak houses and semi-solid houses. One effect of the new policy was that for many families their financial situation gradually improved. A visible effect of this was that families began to put their savings into getting a better house, rebuilding incrementally with more durable materials – materials that now had to be purchased rather than gathered. Worse, few of these newer houses have been built in a manner that would enable them to resist a flood or typhoon, and in effect, the result is that the investment in time and money that families have made is highly vulnerable to damage by floods and typhoons. Despite the large amount of investment in housing, a high percentage of housing stock is still classified as 'semi-solid', and temporary or weak houses still exist even though the Viet Nam government has made a great effort in its temporary house eradication program to address this.

The average rural house for a family with a monthly income of between $50 and $100 has a main house with a floor area of 35 m² (5x7 m) divided into three bays, and a covered terrace (2x7 m) in front, and a kitchen/multipurpose enclosed area to the right of the house (see Figure 2). The family may have made their cement tiles and blocks. But they will buy most other materials

including cement, steel, roof tiles or roof sheeting, bricks, shutters, doors and windows, and may have borrowed to do so. Along with these changes in building practice many of the flood and storm resistant features of traditional housing, which, for example, had tied the roof down and held the structure together, have been neglected. The result is that along with investments in improvement and new building, there are also more materials, investment and effort, which are at great risk of being lost and destroyed.

Figure 2: Typical recently built rural house in Thua Thien Hue province

One concludes that improvements that have been made in building, particularly the semi-solid building, have paradoxically contributed to increased vulnerability to loss caused by disasters, when this loss is considered in terms of the cost to the family of recovery and rebuilding a damaged or destroyed home after a disaster. Because more time and money has been invested in the home, the recovery cost has multiplied. As a result, vulnerability has in effect increased. There is more to lose.

1.3 DWF project in Central Viet Nam

In response to this vulnerability, government, non-government organisations and other social actors have made great efforts over decades to prevent and mitigate the negative impacts of disasters, and much of this has taken place in the Central Region of Vietnam. Amongst these, the work of Development Workshop France (DWF) in central Vietnam is judged a significant example. Building on disaster risk reduction experience begun in 1989 in Central Viet Nam (in partnership with GRET), since 2000 DWF has been promoting the preventive strengthening of houses of the poor, the strengthening of public buildings, and the integration of safe construction techniques in new buildings so that they resist the impact of typhoons and floods.

Development Workshop France undertakes actions in Central Viet Nam that help families, communities, community leaders and civil society reduce vulnerability to natural disasters and climate change and develop the opportunities and a safer environment that contribute to poverty reduction.

10 key points of typhoon resistant construction:
generic principles that apply to all types of housing using local resources

DWF - PREVENTING TYPHOON DAMAGE TO HOUSING IN CENTRAL VIET NAM

Supporting commune People's Committees for disaster risk reduction

Assisting the People's Committee in partner communes to encourage preventive strengthening of houses and public building to resist cyclones. The DWF programme has encouraged inter-commune 'prevention' networking that builds on ten years work on disaster risk reduction, so that Communes now participate in sharing their experience with additional communes.

Working with provincial institutions

DWF assists the Provincial Committee for Flood and Storm Control and works with the Department of Construction in helping their promotion of safe construction techniques.

Preparing for the future - Establishing commune damage prevention action plans

DWF works with families and with the People's Committees to develop multiyear action plans for prevention. DWF promotes democracy in the village decision making process to ensure equitable selection of partner families and a balanced gender approach.

Developing 'safe' construction skills

DWF trains local building brigades in all the communes where it works, to improve the general quality of building and in order to develop skills in disaster resistant construction. Trained builders work on local construction programmes that bring in revenue, and act as building advisers to families in the community.

Awareness rising - Making prevention a priority through participative animation

DWF makes information exchange and animation about the need for prevention against disaster a cross cutting priority, using popular media, theatre, concerts, inter commune boat races, mobile displays and school events and plays by children – anything that will lodge the prevention idea in long term memories!

Safer shelter & infrastructure

- Retrofitting existing houses to resist floods and cyclones
- Integrating hazard resistance into new construction
- Making public buildings safer

Since 1999 DWF has encouraged and supported the preventive strengthening of existing houses in central Viet Nam. Roughly 70% of rural housing has been rebuilt by families since 1985, but the quality is poor and the result unable to resist the effects of storms and floods. DWF helps families strengthen their existing home at an average extra cost of 15-25% of the total value of their house. By 2010, some 2500 family homes have been made stronger and have shown that they resist cyclones and floods.

Credit for safe and affordable houses

In 2008 DWF launched loans for house strengthening to inhabitants of Thua Thien Hue Province with the Vietnam Bank of Social Policy and partner communes. Pay back rates are good and families recognize the social and economic value of a resistant safe home and the contribution it makes to family stability and growth.

Access to safe schools and infrastructure

DWF partners with communes in Thua Thien Hue to strengthen existing public infrastructure and build safe new schools, markets, health facilities. At village level, providing kindergartens helps small children access early education.

Getting prevention into the school curriculum

DWF works with schools to train teachers about disaster prevention, and runs workshops with children about their concerns. Children are active in school and in the community in promoting the vulnerability reduction message.

Some images illustrating the DWF program, which places great emphasis on communication in partner communes.

II. STUDY OBJECTIVES AND METHODS

2.1. Goals and Objectives of the study

The goal of this study is to achieve a comparative assessment of the direct and indirect impact of the DWF programme at many levels, including the impact on the lives of a sample of families directly and indirectly involved, on children, on safer building practice and on other stakeholders (e.g. policy makers, local builders). In doing so, the study provides measures of the efficiency of the DWF program activities and also provides pointers for future actions.

To achieve the goals, this study aimed:

- *to assess the impact of the work of DWF program actions for both identified beneficiaries and partners and for a wider public,*
- *to evaluate the level of vulnerability and performance of buildings with and without the application of the DWF10 key principles taking account of changes in climate and weather patterns, and changes in building materials and techniques that are being used and the evolving economic situation of families,*
- *to assess the degree of social and official appropriation of the DWF principles and the reasons for this, and the level and form of 'refusing' to the change in building practice that limit the adoption of safer construction techniques.*
- *to identify barriers and difficulties constraining beneficiaries groups and partners from performance of DWF program's activities,*
- *to provide recommendations for future monitoring of DWF program's activities in Vietnam and in neighbouring countries.*

Poster for the World Habitat Award 2008 study tour to Central Vietnam :

one of the 10 Key points of typhoon resistant construction is used as the central image

2.2. Implementation method

2.2.1. Defining stakeholders involved in the study

In order to assess the impact of DWF actions, and particularly on changes in building materials and techniques in local houses and public buildings that relate to their vulnerability to the effects of natural hazards including floods and typhoons, the study considered various stakeholders groups, including direct beneficiaries, indirect beneficiaries and those with no direct exposure to the DWF project in Thua Thien-Hue and Quang Tri provinces.

- *Provincial staff:* The study selected 8 staff at provincial level who have worked in the Provincial Department of Construction, Thua Thien Hue, the Centre for Hydrometeorology Prediction and the Provincial Committee for Storm and Flood control.
- *Commune selection:* five communes were selected based upon the following profiles:
  - Commune with long term participation in the DWF project: **Phu Da commune, Phu Vang district; (2000-2010)**
  - Communes with short exposure to the project. **Vinh Xuan with DWF work in 2000 – 2001 and Vinh Phu commune in Phu Vang district where DWF has conducted some activities since 2005.**
  - A commune with only short exposure to the DWF project: **Hai Hoa commune in Hai Lang district, Quang Tri Province District (2005-2006).**
  - A commune with no exposure to the DWF typhoon resistance project: **Huong Phong in Huong Tra District,** but where a recovery programme was implemented by DWF after the 2007 flood.
- *Commune staff:* for each commune, People's Committee (Local government body) staff were selected to participate in the study; these included the Chairperson of the commune, the head of commune government units and members of mass organizations such as the Farmers' Association, the Women's Union, the Youth Union, members of Commune Committees for Storm and Flood control, and in addition the heads of villages in the most flood and storm-prone villages.
- *Local builders:* Local builders who had participated in training courses run by the DWF project in beneficiary communes. Local builders in non-beneficiary communes were also invited to interviews and focus group discussions. The study also considered their practices in these communes.
- *Householders:* Three groups of households were selected:
  - Direct beneficiary group with households which were given training courses on safer construction and received financial support to reinforce or build their house with the application of the DWF typhoon resistant construction techniques.
  - Indirect beneficiary group with households who were invited to training courses offered by the DWF project without financial support for reinforcement and building house.
  - Non-beneficiary groups i.e. households neither involved in training courses nor given financial support by DWF.

2.2.2. Research methods

For the purpose of this study, the following research methods were used for data collection and analysis. The range of methods provided the opportunity for gathering a greater diversity of

divergent views about the research objectives, and also gathered answers to both confirmatory and exploratory questions.

- Assessment of existing data and annual reports on socio-economic development and disaster prevention and mitigation were collected from various sources including the Provincial Storm and Flood Control Committees, local governments (Communes People's Committee) in the 5 selected communes. This information was reviewed in order to contextualize the study and analyze the situation of climate (change) and disasters as well as the impacts of disasters on local communities.
- A Focus Group Discussion Method was conducted in each of the 5 selected communes. Researchers prepared an agenda explaining the purpose of the meeting and the study, how the discussion would be run and a list of the issues to be addressed. In each commune, 5 intensive focus groups were established for discussions on issues related to DWF programme actions in the commune. Participants were drawn from different groups: teachers and pupils; direct beneficiaries; indirect or non beneficiaries; Commune People's Committee staff; local builders. Each focus group discussion included 8 – 10 participants.
- A Key Informant Interview Method was also employed. These included provincial staff who are working on or concerned with the themes of natural hazards; members of the provincial department of construction. At commune level, key informants selected for interviews included People's Committee staff, local builders, teachers, pupils and households on project sites. The list of key informants interviewed is shown in Table 1.

Table 1: Number of Key Informant Interviews

From:	Number of key informant interviews
1. Provincial Department of Construction	3
2. Head of Provincial Committee for Flood and Storm Control (CCFSC)	3
3. Centre for Hydrometeorology Prediction	2
4. Commune staff (Phu Da, Vinh Phu, Vinh Xuan, Huong Phong and Hai Hoa)	40
5. Direct/indirect beneficiary households in five communes	42
6. Non-beneficiary households in five communes	38
7. Local builders in five communes	37
8. Teachers and pupils	41

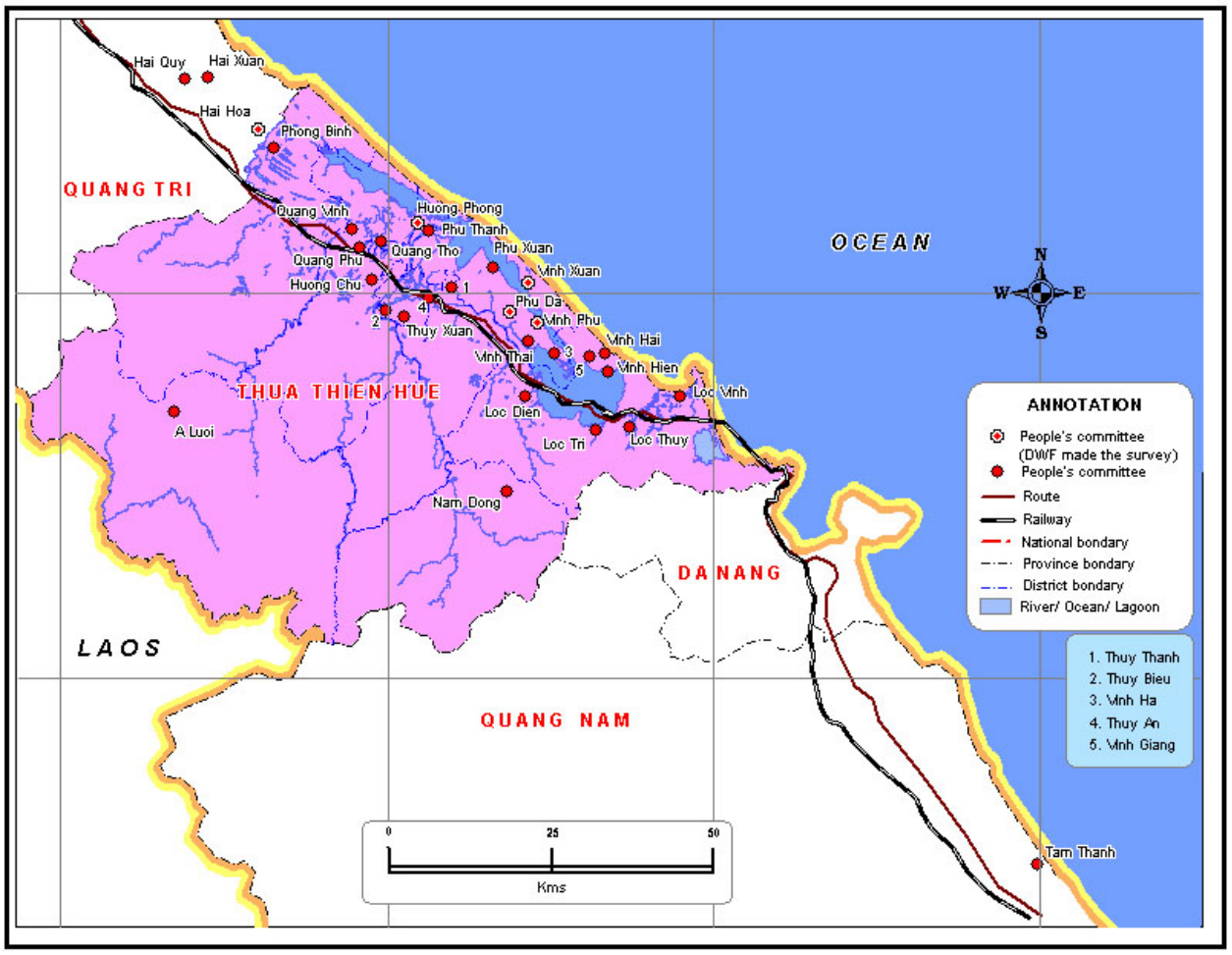
- Household questionnaire surveys were used to collect quantitative information at household level. A sample of 50 households was randomly selected based on the list of households of each commune, giving a total of 250 households surveyed. (See Table 2). The respondents were in most cases the household head (79.6% of total respondents). Gender perspectives were also considered during the process of data collection in this study.

Table 2: Distribution of Respondents involved in the household questionnaire survey

Commune	Direct benefit with DWF project	Indirect benefit group with DWF project	Not-related to DWF project	
Phu Da	16	34		50
Vinh Phu	25	25		50
Vinh Xuan		50		50
Huong Phong			50	50
Hai Hoa	2	48		50
All	**43**	**157**	**50**	**250**
%	**17 %**	**63 %**	**20 %**	**100 %**

- Case Studies were used to collect qualitative information in response to 'how and why' questions. This helped to analyse the situation of selected households, to study their situation retrospectively and to assess the impacts of the DWF project intervention over the time since they had benefited from the project. 2 case studies were selected in Vinh Xuan communes, all of them direct beneficiaries households.

III. OVERVIEW OF THE COMMUNES



Map 2: DWF Project & DWF survey

3.1. Survey sites and outline of project actions

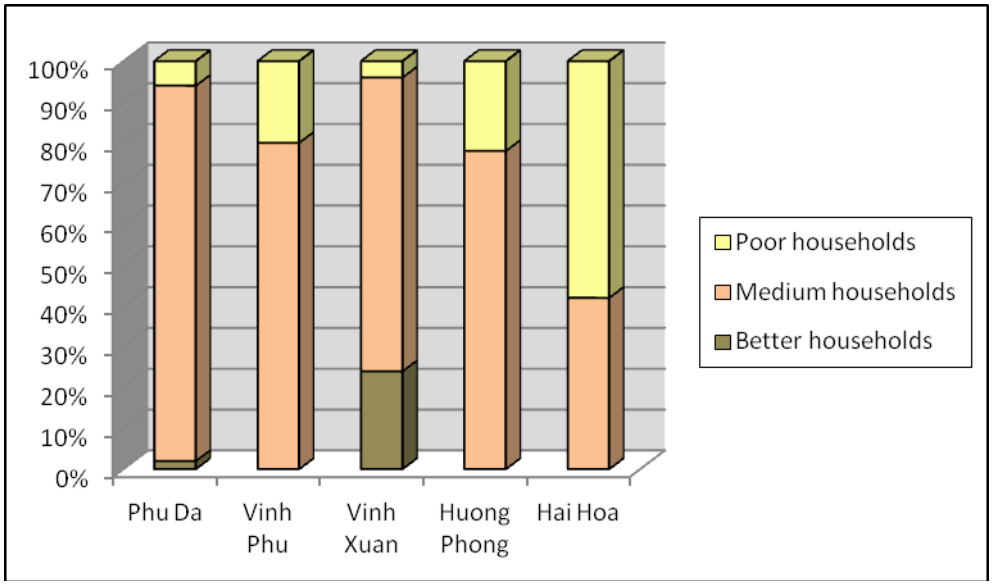
The communes (in Thua Thien Hue province, with the exception of Hai Hoa, which is in Quang Tri Province) have been exposed to varying levels of contact with and intervention by DWF between 2000 and 2010 as follows:

Commune	Phu Da	Vinh Phu	Vinh Xuan	Huong Phong	Hai Hoa
DWF intervention	***Long term*** (2000-2010)	***Medium Term*** (2005-2010)	***Short term*** (2000-2001)	**None**	***Short term*** (2005-2006)
Support to housing	**216**	**33**	**15**		**6**
Reconstruction	*43*	*20*			*6*
Reinforcement	*173*	*13*	*14*		
Public buildings	**11**	**2**	**1**		**1**
Loan VSPB (2009)	**60**	**20**			
Training courses	**10**	**3**	**1**		**1**

All these communes are located in the coastal plains of Thua Thien Hue and Quang Tri provinces, and are prone to flooding and typhoons, with a population largely surviving on agriculture and some aquaculture. The poverty rate of the 5 communes selected is up to 22% of total households.

The ratio of semi-permanent and non-permanent housing is relatively high, at approximately 65%. Thus local people are highly exposed to annual floods and typhoons, particularly in the context of increases in the frequency and intensity of these events.

Figure 3: Type of households according to government criteria by commune



3.1.1. Vinh Xuan Commune

Located on the edge of the lagoon and about 30 km from Hue city, Vinh Xuan is a better–off commune of Phu Vang District. The total population of Vinh Xuan is about 8 000 people, living in 1 500 households. The study found that local people are largely dependent on agriculture in which rice cultivation, livestock raising and aquaculture are the main activities. The total area of paddy rice is 167 ha and annual yield reaches 43.8 quintal/ha which is low in comparison with average provincial figures of about 56 quintals/ha. There are 183 ha devoted to other food crops with average annual yield of 20 ton/ha. Vinh Xuan also has 100 ha of aquaculture, which was, in early 2000, the economic mainstay of the commune, but also pushed many households into debt. As shown in Figure 3, about 4% of households involved in this study were classified as "poor" according to government criteria. There are two primary schools (Vinh Xuan 1&2). The commune also has health care station, which provides basic medical services to local communities and plays an important role in treating for victims during the disaster season.

The review of government reports and the results of Focus Group Discussion (FGD) conducted at Vinh Xuan commune indicated that storms and tropical depressions are the most severe disasters in Vinh Xuan. Storms had a tremendous impact on local communities, particularly damaging to agriculture production, aquaculture and to houses. For example, there were 40 houses with roofs blown off or collapsed due to Typhoon Ketsana 2009. In response, local government and communities have adopted various response and adaptation options such as reinforcing public buildings, reinforcing houses and temporary houses, changes in cropping calendars and patterns, etc.

DWF program selected Vinh Xuan commune as a partner for program actions in 2000-2001. The DWF project has conducted various activities in this commune including delivering training courses about the DWF 10 principles, raising local awareness both amongst the communities and at schools using posters, organizing events related to disaster risk reduction, and reinforcing a kindergarten. 11 households were provided with support to reinforce their homes.

3.1.2. Vinh Phu Commune

A neighbouring commune to Vinh Xuan, Vinh Phu is located to the south of Phu Vang District about 33 kilometres from Hue City. Vinh Phu is a very poor commune with an average poverty rate of 20% of total households and about 80% of population living in "medium" households (see Figure 3). With a total natural land area of about 1 000 ha, of which 380 ha of cultivated land with 86 ha of two-crop arable land, the average yield per annum reaching about 35 quintals/ ha, this yield being very low in comparison with provincial rice yield. Large areas of cultivated land in Vinh Phu are used for cereal and one-crop rice arable land. The possibility of alternative crops is limited due to the hard natural environment and the poor fertility of the sandy soil. Livestock raising is also an important livelihood practice for the communities in Vinh Phu, with cattle, pig raising and poultry generating extra income for 80% of local communities (source: Vinh Phu People's Committee, Annual Socio-Economic Development Report, 2009).

The study found that storms and tropical depression often occur and cause serious damage to both local livelihoods and to houses. The FGD showed that there is an increasing intensity of storms and that it is difficult to forecast their magnitude. It is stated that previous storms lasted for about 4 to 6 hours, but that recent storms last from 12 to 15 hours, or even longer, and caused more serious damage to local communities than before.

The DWF project began in this commune in 2005 with a set of activities aimed to increase local capacity to adapt to the impacts of typhoons. DWF delivered training courses with practical demonstration of safe construction for local PC staffs and local builders. These trainees have then acted as resource persons to disseminate knowledge and the principles of DWF typhoon resistant construction. Since 2006, the DWF program supported 35 households to rebuild or reinforce their homes and above all the roof through the application of DWF principles. DWF also organized local raising awareness activities using a variety of media including posters, messages about preventive strengthening and providing DVDs for schools about work on typhoon risk reduction. The project also provided local pupils with notebooks. Many teachers have been sent to training courses delivered by the DWF project about the environment, typhoon risks and risk reduction. These trainees are also important actors to deliver training courses to other teachers at schools in Vinh Phu commune. This has increased the impact and increased the sustainability of the DWF project. The project also provided local government staff who are working in the commune committee for storm and flood controls with torches, life vests, and helmets and an electricity generator. The DWF project, with support from the Ford Foundation and in collaboration with the Vietnam Bank for Social Policy, has provided loans of VND 09 million for 20 households in order to reinforce their households with the application of the DWF 10 principles. DWF technical staff also supervised local builders and households to ensure the application of the DWF 10 principles.

3.1.3. Phu Da Commune

Phu Da shares borders with Phu Luong and Vinh Xuan to the north, with Vinh Phu to the south and with Tam Giang lagoon in the east. There are 11 500 inhabitants living on 2 990 ha of natural land areas. Phu Da is the main township of Phu Vang district, and a large area of this commune has been taken for district building construction in recent years. Local communities are largely dependent on agricultural production with total arable land of about 650 ha in which paddy rice is the main crop. Raising pigs, buffalos, cows and poultry are also important income generation practices in this commune.

The local communities stated that floods and storms are the most severe disasters which cause tremendous damage in Phu Da commune. For example, 149 houses lost their roofs during typhoon Xangsane in 2006 - *all of these households were non-beneficiary group of DWF*.

The DWF project selected Phu Da as the first commune for the project program in 2000. 168 households received DWF financial support to purchase materials such as cement, steel, and sand for reinforcing their houses with strict application of the DWF safe construction principles. The

project also contributed to the construction of 10 public buildings (kindergarten, meeting hall, etc..The project provided local stakeholders (such as teachers, local builders, households, local government staff) with training courses about the 10 typhoon resistant house construction principles in order to reduce the impacts of such storms. DWF also provided training courses about storm risk management for local teachers and conducted local raising awareness about disaster risk reduction to local communities and pupils. DWF organized events with the purpose of integrating disaster risk management for schools in Phu Da commune. By doing so, local communities and pupils easily absorbed knowledge about safe construction skills promoted by the DWF project.

3.1.4. Huong Phong commune

Huong Phong is located in the east of Huong Tra district, and is one the two most typhoon–prone areas in this district. The commune shares borders with Thuan An to the east, and with Quang Thanh commune, Quang Dien district to the west and with Huong Vinh in the south. There are 14 300 people living in 1 569 of ha of natural land. For 65% of the population, agriculture is the main source of income, with paddy rice cultivation being the main crop, the success of alternative crops being very limited due to unfavourable conditions in the commune. Livestock raising is also an important source of income for households. A large proportion of local people are also involved in fishing activities and aquaculture. However, the income gained from the latter has dramatically dropped in recent years due to overexploitation of Tam Giang lagoon and bad harvest of aquaculture.

Huong Phong is a commune very prone to disaster (storm and floods). Annually, Huong Phong suffers badly from the consequences of disasters. In the last 10 years, flood has had the most catastrophic impact on local communities. For example, floods in 2007 caused damage to 40% of total area of paddy. Typhoon Ketsana with associated flooding in 2009 caused almost as much damage to communities, and 50 houses lost their roofs and 20 non-permanent houses were destroyed by this event.

The DWF project selected Huong Phong for action since 2008 - a year of flooding and extreme cold affecting local communities. In order to help local communities to recover after the floods, the project decided to place special focus on local livelihood by providing 91 beneficiaries households with 171 pigs. The project also supports each village with one boat and one means of transportation.

3.1.5. Hai Hoa commune (Quang Tri Province)

Located on the north bank of O Lau River, Hai Hoa is very low-lying plain delta commune and being locally recognized as flooding basin of Hai Lang district, Quang Tri province. With total natural land area of 1 183 ha of which 650 ha are the only two – crop rice arable land. The alternatives for local communities are limited due to unfavourable natural conditions. The result of study found that local people are mainly dependent on rice production. Besides, local communities in Hai Hoa also involve livestock raising such as pig, cattle and poultry. There is also migration trend in young labour of this commune, about 1 000 young labourers after high school have gone to seek work in bigger cities in southern regions (DWF- FGD, 2010).

The flood is the most catastrophic disaster in Hai Hoa commune. Annual floods cause huge losses to agricultural production such as rice, vegetables and animal raising and also damage to assets such house, properties. For example, the most recent early floods in 2009 caused great damage to agriculture, about 100% of summer-autumn rice cultivation were swept away. Social disruption due to flooding to since schools, markets and health care must also stop. It is reported that primary and secondary schools often have to stop for about two weeks during flooding season (Pham Nhu Tri, Principle of Hai Hoa secondary school, interviewed 2010).

The DWF program selected Hai Hoa commune for its action plans in 2005-6. The project has supported the local government to build a multi-purpose communal house, which is locally evaluated as very effective intervention by this project as it provides local communities with meeting halls, office for Hai Hoa cooperatives and also becomes a safer evacuation centre. Government also used it for keeping commune assets. Besides, the DWF project also supported six households with materials in order to reinforce their households using the DWF 10 principles. Many participants did not remember exactly all of the DWF 10 typhoon resistant construction principles, but considered that some key techniques can be applied.

IV. RESULT OF IMPACT STUDY OF DWF PROGRAMME

4.1. DWF Project's approach and implementation method

A participatory approach has been used by DWF for this project in all stages of the work from beneficiary group selection through program implementation. This approach served to solve many of the problems that might otherwise arise if there is a lack of common understanding about the goals of the project between different stakeholders. By adopting a participatory approach, DWF has involved many stakeholders (both direct/indirect beneficiary groups and non beneficiary groups) in sharing information and decision-making that are able to minimize the possible weakness and threats that might otherwise challenge the success of activities.

The study found local communities are strongly in agreement with the method that the DWF project used to define activities and to select target households. There is no local resistance to any target households selected to benefit from project activities such as participation in training courses on the DWF 10 typhoon resistance principles or getting support for reinforcing their houses. For instance, 100% of households participating in this study in Phu Da, Vinh Xuan and Vinh Phu confirmed that they are happy to support the method in which DWF used for beneficiary household selection. In order to select households, the project staff in collaboration with commune staff analyzed the household conditions and status of households based on the list of households in the commune, with priority given to poor households with a non-permanent house, or temporary houses occupied by a widow. Based on this analysis the DWF project and local government staff collaborated with the head of village in order to organize a meeting with head of households in the concerned villages, who in turn voted for household selection. Households selected for DWF support to rebuild or reinforce their house had to commit that they would adopt DWF typhoon resistant principles. During work on the house, the DWF and commune technical staff supervised local builders and the head of households in order to make sure that building/reinforcing work was conducted in accordance with DWF safer construction principles.

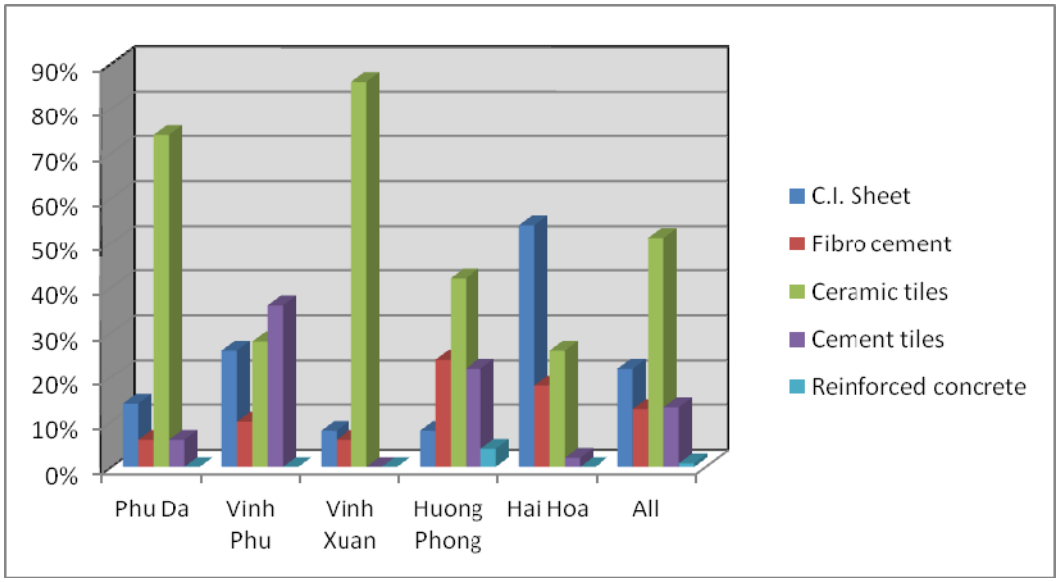
In terms of training courses and local awareness raising, the methods adopted in this project is highly evaluated as it maintains sustainability of this project. Local builders, local government staff and teachers were invited to training courses and then acted as resource persons to disseminate the knowledge and skills of this project to wider group. This was confirmed as important by local government staff, local builders and teachers for when the project ends its activities. Local builders and local government are important stakeholders able to advise heads of households who are involved or not involved in this project about the DWF 10 principles when they construct or reinforce their houses.

4.2. Local housing condition at survey sites

4.2.1 Roof covering

Understanding current local housing condition is an indicator measuring local vulnerability to typhoon and floods and provides valuable insights about changes in household's condition and the impacts of the DWF project on local structural adaptation to typhoons and floods in selected communes. Figure 4 reveals the current status of main roof materials of houses in the survey sites. In general, over half of households surveyed (51.2%) used clay tiles for their house roofs, about 22% used CGI sheet to cover their households. Fibre cement sheets and cement tiles are also quite common materials used for the house roof.

Figure 4: Main roof material of houses of surveyed households



There is also significant difference in the main materials used for roofs by local communities in selected communes. As shown in Figure 4, up to 54% of households surveyed in Hai Hoa commune used CGI corrugated sheeting for roofing the house, while this material is much less common in the four communes in Thua Thien Hue province. The result of focus group discussion (FGD) showed that participants confirmed the higher vulnerability of houses with CGI sheets for roofing as they are more vulnerable to whirlwind and storm in comparison with cement tiles and ceramic tiles. The economic situation of households drives their decision when selecting CGI sheets, tiles or concreted-reinforce roofs. The study found that less than one percent of household surveyed have houses with reinforced concreted roof. Given that a large proportion of households in Hai Hoa used CGI sheets for the house roof (see Figure 4), this is the reason why many households living in this commune often suffer the roof being blown way due to whirlwind or storms. It is important to note local communities are well aware of the importance of the house's roof. However, many households could not afford to do anything about this (see Appendix 3).

As one participant in Hai Hoa commune said (FGD, 2010):

> *"…it is very good if we could build our house with reinforced concrete roof, thus we are not afraid of any risks of disasters. But you know that local people staying here are very poor, we made great effort to survive, so how can we afford it? Using CGI sheets is much better option for us if you know that in this commune, for about 15 years ago, there were many households*

used thatching for roofing… We hope that we have some money to reinforce concreted roof for one room".

One of commune staff in Phu Da commune (interviewed in May, 2010) stated that:

"…as you know, local people have better awareness about the importance of the roof material of their house. Before local people used CGI sheets for roofing house without using U shaped brackets and L shaped steel bar to connect the sheets to purlins, or they used roof tiles without R.C. ribs to hold them down or they built wide roof overhangs, and as a result storm and whirlwind often blew off the roof. Now local people, if they are in better-off households, they build reinforced concrete roof, or fired clay tiles with R.C. strap beams to reinforce the roof, and if they use metal for roof they also use U shaped brackets and L shaped steel bar, and especially they never build wide roof overhangs anymore."

An interviewee from the provincial department of construction (interviewed in June 2010) said that:

"…I think you could see many public buildings and schools used metal for roof, but [you] also see the use of U shaped brackets and L shaped steel bar to connect iron sheets or anchoring of metal roof, and reinforced concrete ribs, and the use of cross bracing in the roof to stiffen the entire roof structure…. For public buildings constructed recently, their roof are now reinforced by concrete, and then roofed by metal..."

These statements highlight the fact that there have been changes in main roof materials in both public buildings and homes in sites targeted by the DWF project, and in which stakeholders tend to use stronger materials and typhoon resistant techniques in order to reinforce the roofs. This is clear evidence of the positive impacts of DWF in social construction work in terms of typhoon resistant techniques.

4.2.2 Roof structure

The main roof structure is recognized as a very important factor to strengthen houses against typhoons. In reality, both the wooden frame structure, and concrete and wood structure are amongst the most popular roof structures for local houses in study areas, with 45.6% (timber) and 28.8% (timber/r.c. beam) of surveyed households confirming this. There are still a large proportion of households using only bamboo and wood–bamboo structure for their houses (18% of households surveyed), and overall figures are higher – thus the study also found that over 80% of households in Vinh Xuan and Vinh Phu and about 66% of households surveyed in Hai Hoa used only bamboo and bamboo-wood structures for their households. The metal purlin is also a recent option for the roof structure for some local people with 5.2% of households using it (see Figure 5). One concludes that the current status of roof and roof structure of local households is that they are still vulnerable to extreme disasters. This is confirmed by the results of interviews conducted with local government staff in Vinh Phu, Vinh Xuan, Phu Da, Huong Phong and Hai Hoa that current houses in local communities are only able to resist storms with winds of up to level 10, i.e. about 90 – 110 km/hour.

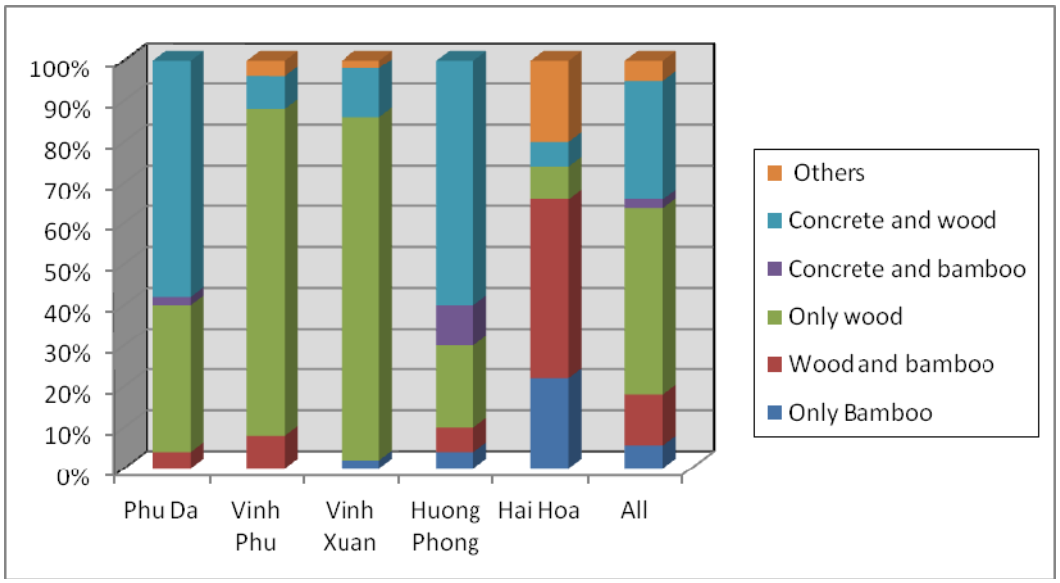


Figure 5: Main Roof structure of current house of households surveyed

	Direct benefit with DWF project	Indirect benefit group with DWF project	Non-related to DWF project	
Only Bamboo	0%	8%	4%	6%
Wood and bamboo	5%	17%	6%	12%
Only wood	60%	50%	20%	46%
Concrete and bamboo	0%	1%	10%	2%
Concrete and wood	33%	18%	60%	29%
Others	2%	8%	0%	5%
	100%	100%	100%	100%

The study found that there is a slight statistical significance in the adoption of the main roof structure of DWF project amongst direct beneficiary households and indirect beneficiary household groups. There are no direct beneficiary households using only bamboo for roof structure against 8% & 4% of indirect and non beneficiary groups. There are only 5 % of DWF direct beneficiary group used wood & bamboo for the roof structure while 17% - 6% of indirect and non beneficiary households used these materials. Direct beneficiary groups tend to reinforce their roof with stronger material such as reinforced concrete beams (33% of total direct beneficiary group) against 18% of indirect beneficiary households (see Figure 5). This suggests the effectiveness of DWF's project in changing local awareness to, and enhancing local resilience to, floods and typhoons. This finding is also confirmed by the result of key informant interviews and focus group discussion.

As one staff member of Phu Da commune (interviewed in June 2010) confirmed:

> *"…living in a region with there are many floods and storms, anyone would wish to have house with reinforced concrete roof in order to protect their family from flood and storm. There are only some better-off households could afford it, large proportion of households in Phu Da are still using concrete and wood for their roof structure. For recent constructed-houses with metal roof, I think, 100% of households use cross bracing in the roof to stiffen the entire roof structure. However, it is clear that local people*

now tend to use stronger materials for their houses, particularly their house roof…"

An interviewee from Provincial Department of Construction (interviewed in June 2010) stated that:

"…within the past 5 to 6 years there has been considerable change in roof structure of both public buildings and households; owners tend to use reinforce concrete beams and wood/metal purlins for their roof structure. They also used cross bracing in the roof to stiffen the entire roof structure. This is very effective measure to mitigate the impact of storms…"

There have been significant changes in main roof structure between direct beneficiary group and indirect ones in the target communes of DWF project. This can be attributed to the impact of DWF actions in these communes. The principle of using bracing and ring beams to stiffen the entire structure is locally evaluated as an effective measure and works well in the target communes.

4.2.3. Main wall materials

The study investigated the main wall materials of current houses of households in the surveyed sites. The result showed that for communities living in the four Thua Thien Hue communes, cement blocks are the most popular materials used for the wall construction, indeed nearly 100% of households in Phu Da, Vinh Phu and Vinh Xuan adopted these for their house wall construction. Only a few households in these communes constructed walls using bricks, whilst this applies to about 18% of households in Huong Phong.

Figure 6: Main wall materials of current houses of households surveyed

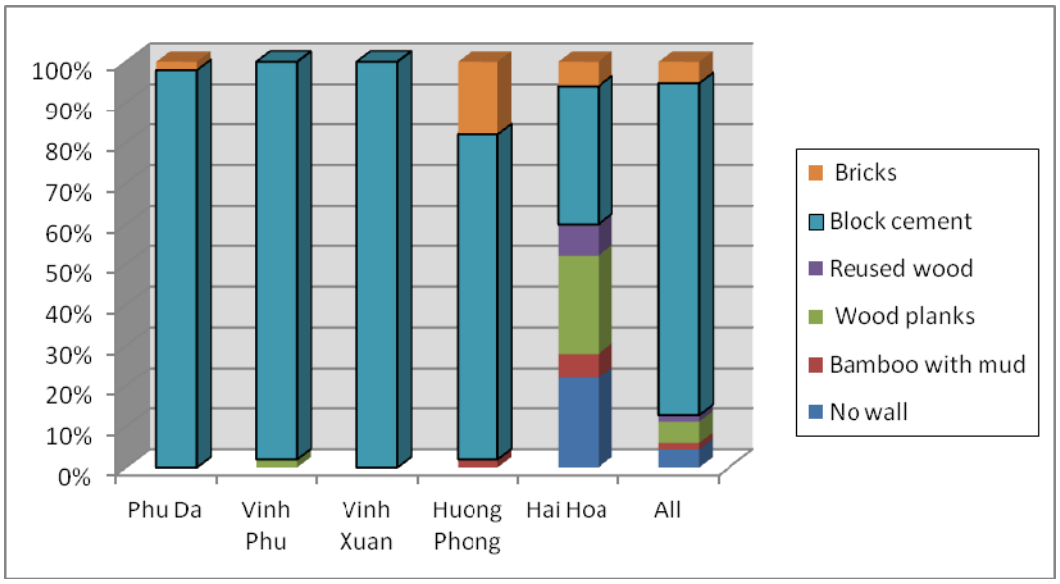


Figure 6 also highlights the difficult status of the main wall material for houses in Hai Hoa, Quang Tri where up to 60% of households surveyed used non-permanent materials for house wall construction. Up to 22 % of houses have no wall, 6% used bamboo with mud and 24% used wood planks for wall construction. This means that living in this housing condition, local people in Hai Hoa are intensively exposed to the risks of disasters, particularly typhoons, whirlwinds and floods.

The significant difference in main wall materials can be explained by economic factors; a large proportion of households in Hai Hoa is poor. It is important to note that there is not much difference in terms of type of disasters and impacts in general between Hai Hoa and the other communes in this study. This difference in main wall materials can also be seen as one of the impacts of the DWF project. As shown in Table 3, there is significant difference in main wall materials between DWF direct benefit households and DWF indirect benefit households. It is evident that almost all of direct benefit households used cement blocks for wall construction (93% of households) in comparison with 80% of indirect benefit ones. There are no households in this group who had constructed their house without walls or used bamboo with mud for wall construction.

Survey respondents highlighted that there has been increasing use of reinforced concrete and more cement for wall construction in the DWF project sites. Heads of households often consult local builders and receive advice from local builders, local staff or neighbours about the way to reinforce their wall, including building columns and making better rafter connections using anchors of steel bars or bolts embedded in the concreted columns. When questioned how local people know these techniques, the answer is that they were all participants in training courses on typhoon resistant construction work delivered by the DWF project, and some of them got advice about this from local builders, local staffs and their neighbours.

Table 3: Crosstab between main wall materials and type of households in DWF project

Main wall material	Direct benefit with DWF project	Indirect benefit group with DWF project	Non-related to DWF project	%
No wall		7%		4%
Bamboo with mud		2%	2%	2%
Wood planks	2%	8%		5%
Main wall material - Reused wood		3%		2%
Block cement	93%	80%	80%	82%
Bricks	5%	1%	18%	5%
Total	100%	100%	100%	100%

In an interview with a head of household who is constructing a new house of about 70m² and with about 4 tons of steel and over 10 tons of cement in Vinh Phu, he answered the question "why did you use so much steel and cements for your house construction" with this reply:

> *"…living in area where storms and whirlwinds often occur, I want my family living in safer house. This is my purpose. Local builders advised me and I bought steel and cement at their suggestion in order to make sure that my house is a permanent construction for my family. In this commune, I think all people know the DWF principles, but I think I do not have to remember them as if you want to know just simply consult your builders. They know the principles very well as they apply them daily not only within this commune but also neighbouring ones… the main thing is that whether house owners can afford it…"*

One local builder (interviewed in June 2010 in Vinh Phu commune) said that:

> *"…in recent years, block cement and cement are main materials for any households who build a new house. We often use bolts/bolt embedded in the*

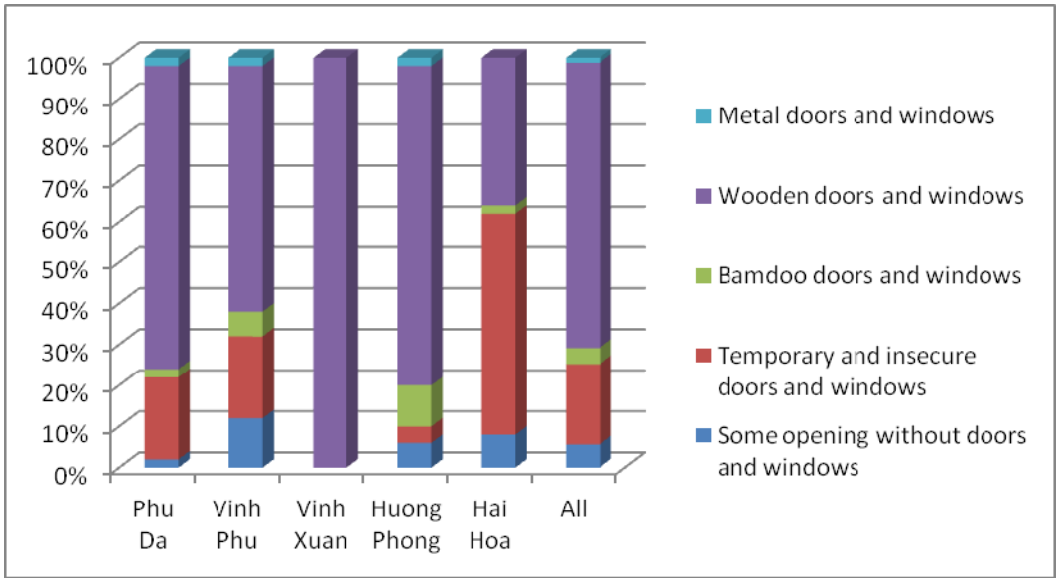
wall or in concrete to connect with columns or rafters in order to strengthen the house. This is very common technique for any local builders and widely applied in communities…"

It is clear that DWF project has successfully created an impact on local builders and households in terms of typhoon resistance house construction in the target communes.

4.2.4. Doors and windows of houses

In terms of doors and windows of current houses, the study found that putting in wooden doors and windows are common options of households in the five communes selected with nearly 70% of households doing this. The percentage of householders who owned houses without windows and temporary windows is still relatively high with about 20% of total households surveyed in Phu Da and Vinh Phu commune. The highest figure was found in Hai Hoa commune where over 62% of surveyed householders owned houses without proper doors and windows, or with temporary and insecure doors and windows. The result of FGD reveals that in general, if a householder is living and working within commune (without income), their house is often built in many stages. The first stage is to build the hard structures of houses with or without temporary windows and doors. The second stage is to decorate the houses and install secure windows and doors. The length of time between two stages is often about 3 – 5 years, in some poor households, the length of building time is even much longer. This means that over several years the house may be incomplete and not have doors and windows

Figure 7: Doors and windows of current house of households surveyed



The study found that there is considerable difference in using door and windows for current households between DWF direct benefit households and DWF indirect ones. 81 % of DWF – direct benefit households constructed or reinforced their houses with wooden doors and windows in comparison with 64 % or 78% of indirect households. Up to 34% / 10% of indirect / non direct benefited households constructed/reinforced their houses with some door and window openings without doors and only temporary doors and windows (See Table 4).

Table 4: Doors and Windows of current house by type of DWF household group

Doors and windows	Direct benefit with DWF project	Indirect benefit group with DWF project	Not related to DWF project	Total
Some opening without doors and windows	5%	6%	6%	6%
Temporary and insecure doors and windows	7%	28%	4%	20%
Bamboo doors and windows	5%	2%	10%	4%
Wooden doors and windows	81%	64%	78%	70%
Metal doors and windows	2%	1%	2%	1%
	100%	100%	100%	100%

This does not mean that local people are not aware of the importance of secured windows and doors in resistance to typhoon and whirlwind. It is important to note that all participants in this study recognized the importance of doors and windows in mitigating impacts of typhoons and whirlwind. Participants in this study confirmed their extensive experience of damage to houses due to unsecured window and doors, however, poverty has prevented them from constructing secured windows and doors for their houses. As one of the heads of household participating in the Focus Group Discussion in Vinh Xuan commune reported:

> *"…we know secure doors and windows are very important to protect our house from storm winds. If the house is without door and windows, storm wind will blow it away, many houses' roofs were blown away because they were without or with only temporary and insecure door and windows. I think many people know it, but we often do not have enough money to build it. We often mobilize all resources, including taking loans in order to build house, thus we need some years to recover after house construction…"*

This is also confirmed by a staff from Vinh Xuan commune (interviewed in June 2010):

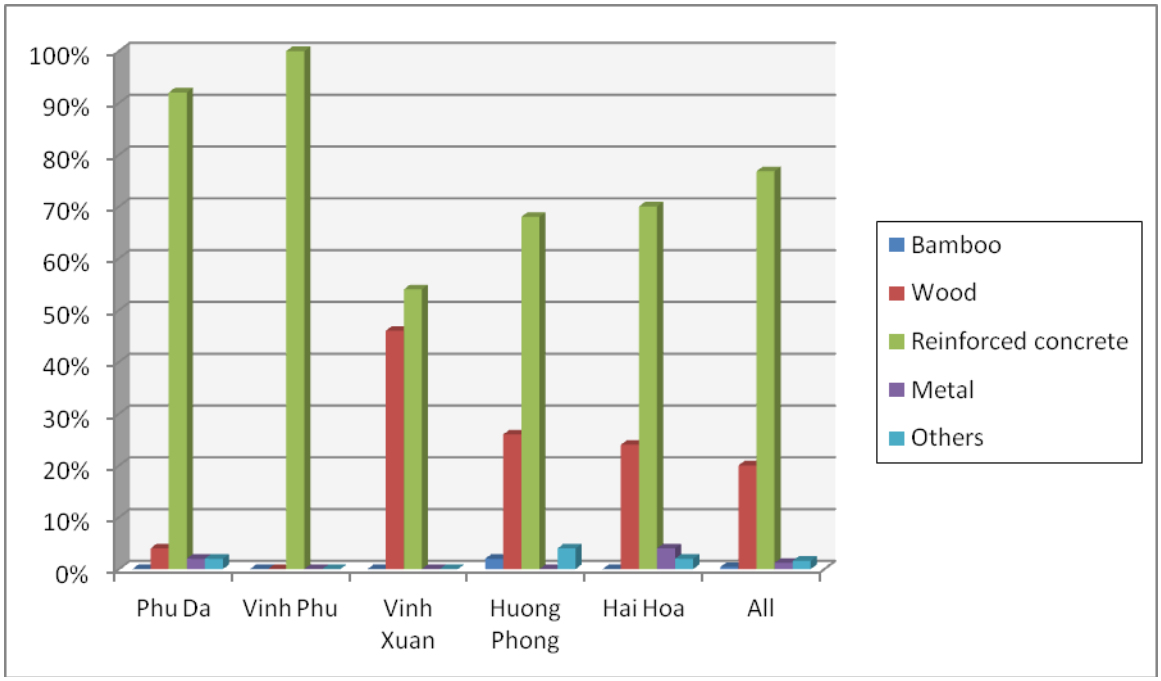
> *"…local people know the importance of doors and windows to prevent house damage from storm and whirlwind. However, local people are very poor, particularly young couples just separated from their parents; they have dealt with many difficulties in building their house. The building time is often 2 – 3 years to complete house with temporary door and window. In some cases, they could not build secure door and windows after 10 years…"*

These statements indicate that local people are aware of the importance of door and windows of their houses for typhoon impact resistance. However, many of them could not install these due to a lack of money.

4.2.5 Structure of current house

Figure 8 shows that reinforced concrete is commonly used to strengthen current houses of households surveyed. About 77% of households surveyed confirmed this technique in their current households. This figure is relatively high in Phu Da and Vinh Phu with 92% and 100% of houses surveyed respectively. There is significant difference in using support columns in building or reinforcing a house between DWF direct benefited households and DWF indirect benefited ones; up to 95.3% of households and 72.9 % respectively. This is also clear evidence of the good performance of one typhoon resistant principle of "Reinforce the column and rafter connection" in the target commune.

Figure 8: Support column of current houses of households surveyed



4.2.6. Number of storeys / attic construction

The housing condition of households surveyed is also considered the number of storeys and the accommodating capacity for people during floods. The study showed that 96.4% of houses are one storey houses without an attic that could accommodate people and store food and goods during extreme storms or floods. Only 2.8% of houses are classified as a one storey house with an attic capable of accommodating people. Less than 1% of houses have two storeys or more in the study site. In Hai Hoa, Huong Phong and Phu Da which are considered in the flood basin, over 90% of houses have only one storey and no attic to accommodate people during the floods (See Table 5).

Table 5: Second floor of houses

commune	Second floor	Frequency	Percentage
Phu Da	One floor without attic - can accommodate people during flood	49	98 %
	One floor house with attic - can accommodate people during flood	1	2 %
Vinh Phu	One floor without attic - can accommodate people during flood	49	98 %
	More than two floor house	1	2 %
Vinh Xuan	One floor without attic - can accommodate people during flood	49	98 %
	One floor house with attic - can accommodate people during flood	1	2 %
Huong Phong	One floor without attic - can accommodate people during flood	45	90 %
	One floor house with attic - can accommodate people during flood	4	8 %
	Two floor house	1	2 %
Hai Hoa	One floor without attic - can accommodate people during flood	49	98 %
	One floor house with attic - can accommodate people during flood	1	2 %
Grant Total	One floor without attic - can accommodate people during flood	241	96,4 %
	One floor house with attic - can accommodate people during flood	7	2,8 %
	Two floor house	1	0,4 %
	More than two floor house	1	0,4 %
	Total	250	100 %

4.2.7. Foundations

There is also a trend by local people as a flood adaptation measure to build houses with a higher foundation plinth. As shown in Table 6, local people built houses with high foundations/plinths, particularly in low-lying communes such as in Phu Da, Huong Phong and Hai Hoa which are commonly known as flooding basins. For example, the average height of house foundation/plinth built in Huong Phong and Hai Hoa is 82.8 cm and 64.3 cm respectively. The highest foundation plinth is up to 2 meter height found in Huong Phong commune and about 1.2 meter height in Hai Hoa. The study also found that local people in 4 communes selected for this study in Thua Thien Hue also built their house foundation with reinforced concrete using steel and cement.

Table 6: Level of foundation of current households (cm)

	Foundations			
Commune	**< 20 cm**	**20 - 50 cm**	**50 - 100 cm**	**100 - 200 cm**
Phu Da	24%	76%		
Vinh Phu	4%	68%	28%	
Vinh Xuan	8%	90%	2%	
Huong Phong	0%	40%	32%	28%
Hai Hoa	6%	52%	22%	20%
All	***8%***	***65%***	***17%***	***10%***

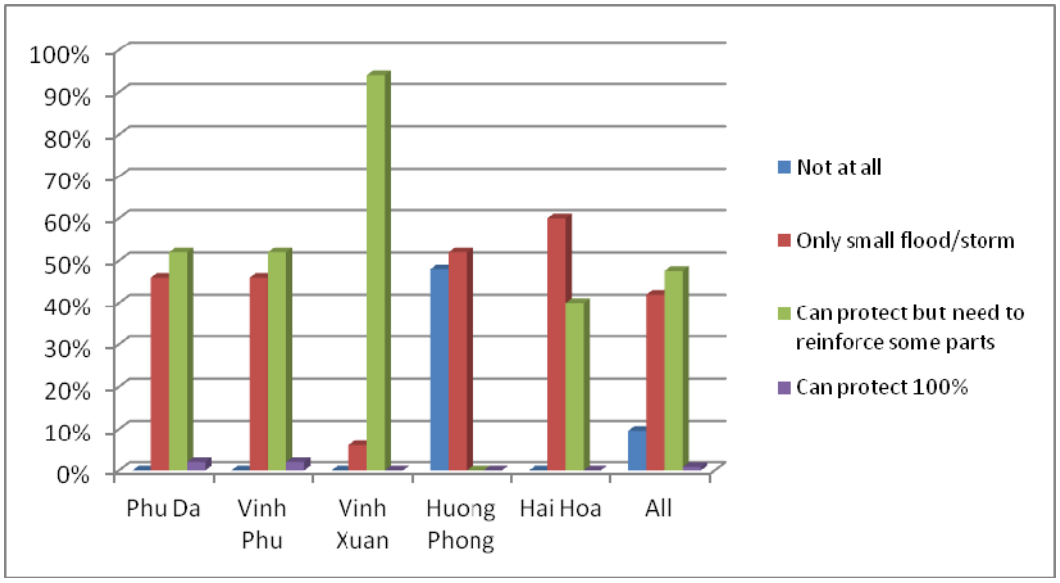
4.2.8 Local housing vulnerability

As shown in Figure 9, in general over half of respondents confirmed that their houses can either not protect at all (9.6%) or (42%) at best can only protect their family from small floods and storms. About another half of respondents confirmed that their current house can protect their

family from 1999 historical floods or 1985 storm but really need to reinforce some parts of the houses. There is only 1% of respondents confirmed that their current house can protect their family 100% from these events (see Figure 9).

The above analysis indicated that households are still vulnerable to extreme disasters, particular to extreme typhoon and floods. Despite local people being well aware of (and indeed adopting many of) the technical principles of the DWF project, lack of resources and budget are still constraining local communities in the study sites from reinforcing their house with effective measures. The following question was asked of all participants in FGD: *"Would you evaluate your current housing condition in the event of another extreme typhoon like the one in 1985?"*A large proportion of participants, particularly in Huong Phong, Vinh Phu, Vinh Xuan and Hai Hoa commune confirmed that their current houses are able to resistance typhoons with wind level of 9^{th} to 10^{th} intensity (about 90 – 110 km/hour), but that their house may collapse or the roof might be blown away if there is bigger typhoon like that of 1985.

Figure 9: Current house and rating for capacity to protect their family from 1999 floods and 1985 storm

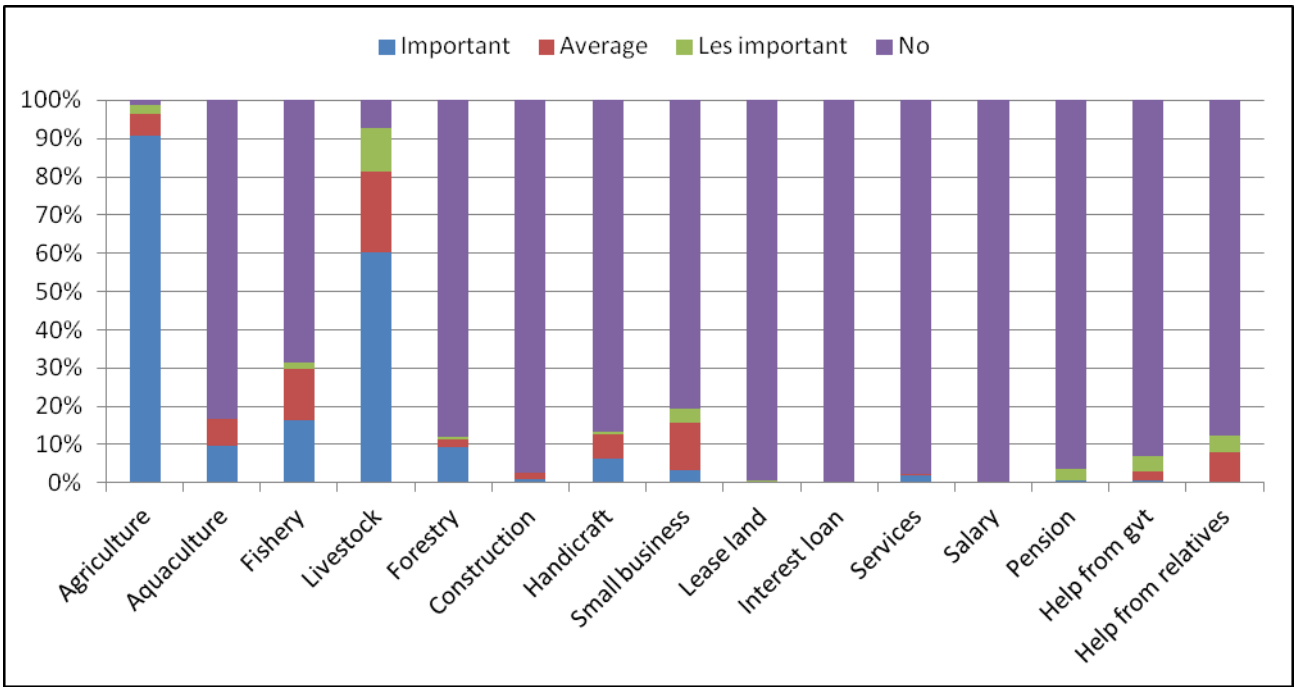


It is important to conclude that there has been considerable difference in local awareness to risk of typhoon and current status of their house between communes selected for DWF project. The awareness of local respondents about typhoon resistant house construction increased with the length of time of DWF project work. Current status of local houses such as main roof material and structure, door and windows, support column, foundation and main wall materials in Phu Da, Vinh Phu and Vinh Xuan is in general stronger than that of Huong Phong and Hai Hoa with no or low project input.

4.3. Local livelihoods and disaster damage

Agricultural production such as paddy crops, cereal crops, vegetables are the main livelihood strategies for local communities in the study sites. For over 90% of household involved in this study agriculture is the main livelihood practice, and about 60% of households confirmed livestock raising was an important source of income for the family. The study found that local communities have also been involved in non-farm activities such as construction, handicraft, or have moved away to seek work. Local livelihood strategies are simple and intensely vulnerable to annual typhoon and floods (see Figure 10).

Figure 10: Sources of income of your family during last year by following activities



Reviewing government reports showed that per capita income of local inhabitants living in these five communes is mainly in the range of US$ 500 – 600/ person / year in 2009. However, local people have to spend this amount of income on various items in both living costs and production cost. Table 7 shows that main living cost items of local communities is food with VND 45,000 /day (about VND 15 million per year), with the cost of education, health and clothes also featuring as main costs. The production costs of households also require a large proportion of their income: thus costs invested in agriculture (about VND 3.5 million) and in livestock raising (VND 3 million) are the main cost items in their livelihood.

Table 7a: Expenditures of family for daily food (VND / day)

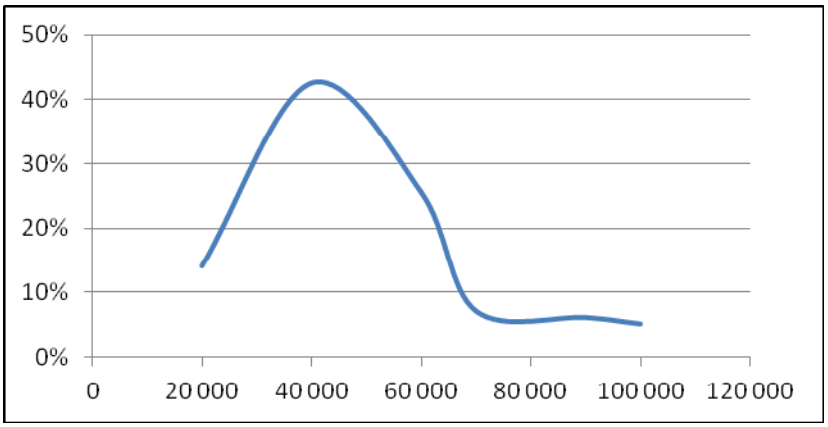
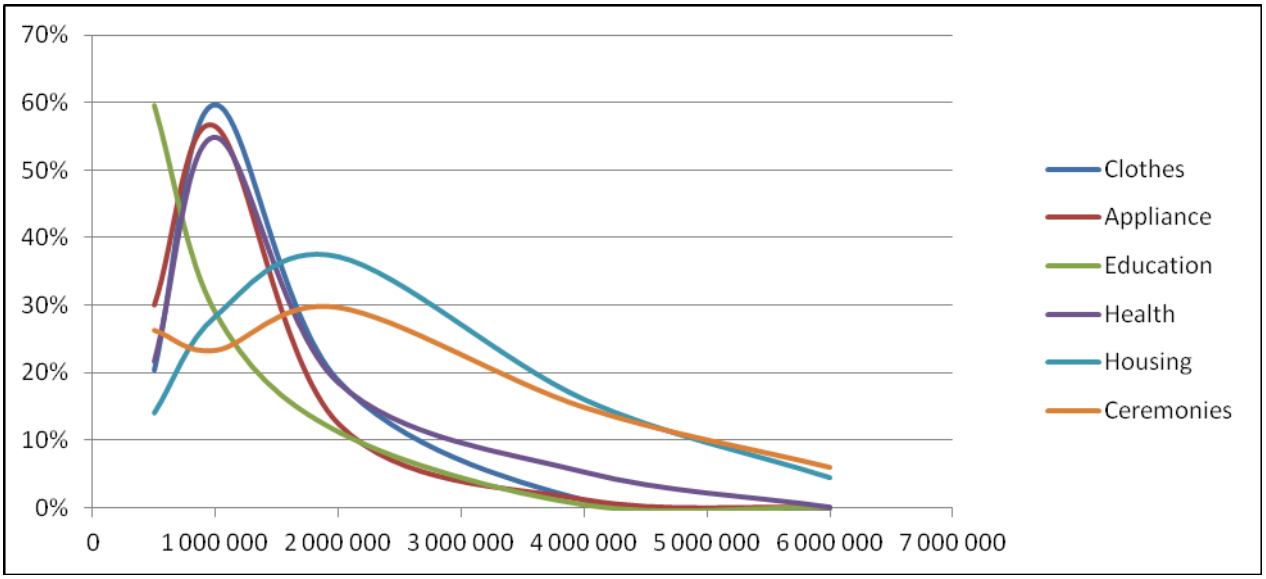
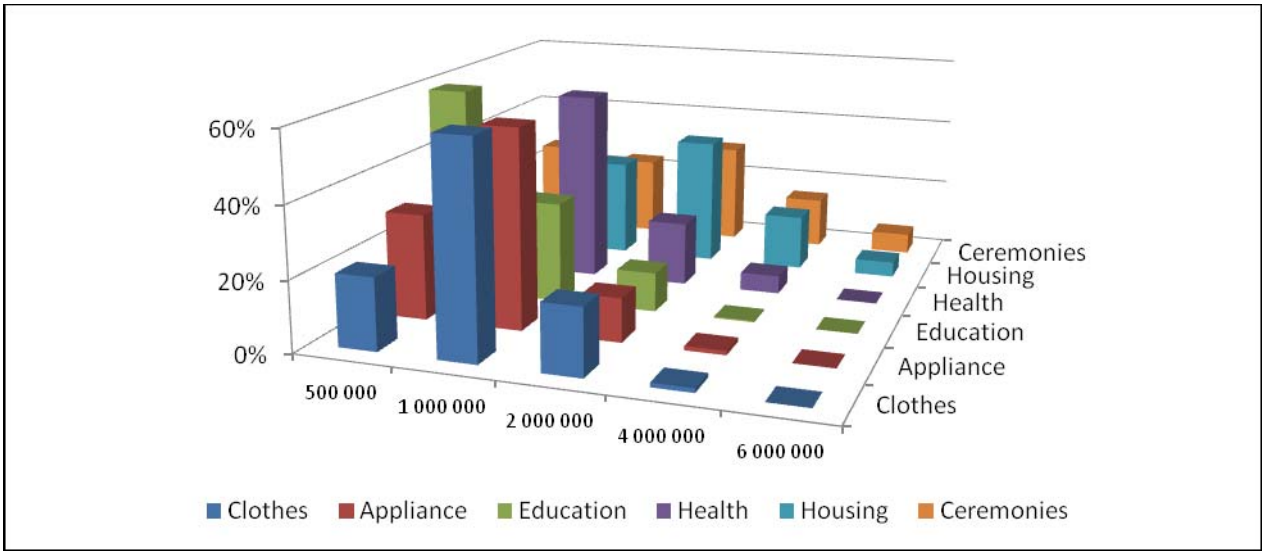


Table 7b: Expenditures of family for the following items (VND / year)





Poverty

This result is consistent with the findings of FGD and key informant interviews, when participants stated that the reason they could not build a new house or reinforce their house in order to protect their family from floods and typhoon is lack of money as their income is just enough for their daily expenses.

One participant of a focus group discussion in Hai Hoa reported that (DWF-FGD in 2010):

> *"…as you know we are living here largely depending on rice cultivation and some pigs and poultry. Bad harvests and disease often occur to our crops. We hope to have enough food for family, we do not have money… we know reinforcing houses is important option to protect our family, but where is money? Please if a project has any program, please support us to reinforce our house that would be very good action…"*

One local staff from Vinh Phu commune (Key Informant Interview, 2010) stated that:

> *"…local people living here are very poor, some households have children migrating to Cities who can make some money and send home. Agriculture is largely rain–fed, if weather is unfavourable, many households are hungry. Some better-off households have small savings which is for emergency situation, not for building new house. Some of households constructed houses but need many years to complete…"*

One commune staff from Hai Hoa commune (interviewed June 2010) reported that:

> *"Hai Hoa is very poor commune of Hai Lang, Quang Tri. It would be reasonable to say that rice is the main source of income of commune. 100% households involve in rice cultivation. Local communities are living in very vulnerable housing condition. In other words, up to 60 – 70 % of local houses are temporary houses and where floods and whirlwinds occur annually, many households were pushed into chronic poverty due to their house and their livelihood being damaged by extreme floods. Indeed, we got support from DWF very recently, but very effective, particularly for community houses. If DWF project still has a program on typhoon resistant housing construction, please support poor houses in Hai Hoa, if not they wouldn't be able to build a typhoon resistant house and escape from poverty…"*

These and similar statements show the fact that in our study area local people are living with vulnerable livelihoods and low income and dealing with many difficulties in their daily life. The question that comes up with this study is how to enhance local capacity for local communities in order to prevent and mitigate the impacts of annual floods and storm. Improving the income and living condition for local communities is among the most important concern of participants in this study.

V. EVALUATING IMPACTS OF THE DWF PROJECT ON LOCAL COMMUNITIES

5.1. Local disaster risk perception and adaptation

5.1.1. Disasters and impacts on local communities

The study found that annual disasters, particularly extreme floods and storm such as historical flood in 1999, Xangsane typhoon 2006, Ketsana typhoon in 2009, all caused tremendous impacts on local communities, particularly on poor communities. As shown in Table 8, about 60% of respondents confirmed that the 1999 flood caused severe to extreme damage to agriculture and animal husbandry. About 70% of households assessed the damage to their house as fairly severe to extreme due to the same 1999 floods.

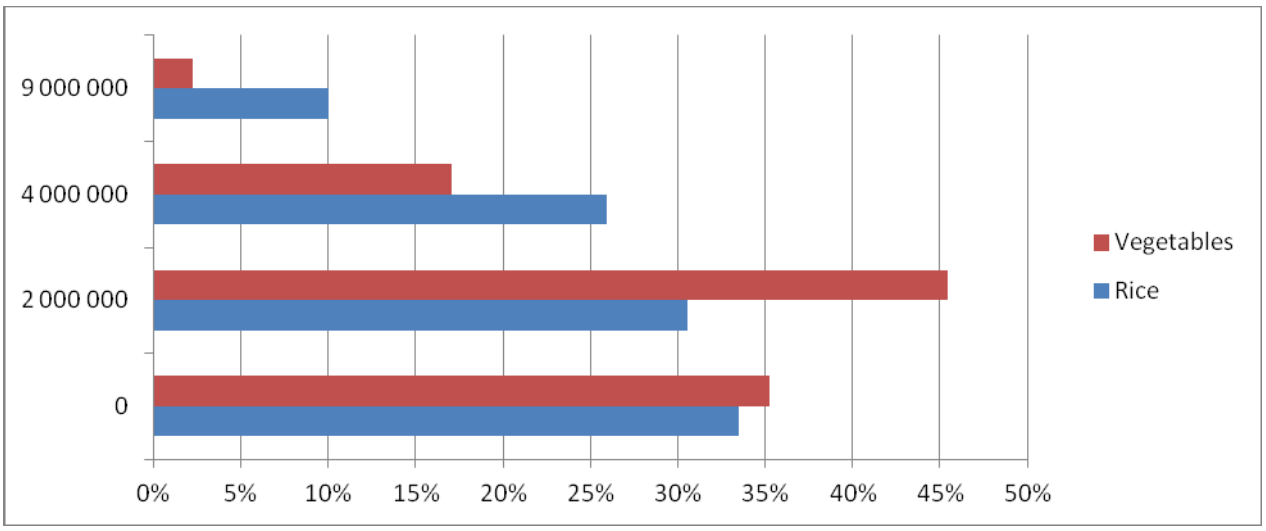
A similar result was also found in terms of impacts of typhoons on local communities in the selected communes where the impact on houses, agriculture and livestock raising were highest. Investigating the impacts of Ketsana 2009, the study reveals that 82% of households involved in this study confirmed the level of damage due to the typhoon to be between fairly severe to extreme with 13%, 39% and 29.8% respectively (see Table 8). There is also a difference in terms of the level of damage to items according to the communes. The study found that Huong Phong and Hai Hoa are more prone to floods than Vinh Phu, Vinh Xuan and Phu Da. Meanwhile typhoons are recognized as the hardest to hit these three communes (see Appendices 4 & 5).

Table 8: Ranking the damage caused by severe floods/typhoons to your family by sectors

Events	damage to	No damage	Less damage	Moderate damage/loss	Fairly severe damage	Very damage/loss	Extreme damage/loss	Total
1999 floods	Aquaculture	41.9	42.7	4.3	5.1	4.3	1.7	100
	Fishing activities	39.3	40.2	10.3	2.6	0.9	6.8	100
	Agriculture	1.7	5.1	29.9	31.6	12.0	19.7	100
	Animal Raising	0.9	11.1	14.5	25.6	28.2	19.7	100
	Housing	4.3	12.0	13.7	19.7	32.5	17.9	100
	House appliance	20.5	12.0	30.8	8.5	9.4	18.8	100
2004 floods	Aquaculture	55.2	32.8	4.5	7.5	0.0	0.0	100
	Fishing activities	40.3	37.3	7.5	4.5	1.5	9.0	100
	Agriculture	9.0	23.9	26.9	14.9	9.0	16.4	100
	Animal Raising	11.9	13.4	23.9	23.9	23.9	3.0	100
	Housing	13.4	10.4	9.0	28.4	23.9	14.9	100
	House appliance	35.8	1.5	29.9	3.0	7.5	22.4	100
2006 Xangsane	Aquaculture	54.3	25.7	3.8	5.7	1.9	8.6	100
	Fishing activities	22.9	50.5	5.7	5.7	11.4	3.8	100
	Agriculture	5.7	7.6	23.8	44.8	14.3	3.8	100
	Animal Raising	11.4	15.2	21.9	27.6	10.5	13.3	100
	Housing	8.6	7.6	10.5	12.4	39.0	21.9	100
	House appliance	26.7	9.5	26.7	16.2	1.9	19.0	100
2009 – Ketsana	Aquaculture	72.0	19.3	3.7	0.0	1.2	3.7	100
	Fishing activities	21.7	70.2	1.9	3.7	1.2	1.2	100
	Agriculture	5.0	11.8	18.6	39.1	13.7	11.8	100
	Animal Raising	5.0	5.0	17.4	34.8	19.3	18.6	100
	Housing	4.3	3.1	10.6	13.0	39.1	29.8	100
	House appliance	13.7	2.5	39.1	13.7	11.8	19.3	100

Table 9 presents the estimated cost of damage to rice field and vegetable crops in VND (current prices) in the study area. The result confirmed findings from previous discussions that typhoon and storm caused tremendous impacts on agricultural productions such as affected cultivated area of crops, damage to rice and other products kept at home, cattle killed, damage to inputs such as seeds, fertilizers, and area of aquaculture. The cost of damage per household due to floods and typhoons in the last 10 years is estimated at a mean cost (total of mean) of about VND 10 million.

Table 9: Damage for rice field and vegetable crops (current price – VND)



In order to evaluate the impact of the DWF project in the target communes during the length of time of the DWF project, Table 10 reveals that there is not much difference in terms of the number of house collapsed or damaged due to extreme disasters (floods and storms) since 1985 between Phu Da (long-term work of DWF project) and short-term ones such as in Vinh Xuan, Vinh Phu and non-DWF work commune Huong Phong. However, it is important to note that there has been a slightly change in the number of house collapsed and damaged, which has tended to go down, particularly in communes selected for DWF project during this period. For Phu Da, Vinh Xuan and Vinh Phu where DWF project had a special focus on typhoon resistant constructions, only 1 or two houses collapsed and were damaged due to typhoons compared 31 houses in Huong Phong commune (see Table 10).

Table 10: Local house collapsed or damaged due to flood and typhoon by years

Commune	Year	Collapsed	Damaged	Total
Phu Da	1985	0	7	7
	1999	0	3	3
	2004	0	4	4
	2005	0	1	1
	2006	3	29	32
	2007	0	1	1
	2009	0	1	1
	Total	3	46	49
Vinh Phu	1985	0	7	7
	1999	0	3	3
	2004	0	4	4
	2005	0	1	1
	2006	3	29	32
	2007	0	1	1
	2009	0	1	1
		3	46	49
Vinh Xuan	2006		3	3
	2007		1	1
	Total		4	4
Huong Phong	1985	18	6	24
	1999	10	0	10
	2007	3	0	3
	2009	0	3	3
	Total	31	9	40

People are obliged to spend scarce money on repairs. A large number of households (62% of households with house collapsed or damaged) spent VND 5 – 10 million on house repairs, and about a quarter of households spent VND 15 – 20 million on house repairs in Phu Da. In Vinh Phu, 18% of households with damaged houses spent less then VND 5 million on house repairs. About 44 % of these households spent VND 5 – 10 million in order rebuild or repair their house. The amount of money spent to repair their collapsed or damaged houses is even higher in Hai Hoa commune when up to 60% of households spent over VND 20 million and 40% of households spent VND 5 – 10 million (see Figure 11).

This is a vicious circle. Householders hope that damage will not occur, and since they are poor, they do not prepare. One of reasons explaining why local communities still did not reinforce or rebuild their house with the application of the DWF 10 typhoon resistant construction principles is that while they are well aware of the effectiveness of DWF principles, too many households are too poor to afford to adopt them. As a result, many poor families suffer as a result of their homes collapsing or being damaged due to typhoons in recent years. As shown in Figure 11, many of them also *then* spent VND 5 – 10 million, or even over VND 20 million, in order to repair their houses.

This same amount of money is more than enough to reinforce their houses with DWF 10 principles of typhoon resistant construct work application.

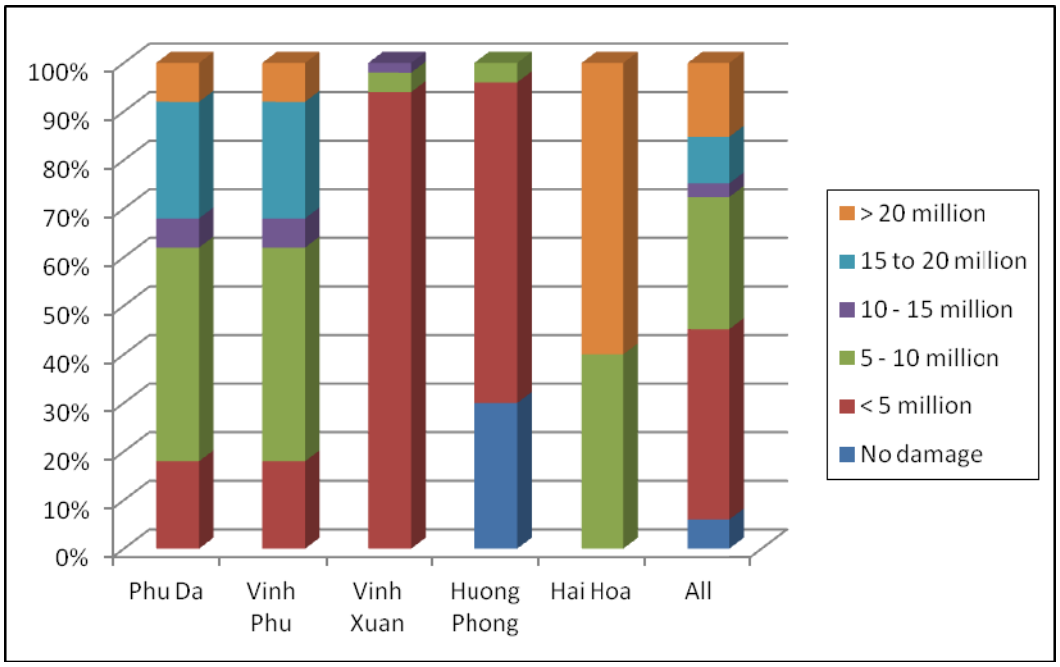
Secondly, in making decisions about how to spend their scarce resources the reality is that these people have many daily demands on their resources and often prefer to spend money on buying items such as TV, DVD, or motorbikes rather than invest in reinforcing their house against a disaster *that, in their minds, they hope will not happen to them – and this despite (see section 5.1.2.) a collective high level of knowledge that disaster is likely to hit.* As one local government staff in Vinh Phu commune (interviewed in May, 2010) stated:

> *"…Poor people living here are very objective about disaster; they think that typhoon and flood might only occur some times in a year, maybe some years. Thus, they don't care much about their houses, if they saved some money, they will buy TV or motorbike which meets their daily demand…"*

The similar situation was also confirmed by one local staff from Vinh Xuan commune who participated in FGD (conducted in June 2010 in Vinh Xuan commune, Phu Vang District):

> *"…we should frankly recognize the fact that our local people have low awareness to the risk of floods and typhoon that is the main reason constraining the wide application of DWF 10's typhoon resistant construction principles though we are well understanding the importance and the effectiveness of these principles to mitigate the impacts of storm. This is also reason why there were still many houses damaged due to storms in recent years. We strongly recommend that it is important to conduct more local raising awareness to risks of storms and application of the DWF 10 principles…"*

Figure 11: Estimate the cost to repair your house if a typhoon like Xangsane typhoon 2006 or Ketsana 2009 occurs



Once concludes that extreme typhoons caused serious impacts on local communities in which damage to agricultural production, livestock raising and houses are the most severe impacts. There is a difference in the level of damage to households surveyed between target communes of

DWF project, in which Vinh Xuan, Vinh Phu and Phu Da which are more prone to storm while Huong Phong and Hai Hoa are more severely affected by floods, with a correlation to both geographical location and local livelihoods. There is also an association between local awareness of the risk of floods and storms and level of damage; the lower the awareness of the risk of floods and storm, the more severe is the damage to the house. Surveyed households in target communes spent a relative large amount of money (about VND 5 – 10 million) on their house repairs but many of them did not allocate this budget to reinforce their house beforehand with the application of the DWF typhoon resistant construction techniques because they spent money on other items.

5.1.2. Local perception on disaster risks

The highest risks to local communities are catastrophic typhoons and then catastrophic floods. Families confirmed that the damage caused by storms is greater than that caused by floods and other disasters due to its magnitude.

Figure 12: Local rating level of risk perception of the following hazards to their house

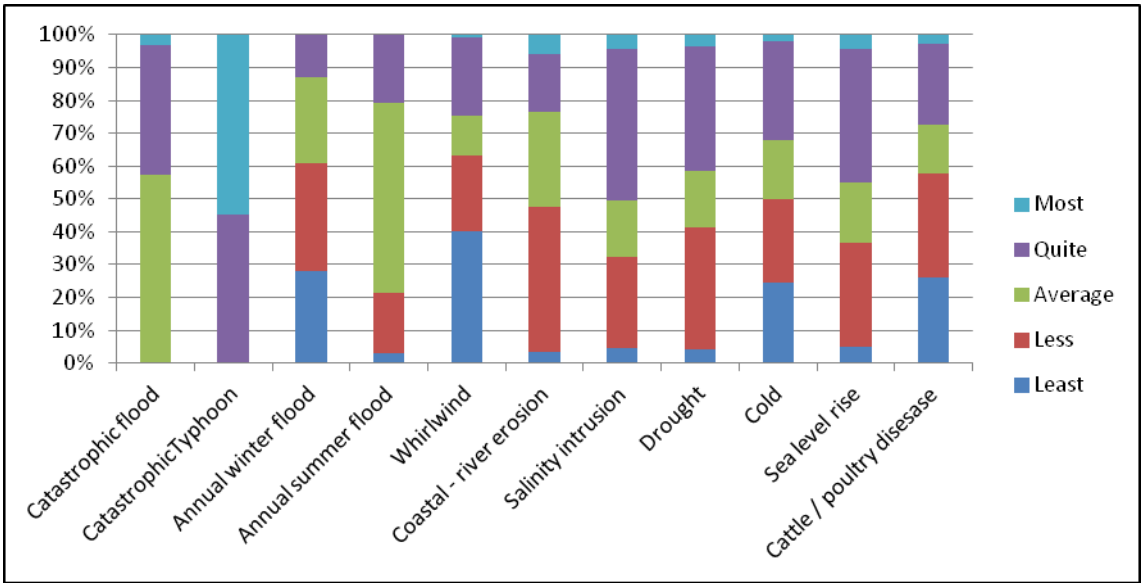


Figure 12 also indicates that temporary sea level rise, landslide, droughts and severe cold are also disasters occurring frequently in the communes. There is a significant difference in perception about the risk of typhoon between DWF direct beneficiary and indirect ones, when direct beneficiary group have had access to training courses and support for house reinforcement. The latter have much better awareness about - and know how to mitigate - the impacts of typhoon risks. Thus, a majority of them (60%) consider typhoons to be significantly risky disasters, compared with less than half (42%) amongst the total indirect benefit group (see Appendix 7).

Local participants were also asked to rank the possibility of occurrence of floods like 1999 and typhoon 1985, and the study found that up to 82% of respondents confirmed that this is very likely to happen and about 16% stated 50% possibility of occurrence of such event. 100% of respondents living in Vinh Xuan and Hai Hoa commune confirmed its possibility as very likely to happen again in the future (see Table 11).

Table 11: Ranking possibility of occurrence of floods like 1999

Commune	Very likely happen	50%possibility	Happen but chance are rare
Phu Da	82%	18%	0%
Vinh Phu	82%	18%	0%
Vinh Xuan	100%		
Huong Phong	48%	44%	8%
Hai Hoa	100%		
All	82%	16%	2%

According to local experience, there has been no increase in frequency but an increase in the intensity of typhoons in the last 50 years in the survey area. The records of the Provincial Centre for Hydrometeorology show that from 1978 to 2008 there have been 108 floods with water level reaching over flooding warning level 2, or an annual average of 3.5 floods. From 1999 to date, the frequency of flood occurrence has increased, with 9 floods occurring in 2007 alone (TTH Centre for Hydrometeorology report, 2009). For example, the historical floods in November 1999 in which flood water levels increased to 5.3 meter killed some 352 people in Thua Thien-Hue. In 2007, four severe floods occurred within 1 month from 13 October to 16 November, inundating 90 communes, some of them in Quang Dien, Phu Vang for 30 days (TTH Centre for Hydrometeorology report, 2009).

41 storms and hundreds of tropical depressions have hit Thua Thien Hue over the last 50 years, with about 0.7 storms/year on average. There has been a change in the magnitude of storms and tropical depressions with more southwardly. The hydrometeorology stations found it hard to provide correct early warning to communes that leave local government and community to deal with difficulties in prevention and mitigation of their impact. As a Key informant from Thua Thien Hue Centre for Hydrometeorology (interviewed in 2010) reported:

> *"The climate pattern changed a lot in recent years. Heat waves arrived early, rain is coming lately but concentrates in October to cause floods, extreme cold is longer and colder …There has not been considerable increase in frequency, but yes in severity of storms and tropical depressions. It is especially hard to forecast its heading which leads to difficulties in response to storms and tropical depressions. Thus many communities often suffer more damage to their assets than before. As you know "early" flood in 5th September 2009 caused damage to over 1 100 ha of paddy rice, which is ready for harvest in Thua Thien-Hue …"*

Local participants in Hai Hoa also revealed that the rainfall has also soared and so floods are more frequent. A villager stated that:

> *"…before it rained for about two days or even more and then flood occurred, but now flood is regular occurrence. It rains a couple of hours or even a night and we see water everywhere (i.e. flood). Flood water rises very quickly and inundation lasts longer…"*

These statements highlighted that local people recognize the change in climate pattern, particularly the occurrence of extreme storms and flood in the target communes. There is also a significant difference in local perception about the risk of typhoons between the direct beneficiary group and indirect ones, the direct beneficiary group being much more aware of typhoon risks.

5.1.3. Local adaptation to typhoons

A large proportion of households in the study areas stated that they can do little for their family. Only less than 10 % of respondents see themselves as able to do a lot for their family. Thus there are still many households who need external support in order to improve their adaptation capacity to future disasters.

Figure 13: Local rating of ability to protect the family from a possible severe flood/storm

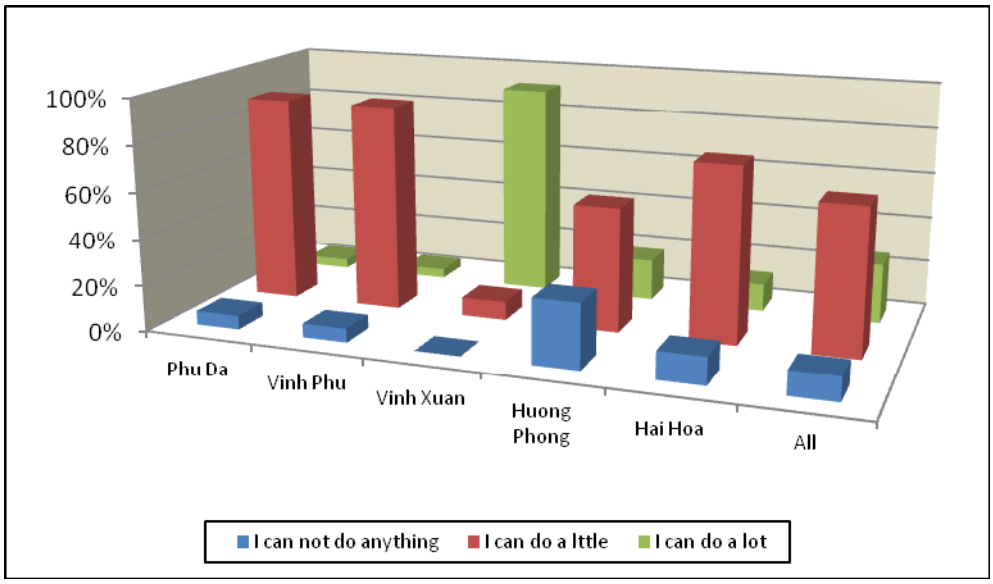


Figure 14: Local rating of the current status of the house and its capacity to protect the family if the 1999 floods and 1985 storms occurred again

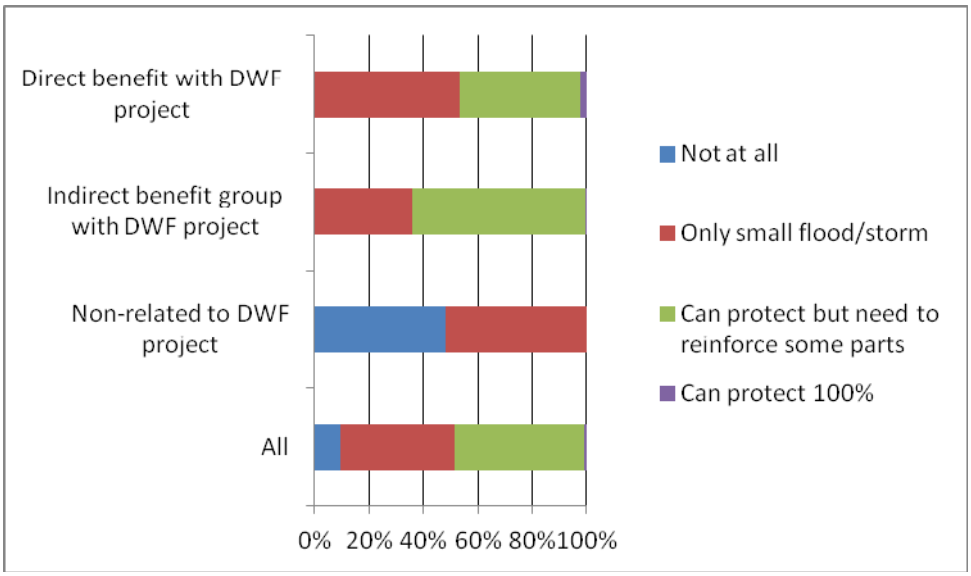
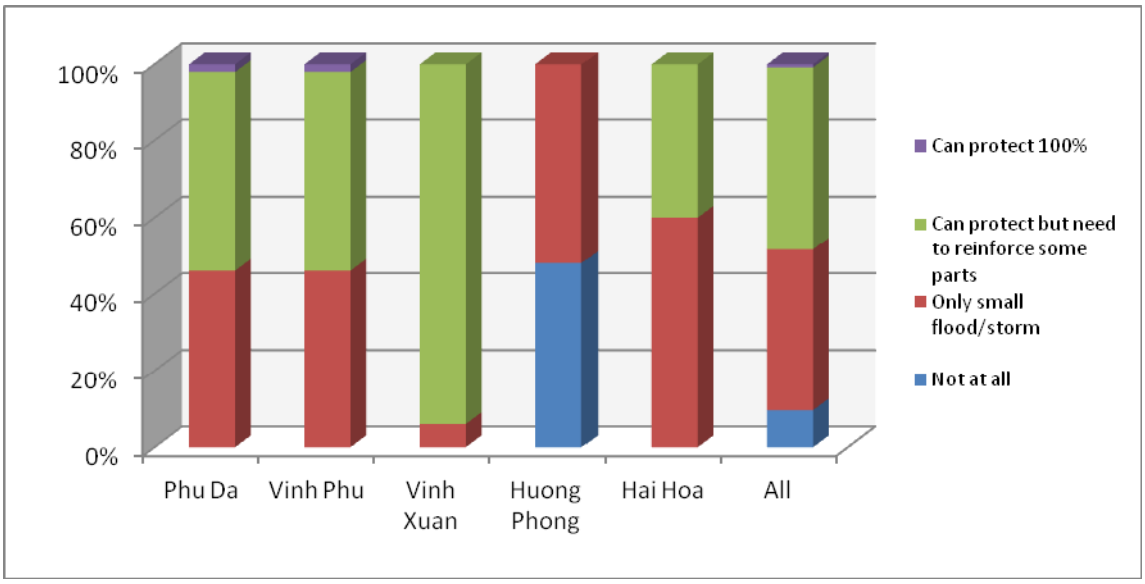


Figure 14 shows that the perception of the capacity of their houses to resist medium hazard events as viewed by direct beneficiary families is quite high (over 50%,) but they think that yet more can be done to improve the house's potential resistance. At the other end of the scale, for non project related families, they consider the potential resistance of their homes to hazards to be low and that there is very little that can be done about it. For both direct and indirect beneficiary families, there is a much stronger perception that one can take action to protect against medium scale hazards and this correlates to better awareness of potential for prevention and the example of this being done in the concerned communes. 44 % of current houses of DWF direct beneficiary

groups are able to protect their family but still need reinforcement, while 48.3% of indirect groups stated the same thing. This finding is consistent with results of FGDs at commune level as local government also dealt with difficulties in finding safer shelters in order to evacuate households in flood-prone areas of communes in the case of extreme events. It also means that in DWF project areas there is high demand for reinforcing houses in order to enhance local resilience to typhoon and floods.

Figure 15 shows the current status of the house in Phu Da, Vinh Phu and Vinh Xuan, which is rated as safer in the face of events like the 1999 floods and 1985 extreme storm than that of Huong Phong commune and Hai Hoa commune. Up to 52% of respondents in Huong Phong and 60% in Hai Hoa commune confirmed that their current house could protect their family against low magnitude flood and storm. None of families in (non project) Huong Phong confirmed their current house can protect 100% and they all need to reinforce some parts against extreme floods/storm. This is important evidence to evaluate the performance of the DWF project and its impact on local house construction, and one concludes that the protection capacity has increased in proportion to the length of time of DWF work, from Huong Phong, Hai Hoa, Vinh Phu, Vinh Xuan and Phu Da.

Figure 15: Local rating of the current status of the house and its capacity to protect the family if 1999 floods and 1985 storms occur again

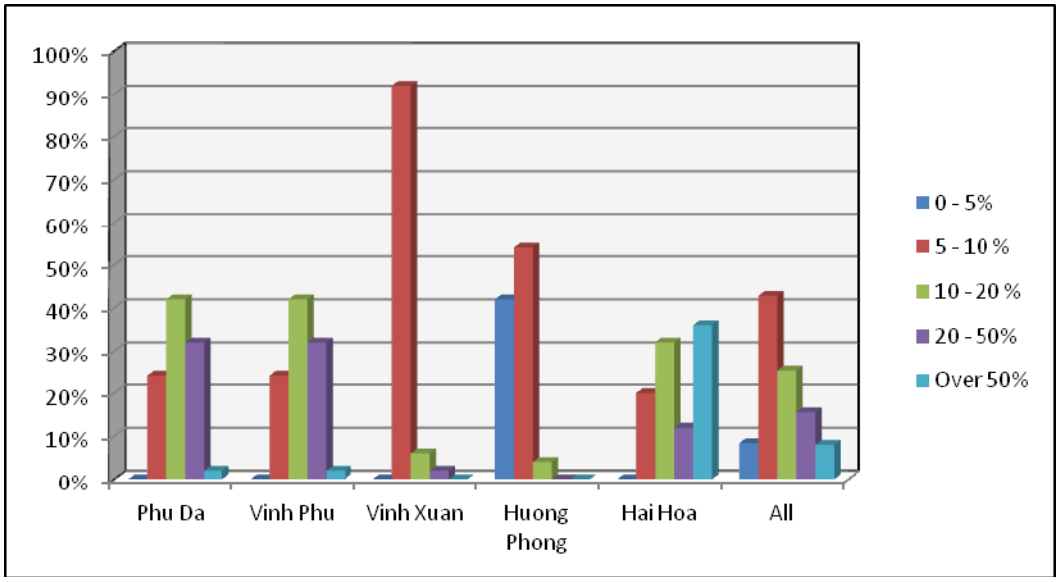


In terms of local adaptation to floods and storm, local communities have made great efforts to adopt various coping measures in order to prevent and mitigate the impacts of typhoon and floods. The most common adaptation measures are structural solutions such as reinforcing/repairing houses, building stronger houses and reinforcing animal breeding facilities. The impact of DWF 10 principles of typhoon resistant construction work was found in this study area. Over 95% of DWF direct beneficiary confirmed that they will reinforce/repair their house to deal with typhoon and flood in the future, compared with 82% of DWF indirect beneficiary group. Building a stronger house is also an effective measure with 44% of direct beneficiary group in comparing with 29% - 16% of indirect ones (see Table 12). The direct beneficiary groups tend to adopt coping options based on knowledge and skill related to DWF project's training courses.

Table 12: Local capacity to protect the family from the impact of typhoons and floods in the future

Adaptation measures	Direct benefit with DWF project		Indirect benefit group with DWF project		Not related to DWF project	
	No	Yes	No	Yes	No	Yes
Heighten their flood bed	70%	30%	88%	12%	54%	46%
Reinforce, repair house	5%	95%	18%	82%	22%	78%
Build stronger house	56%	44%	71%	29%	84%	16%
Build two storeys	98%	2%	99%	1%	100%	0%
Making temporary loft	93%	7%	82%	18%	96%	4%
Buy small boats	100%	0%	100%	0%	68%	32%
Use rice seed that can avoid the impact of floods as much as possible	65%	35%	76%	24%	46%	54%
Sell animal (pig, chicken) before the disasters season	21%	79%	18%	82%	16%	84%
Harvest the aquaculture product before flood season	67%	33%	87%	13%	84%	16%
Diversify the sources of income	65%	35%	90%	10%	72%	28%
Reinforcing animal facilities	58%	42%	75%	25%	60%	40%

Figure 16: What percentage of your yearly income would you be willing to sacrifice for complete mitigation of disaster impacts?



Households were willing to pay for solutions enabling them to mitigate against the impacts of future typhoon and floods. The common value is among 10-20 % of household income per year. Many of them are willing to pay up to 50% of their income. As shown in Figure 16, there is a slight difference in local willingness to sacrifice for complete elimination of all threats to their house between surveyed households in target communes according to the length of time of DWF work. For example, households living in Phu Da commune and Vinh Phu (a better off commune) are willing to sacrifice more of their income in order to completely protect their house from the impacts of floods and storm than in Vinh Xuan, Huong Phong commune where DWF input was shorter. 32% of respondents stated that they are willing to contribute 20 – 50% of their annual income in comparison with about 2% in Vinh Xuan and 4 % in Huong Phong commune where DWF had been less or not present (see figure 16).

This is important information for local government agencies and non-government organizations in designing projects to support local communities to reinforce/build typhoon resistant houses. This is also evidence of participatory contribution for development projects in order to increase the budget and effectives of project activities.

5.2. Impacts of DWF 10 principles of typhoon resistant construction work

5.2.1. Knowledge and other supports

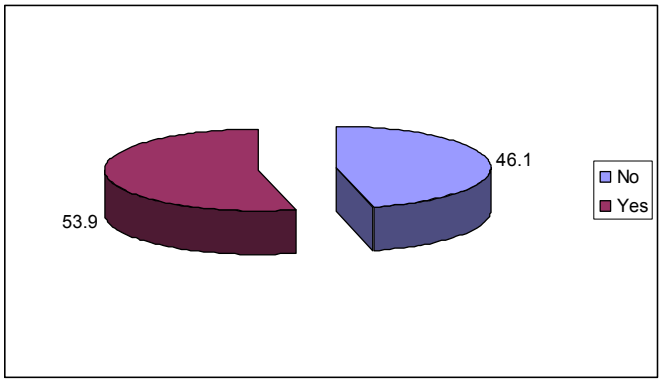
Many government organizations and non-government organizations have delivered various types of training courses in communities with the purpose of enhancing local capacity on various subjects including adaptation to climate change, adaptation to disasters, microfinance, supply chain and local markets, public health, etc. The impacts of these training courses are still open for evaluation, however many of them were *locally* evaluated as being of limited success (DWF-FGDs, 2010).

The DWF project conducted training courses for local government staff, local builders, local teachers and local people in order to provide them with knowledge and experiences in typhoon resistant construction work, gained from working on the themes of typhoons and flood impact mitigation.

The study found that 54.8% of respondents confirmed that they received training about disaster preparedness in the last 10 years, whilst the remainder had not had any training in this subject. Of the training provided by Non-Government Organization in the area, DWF training related to safer shelter accounted for 42% of total training courses. Red Cross, Netherland Organizations and government agencies are among other actors involved in disaster preparedness training courses but not focussed on shelter. Out of all the training (see fig 18 on training provided by various NGO/services, where 54.8% found training useful), 76% were satisfied with the usefulness of training on "Building and Reinforcing Houses" (DWF); inversely, training on the 'five on the spot' (by government services) for example, was only considered useful by about 16%. The trainings provided on Agriculture, Health and Environment were provided mainly by other NGO and by DWf on animal raising (agriculture).

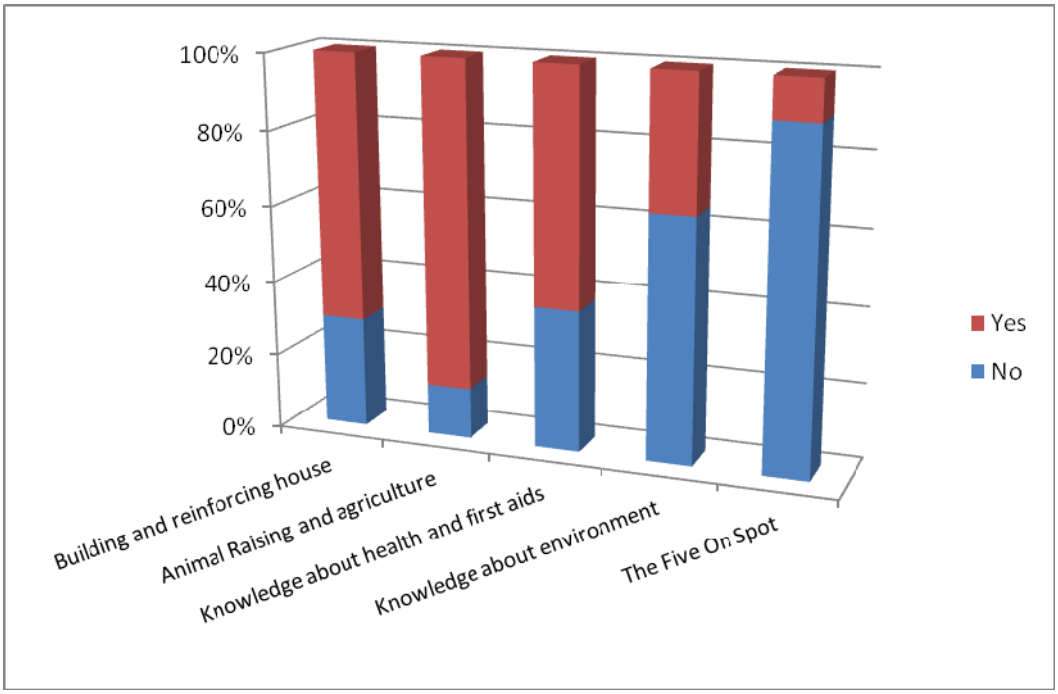
Figure 17 shows that 53.9% of households confirmed that knowledge about safer shelter learnt in training courses is useful for their disaster preparedness in recent years. Many local government staff and head of households participating in this study confirmed that knowledge and skill provided in DWF training courses are based on reality and useful for their disaster preparedness. Many local teachers involved in training courses confirmed its usefulness for them in preparing lectures for pupils and conducting extra activities for pupils in the context of a lack of documents and tools.

Figure 17: Participants' rating of the usefulness of knowledge learnt on training courses delivered by DWF project or others



Respondents were asked to list three useful specific areas of knowledge for them in disaster preparedness. 70.6% listed knowledge and skills on reinforcing house, 86.5% knowledge about livestock raising and cropping, and they also rated knowledge and skills about health care and first aids for victims during the disaster season (see Figure 18).

Figure 18: Listing three useful specific points of knowledge for participants [Tapez une citation prise dans le document ou la synthèse d'un passage intéressant. Vous pouvez placer la zone de texte n'importe où dans le document. Utilisez l'onglet Outils de zone de texte pour modifier la mise en forme de la zone de texte de la citation.]



Five on the spot : a Vietnamese policy to prepare for disasters includes : leadership available, human resources available, logistics organised, equipment available and in Hué, coordination (five on the spot)

The DWF project provided both direct beneficiary groups and indirect beneficiaries with many forms of support in order to reduce local vulnerability to floods and typhoon. As shown in Table 13, 98% of participants received knowledge and skills in construction/reinforcement of the house to reduce vulnerability to floods and typhoons from training courses delivered by the DWF project. 84% of direct beneficiary groups received financial support and construction materials in order to reduce their vulnerability to floods and typhoons. About 72% of DWF direct beneficiary received technical support to construct/strengthen their house from the DWF project.

DWF has played a very important role in supporting local communities in the study area with technical and materials support (see Table 13).

Table 13: Supports to reduce local vulnerability to floods and typhoons in study areas

	Direct benefit with DWF project		**Indirect benefit with DWF project**		**Not related to DWF**	
Supports	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Knowledge and skill in construction/reinforcement of the house from training workshop	2%	98%	73%	27%	100%	0%
Financial supports for constructing/strengthening house	16%	84%	97%	3%	100%	0%
Technical support	28%	72%	84%	16%	100%	0%
Construction materials	16%	84%	97%	3%	100%	0%
Other supports for production like rice seed, fertilizer, etc...	91%	9%	66%	34%	56%	44%

DWF beneficiary groups confirmed that knowledge and skills in construction/reinforcement of the house to reduce vulnerability to floods and typhoons, construction materials and financial support made the biggest difference in responses to flood and storms. This finding is confirmed by key informant interviews and focus group discussion. At provincial level, all key informants confirmed the usefulness and effectiveness of the DWF 10 typhoon resistant construction principles for local communities (both for households and public buildings) to protect themselves from the impact of typhoons. As one staff member working for provincial department of construction (interviewed in June 2010) stated:

> *"…indeed, some typhoon resistant construction techniques have been used for some public building/local houses construction before DWF, but we should confirm that DWF project has provided us with a systematic knowledge about typhoon resistant construction. These techniques are very useful for us. As you know after 2006 Xangsane typhoon, we issued the Decision of Public Building Construction with a requirement for the application of the DWF 10 principles. For my own opinion, almost all principles of DWF project are useful and widely applied in typhoon resistant impact mitigation such as Avoid wide roof overhangs; Build the house with reinforced roof structure; Reinforce the column and rafter connection; Use cross bracing in the roof to stiffen the entire roof structure; Use U shaped brackets and L shaped steel bar to connect iron sheets to purlins. However, I think there are still some principles which have not been applied largely, specifically since we could not choose another location for building, nor for planting trees around the houses, while in some cases people had to cut the branches of trees around the house before typhoon…"*

The FGD participants in Phu Da confirmed the usefulness of knowledge and skills delivered by DWF training courses in typhoon resistant construction. All participants fully understood the DWF 10 typhoon resistant techniques and confirmed that local government staff, local builders and direct beneficiary households are able to apply DWF 10 principles if they build/reinforce their house or consult for their neighbours. However, participants in focus group discussion and key informant interviews from Huong Phong and Hai Hoa have not much awareness about typhoon resistant construction knowledge. In Huong Phong commune where DWF had not done any training, one commune staff who was requested to mention some typhoon resistant construction techniques (FGD in June 2010 in Huong Phong) reported, not very realistically, that:

> *"…I do not know much about that, but I think we should build house with RC. Roof structure, reinforce column and wall, using cross bracing for house roof… I think this is very common knowledge to local communities as we have long experience in dealing with flood and typhoon…"*

In conclusion, in general the knowledge and skill in typhoon resistant construction delivered by the DWF project are perceived as useful and effective for local people to protect themselves from the impacts of floods and storm. Local people living in communes benefitting from the long-term input of DWF are much better aware of typhoon resistant construction techniques than those living in communes with short-term or without the work of the DWF project. In other words, the DWF project has created social impacts in terms of local awareness about typhoon resistant construction techniques.

5.2.2. Performance of DWF 10 typhoon resistant house construction principles

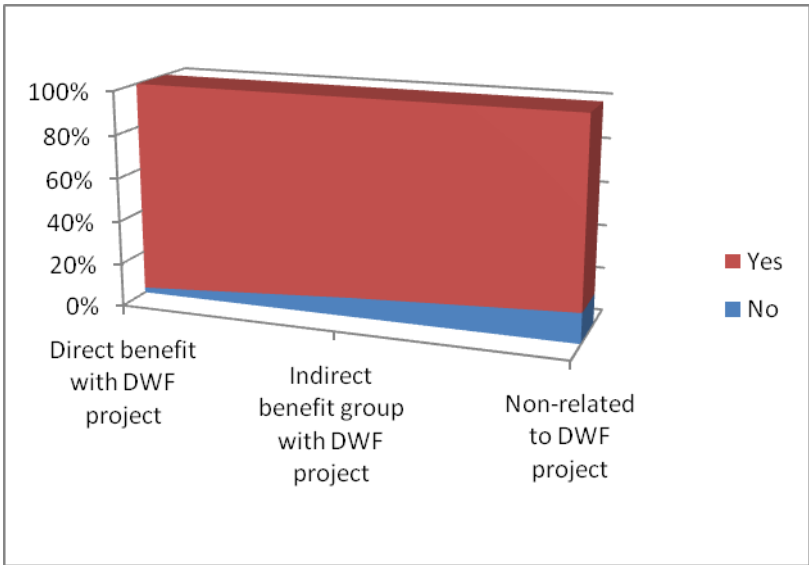
In order to evaluate the performance of DWF 10 key principles of typhoon resistant construction, two points need to be highlighted:

- To evaluate the diffusion of the principles of cyclone resistant techniques, the survey did not ask households about the application of each specific principle itself, but asked about the application of techniques which are directly related to the interpretation of the key principles.
- That DWF conducted training courses on knowledge and skill and provided financial and construction material support over a long period in Phu Da, briefly in Vinh Xuan and Vinh Phu, Hai Hoa and not at all in Huong Phong commune.

The study found that a large proportion of DWF direct beneficiary groups (98% of total households of this group) and DWF indirect beneficiary groups (91%) confirmed that they had adopted some typhoon resistant principles when they built or reinforced their households in the last 10 years. As well, in terms of public building construction, after 2006 Xangsane typhoon the Provincial Department of Construction issued a "Decision on Public Building Construction with requirement for the application of the 10 Typhoon Resistant Principles". Many of the DWF principles have been confirmed as useful, effective and have a wide adoption in society as whole. This is an important indicator to evaluate the impacts of this project in terms of technical impacts. This is also significant to conclude that the DWF project has created a strong impact on local people to adopt typhoon resistant principles in order to build or reinforce houses in the context of climate change. This result is completely consistent with what was found and discussed in the context of local housing conditions. For direct beneficiary groups, the project delivered financial support (since 2008 through loans), technical supervision and advice on safe construction techniques, with a commitment by the beneficiary families for the complete adoption of DWF typhoon resistant principles. Thus, that many beneficiaries adopted these DWF principles in construction and reinforcing their households is understandable.

However, for DWF indirect beneficiaries who might have participated in training courses delivered by DWF or are living in DWF project areas, the ratio of households of this group adopting these principles is still higher. This result is explained by the effectiveness of principles in mitigating the impact of typhoon, and the role of local builders, government staff or their neighbours.

Figure 19: Local house construction/reinforcement in last 10 years



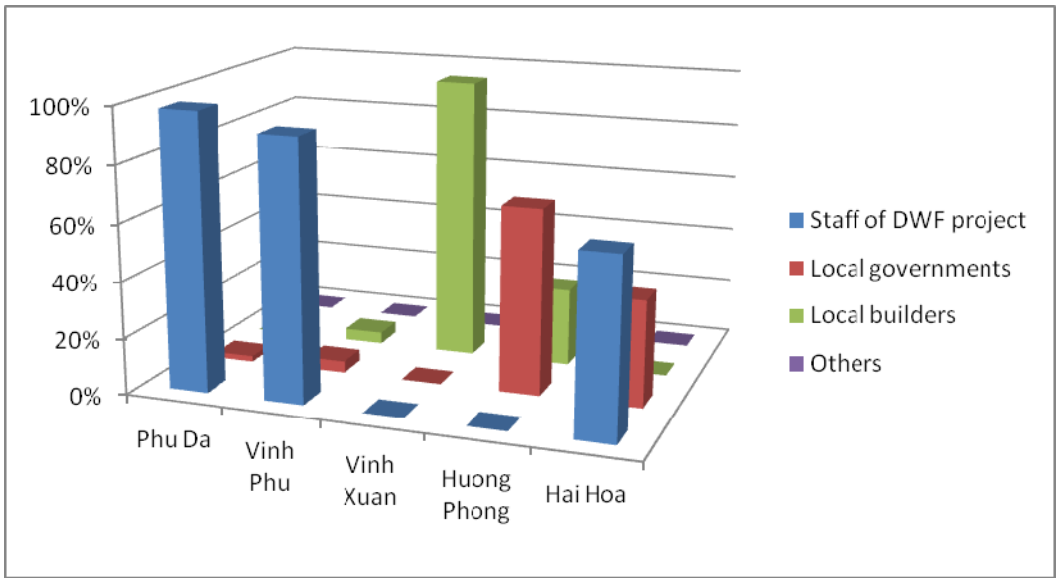


Figure 20 : Origin of techniques used by households

As one of local builder (interviewed in Vinh Phu in May 2010) stated:

> *"…When we build or reinforce houses for local communities in this commune or even neighbouring ones, heads of households often ask us about how to reinforce their house when we build an important part of house such as foundation, door, windows, wall and roof structure. What DWF training gave us is now very common. Living in typhoon prone communes, local people are aware of this, they always try to strengthen their house as much as possible in their condition. Some head of households ask us to do it because they saw their neighbour did,…"*

One local interviewee (interviewed in Huong Phong commune in May 2010) reported that:

> *"…living in a flood and storm prone area, local people have experiences in reinforcing houses to resist to typhoon and floods such as using stronger materials, building house with steel, raised foundations building mezzanine, reinforcing concrete in two sides and on top of the roof,… they sound like what you just mentioned from DWF project. Some of them adopted it even though they did not attend training courses. However, it is important to recognize local builders of the commune or from neighbouring ones; they have intensive experiences in this issue and always advise households with good options…"*

The Chairman of Phu Da commune (FGD in June 2010 in Phu Da commune) confirmed that:

> *"…Our commune has been supported by DWF project since 2000 with many actions, our staff were given opportunities to attend training course on typhoon resistant construction techniques, local people and local builders were also selected for participation in DWF training courses. We now well understand about these techniques. There are 168 direct beneficiary households of DWF project and 57 households were selected to take a loan from DWF/Ford Foundation in order to build/reinforce their house. I am sure that local builders in Phu Da are able to manage DWF 10 principles very well…"*

These statements indicate the reasons why many DWF typhoon resistant construction principles have been adopted widely. However, it does not mean all of the DWF principles have been

working well at household level though they are locally evaluated as very effective measures to typhoon. A detailed evaluation of the effectiveness of each principle will provide the project with useful information and an overview of the performance of DWF principles in reality.

Table 14 shows that among these techniques, the following -

- Build a new house with a simple shape to avoid impact of typhoons;
- Planting trees around the house as wind breaks and to reduce the flow of water;
- Use doors and windows that can be securely closed;
- Avoid wide roof overhangs; separate the veranda structure from the house;
- Reinforce the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters)

- are the most commonly applied in the study area with percentages of direct beneficiaries doing this of 100%, 98%, 91%, 89% and 78% respectively. There are some DWF technical principles which, translated into practical action, are very effective measures to prevent and mitigate the impacts of typhoon but not widely adopted due to many reasons (see below "barriers to adopting DWF principles").

Table 14: Local adoption of DWF typhoon resistant construction techniques when households conducted house construction and reinforcement

	Direct benefit with DWF project		Indirect benefit group with DWF project	
	No	**Yes**	**No**	**Yes**
1. Select another location to avoid the full force of the wind or floods (typhoon/floods)	28%	72%	19%	81%
2. Build a new house with a simple shape to avoid impacts of typhoon	0%	100%	48%	52%
3. Avoid wide roof overhangs, separate the veranda structure from the house	12%	88%	60%	40%
4. Use doors and windows that can be securely closed	9%	91%	36%	64%
5. Build/reinforce the house with RC roof structure	77%	23%	85%	15%
6. Reinforce the column and rafter connection	23%	77%	61%	39%
7. Use cross bracing in the roof to stiffen the entire roof structure	44%	56%	77%	23%
8. The purlin and gable end connection through embedded steel plate in the gable	7%	93%	61%	39%
9. Use U shape steel plate for purlin and common rafter connection	19%	81%	76%	24%
10. Anchoring of roof tiles in RC retaining beams	19%	81%	75%	25%
11. Use U shape bolts and V shape steel bar to connect iron sheets to purlins	37%	63%	76%	24%
12. Plant trees around the house as wind breaks and to reduce the flood of water (typhoon/floods)	2%	98%	12%	88%

There is a clear difference in the adoption of DWF principles between direct beneficiaries and indirect ones. Compared to direct beneficiaries, indirect beneficiaries tend to adopt the typhoon resistant techniques less in many cases. For example, 93% of direct beneficiaries adopted the purlin and gable end connection through embedded steel plate in the gable while only 39% of indirect beneficiaries did it. 100% of direct beneficiaries build a new house with a simple shape to avoid impacts of typhoon compared with only just over 50% of indirect beneficiaries.

Table 15: Local adoption of DWF typhoon resistant construction techniques between target communes of DWF project

DWF typhoon resistant techniques		Phu Da	Vinh Phu	Vinh Xuan	Huong Phong	Hai Hoa
DWF input		***Long term***	***Medium term***	***Short term***	***None***	***Short term***
Selection another location to avoid the full force of the wind or floods (typhoon/floods)	No	20%	10%	4%	100%	55%
	Yes	80%	90%	96%	0%	45%
Build a new house with a simple shape to avoid impacts of typhoon	No	0%	0%	98%	100%	0%
	Yes	100%	100%	2%	0%	100%
Avoid wide roof overhangs, separate the veranda structure from the house	No	6%	0%	100%	100%	55%
	Yes	94%	100%	0%	0%	45%
Use doors and windows that can be securely closed	No	6%	2%	4%	100%	55%
	Yes	94%	98%	96%	0%	45%
Build/reinforce the house with RC roof structure	No	96%	57%	100%	100%	64%
	Yes	4%	43%	0%	0%	36%
Reinforce the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters)	No	18%	2%	100%	100%	55%
	Yes	82%	98%	0%	0%	45%
Use cross bracing in the roof to stiffen the entire roof structure	No	96%	4%	100%	100%	55%
	Yes	4%	96%	0%	0%	45%
The purlin and gable end connection through embedded steel plate in the gable	No	4%	2%	100%	100%	55%
	Yes	96%	98%	0%	0%	45%
Use U shape steel plate for purlin and common rafter connection	No	73%	0%	100%	100%	55%
	Yes	27%	100%	0%	0%	45%
Anchoring of roof tiles in RC. Strap beams	No	71%	0%	100%	100%	55%
	Yes	29%	100%	0%	0%	45%
Use U shape bolts and V shape steel bar to connect iron sheets to purlins	No	90%	0%	100%	100%	55%
	Yes	10%	100%	0%	0%	45%
Plant trees around the house as wind breaks and to reduce the flood of water (typhoon/floods)	No	0%	0%	0%	47%	10%
	Yes	100%	100%	100%	53%	90%

There is a significant difference in the adoption of DWF typhoon resistant construction techniques according to locations with long-term, medium term, short-term and no input from the DWF project.

As shown in Table 15, surveyed households living in Phu Da (long-term work of DWF) tend to adopt DWF principles more widely than households in communes with short-term DWF work. Direct beneficiary households and local builders at Vinh Xuan, Vinh Phu and Phu Da confirmed that the following are widely adopted by local communities, as well as other techniques such as 'Building/reinforcing the house with RC roof structure' (not specifically proposed by DWF, but currently used due to the high cost of wood) and 'Using cross bracing in the roof to stiffen the entire roof structure').

- Build a house with a simple shape to reduce the wind effect of a typhoon;
- Plant trees around the house as wind breaks and to reduce the flow of water;

- Use doors and windows that can be securely closed;
- Avoid wide roof overhangs; separate the veranda structure from the house;
- Reinforce the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters)

Local respondents were asked to rate the effectiveness of typhoon resistant techniques which are a transcription of DWF typhoon resistant principles into the reality of construction in Thua Thien - Hue. As shown in Table 16, in general all DWF principles were locally evaluated with relatively high effective measures in mitigating the impacts of typhoons.

The technical interpretation of the DWF typhoon resistant principles (table 16), shows that techniques 4 to 11 are highly appreciated with over 60% of respondents confirming them. There are practical reasons why finding a safer location cannot be applied in many cases.

Table 16: Local rating of the effectiveness of typhoon resistant techniques adopted if households conduct house construction and reinforcement (%)

Techniques	Not effective at all	Less effective	Moderate effective	Relatively effective	Very effective
1.Choose another location to avoid the full force of the wind or flood (typhoon and flood)	34.9	0.4	0.0	47.2	17.4
2.Build a new house with a simple shape to avoid impacts of typhoon	36.6	5.5	35.7	35.7	22.1
3.Avoid wide roof overhangs; separate the veranda structure from the house	37.0	2.1	12.8	29.8	18.3
4.Use doors and windows that can be securely closed	15.7	15.7	0.0	18.7	49.8
5.Build/reinforce the house with RC roof structure (beams)	0.9	6.8	3.4	13.6	75.3
6.Reinforce the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters)	21.3	4.7	8.5	14.9	50.6
7.Use cross bracing in the roof to stiffen the entire roof structure	3.4	7.2	8.1	14.5	66.8
8.The purlin and gable end connection through embedded steel plate in the gable	8.7	9.8	5.5	18.3	57.7
9. Use U shape steel plate for purlin and common rafter connection	5.1	7.2	7.2	17.0	63.4
10. Anchoring of roof tiles in R.C. strap beams	5.5	6.0	8.1	18.3	62.1
11. Use U shaped brackets and L shaped steel bar to connect iron sheets to purlins	2.6	4.3	9.4	16.6	67.2
12. Plant trees around the house as wind breaks and to reduce the flow of water (typhoon and flood).	30.7	6.1	12.8	19.0	31.3

The case study of Mr. Le Thoai (Vinh Xuan) confirmed the effectiveness of DWF typhoon resistant techniques and impacts of this project on local communities in the study area.

> *He is a poor householder living in Vinh Xuan, his children have grown up, some get married and separate from him, two sons have gone to Binh Duong for work. In 2002, he was selected as a direct beneficiary of the DWF project. He was supported to rebuild a new house. DWF project support him with cement, doors and other construction materials and techniques. His house applied all the DWF 10 typhoon resistance principles.*
> *"Since 2002 there has been no damage to my house even in 2006 Xangsane, 2009 Ketsana and in whirlwinds. There is only one small thing is the door used in my house is not securely closed. I strongly recommend that other people should adopt these principles".*
> *(DWF-Impact survey Case study in 2010)*

The findings of the survey confirmed (a) the effectiveness of DWF typhoon resistant construction techniques in households surveyed, and (b) that most of houses collapsed and damaged in these communes are those that were still temporary and semi-permanent houses.

Appendix 8 shows of the total number of house damaged and collapsed in the past 25 years: overall, 43% are temporary houses and 57% semi-permanent, but within this average 100% of houses collapsed and damaged due to typhoon and floods in Vinh Xuan commune were temporary houses that did not apply typhoon resistant principles.

The result of FGD highlighted that in recent years, the number of houses only partly / little damaged – when compared to others - are those households who followed the DWF typhoon resistant construction principles. The rest of households with house damaged and collapsed are non-beneficiary households in beneficiary communes. Overall, it remains that not all households are interested in prevention and that many of them are poor households who could not afford to reinforce their houses.

The result of FGD in Phu Da, Vinh Xuan and Vinh Phu confirmed that there was much less damage to houses of DWF direct benefit households, even in the 2006 Xangsane typhoon. The conclusion is that the DWF project has had positive impacts on local communities, particularly to enhance local resilience to typhoon.

In evaluating the effectiveness of DWF typhoon resistant construction principles, many of the participants in FGD took the whirlwind that hit Phu Da at 12:00 pm in August 2008 as a typical example: 18 households suffered damage to the roof of the house, and the kindergarten overhanging roof was blown away. Only the building with a roof reinforced by adoption of the use bracing to stiffen the entire roof structure (i.e. *con luon* in Vietnamese) was undamaged. The effective of DWF typhoon resistant construction principles were also confirmed by participants from Vinh Phu Primary School, as the director reported (FGD in June 2010, in Vinh Phu commune):

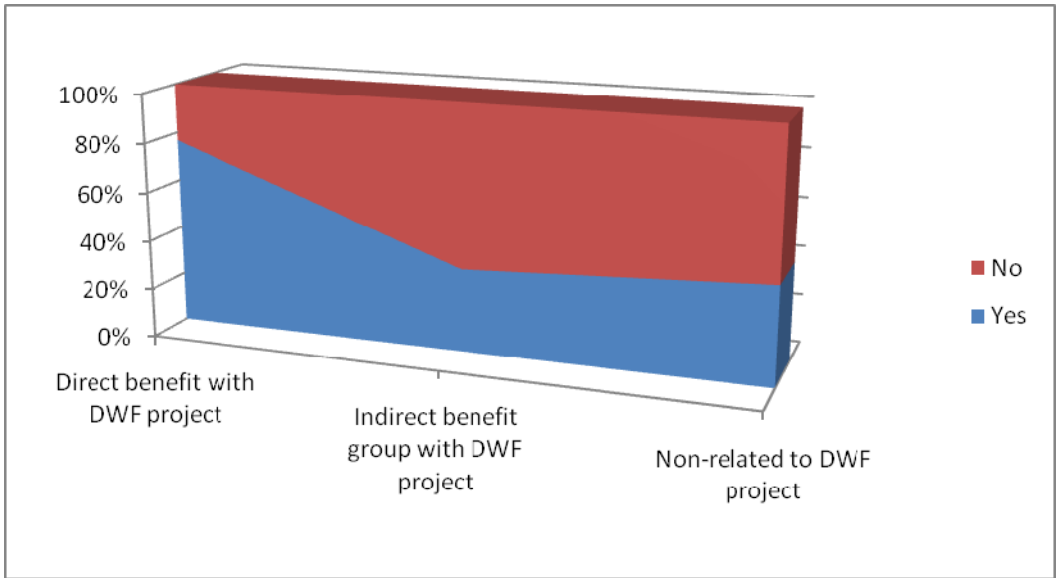
> *"…the DWF project support us with reinforcing roofs on two class rooms and invited us to observe reinforcing techniques. We have 4 class rooms which were built many years ago, due to a lack of budget, we could not reinforce them. The Ketsana typhoon in 2009 blew many tiles off the roof of these rooms while there is no damage to two class rooms that were reinforced by DWF project…"*

We conclude that, in general, DWF typhoon resistant construction principles have worked well to mitigate the damage to public buildings and local houses. The DWF project has strong impacts on local communities in adoption of typhoon resistant principles. Despite a significant difference in awareness of these principles between local stakeholders in the commune with long-term work, and short-term or without work of the DWF project, almost all of these DWF principles have been adopted widely and have proved successful in protecting local communities from the impact of typhoons.

5.2.3. Planning for adaptation to typhoon

The level of satisfaction with housing conditions is linked to the capacity of the families and their awareness of prevention.

Figure 21: Satisfaction of housing conditions



For those "unsatisfied with their house", their plans are shown in Figure 22:

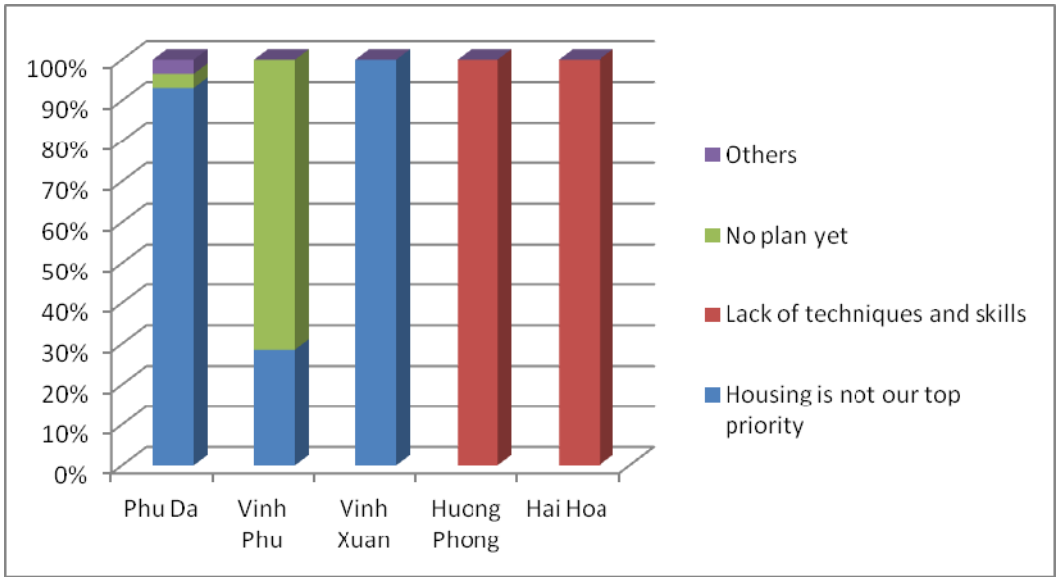


Figure 22: Immediate family plan for unsatisfied families

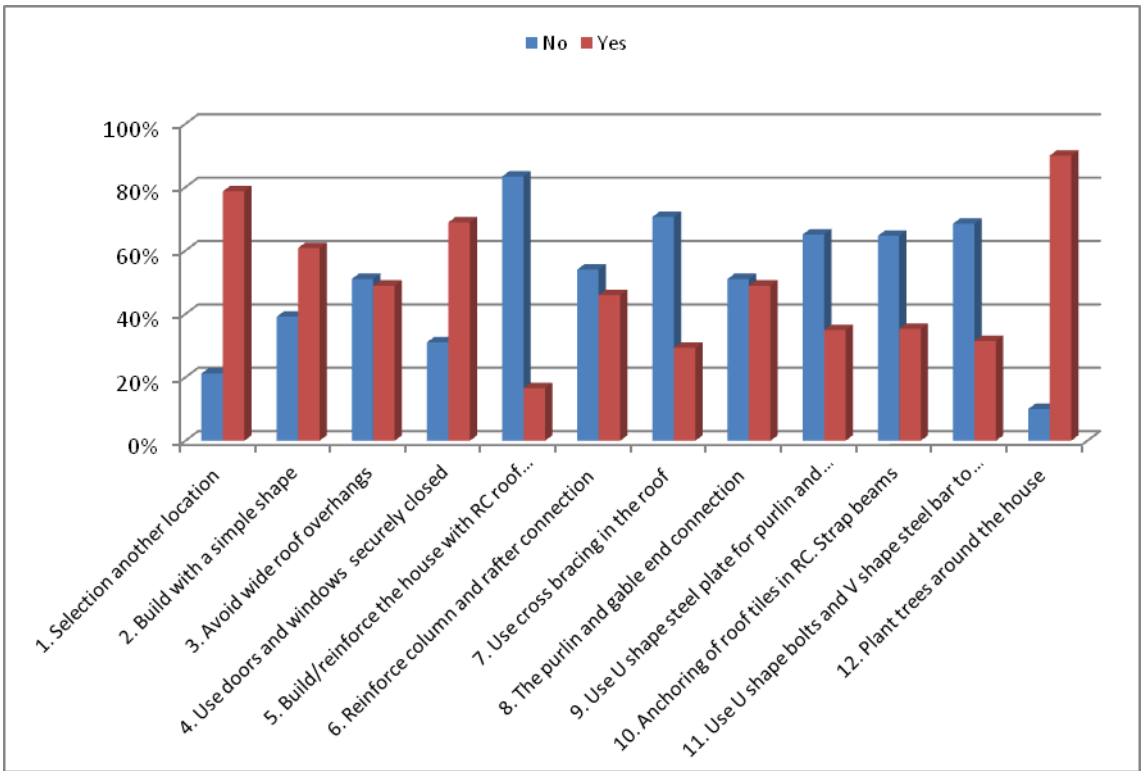
Amongst families whose house has not been strengthened, 70% confirmed their plans for building new houses or reinforcing current houses in the future. 24% of respondents confirmed that they will change their livelihood strategies such as changing cropping calendar and patterns, and the young workers in households will migrate to seek jobs in big cities.

Over 70 % of respondents confirmed they have a plan for building new houses or reinforcing their current house and the study investigated the possibility of their adopting DWF typhoon resistant principles in their future plans. As shown in Table 18, a large proportion of respondents confirmed that they are going to adopt DWF typhoon resistant techniques in their new building or in reinforcing their houses in the future. The study found that common techniques being adopted are similar to what they had done from 2000 to 2009. Some typhoon resistant techniques are locally assessed as very effective measures, but still some popular ideas such as “Build the house

with RC roof frame structure (not specifically proposed by DWF); and "Use bracing in the roof to stiffen the entire roof structure" are desired but difficult to achieve because they are too expensive to adopt in the context of poor households. Other reasons put forward for not adopting a safety practice are:

- not attractive on or in the house;
- 'other people don't do this'.

Figure 23: Building a new house or reinforce current house and adoption of DWF principle to reduce the impacts of flood/typhoons to your house in the future



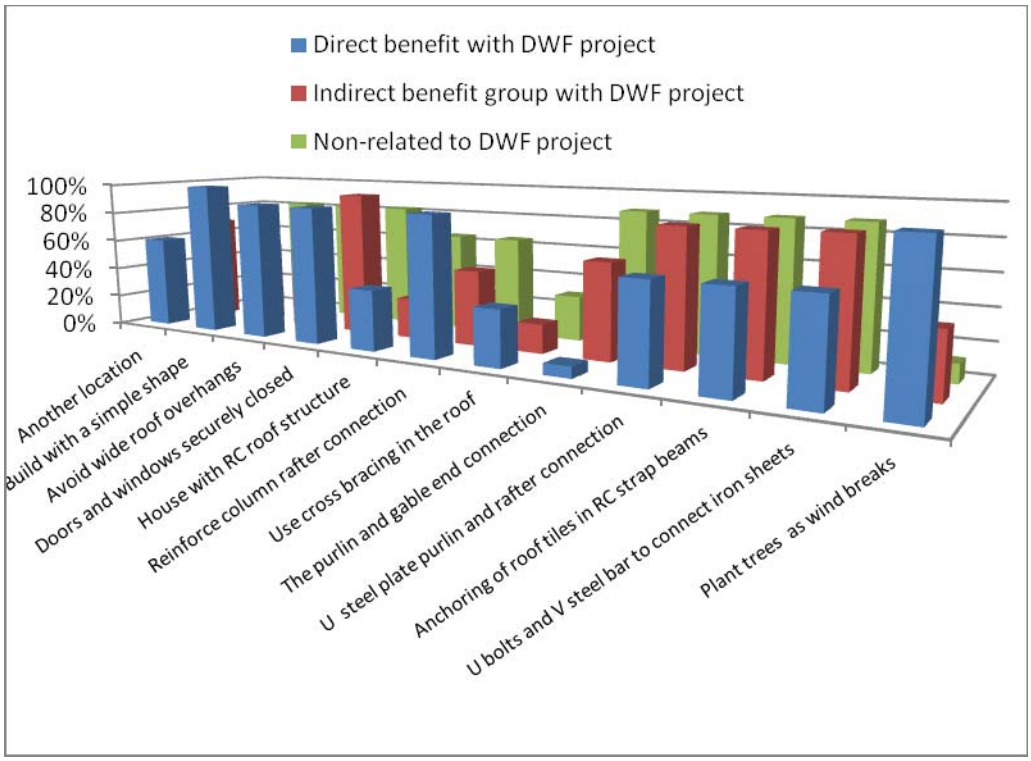


Table 17 : Future construction with DWF key techniques

		Phu Da	Vinh Phu	Vinh Xuan	Huong Phong	Hai Hoa
Typhoon resistant techniques						
Selection another location to avoid the full force of the wind or floods (typhoon/floods)	**No**	24%	26%	2%	88%	88%
	Yes	76%	74%	98%	12%	12%
Build a new house with a simple shape to avoid impacts of typhoon	**No**	2%	0%	100%	18%	18%
	Yes	98%	100%	0%	82%	82%
Avoid wide roof overhangs, separate the veranda structure from the house	**No**	12%	0%	100%	18%	18%
	Yes	88%	100%	0%	82%	82%
Use doors and windows that can be securely closed	**No**	6%	0%	2%	18%	18%
	Yes	94%	100%	98%	82%	82%
Build/reinforce the house with RC roof structure	**No**	98%	4%	100%	35%	35%
	Yes	2%	96%	0%	65%	65%
Reinforce the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters)	**No**	12%	4%	100%	35%	35%
	Yes	88%	96%	0%	65%	65%
Use bracing in the roof to stiffen the entire roof structure	**No**	98%	0%	100%	71%	71%
	Yes	2%	100%	0%	29%	29%
The purlin and gable end connection through embedded steel plate in the gable	**No**	98%	100%	0%	12%	12%
	Yes	2%	0%	100%	88%	88%
Use U shape steel plate for purlin and common rafter connection	**No**	6%	100%	0%	12%	12%
	Yes	94%	0%	100%	88%	88%
Anchoring of roof tiles in RC. restraining beams	**No**	6%	100%	0%	12%	12%
	Yes	94%	0%	100%	88%	88%
Use U shape bolts and V shape steel bar to connect iron sheets to purlins	**No**	4%	100%	0%	12%	12%
	Yes	96%	0%	100%	88%	88%
Plant trees around the house as wind breaks and to reduce the flood of water (typhoon/floods)	**No**	0%	0%	100%	88%	88%
	Yes	100%	100%	0%	12%	12%

Regarding the reasons for adopting these principles, 50% to 70% of local respondents confirmed that they adopt them because it is an effective way to reduce the impact of typhoons/floods. 5% to 10% respondents confirmed that they adopt these techniques because:

- it is a cheap option;
- adopted because of the recommendations of neighbours / builders;
- adopted because of the Government recommendations;
- adopted because it is a common method that everyone does.

The result of study also reveals that respondents (56% of total respondents) will interact with other DWF project members to exchange the knowledge and experience in order to protect their family from typhoon damage.

5.2.4. Barriers constraining the performance of DWF principles

Exploring the reasons to adopt or not adopt these DWF typhoon resistant techniques, there are many factors driving local decisions to adopt DWF typhoon resistance techniques:

1. Adopted because of the requirements of DWF projects
2. Adopted because it is an effective way to reduce the impact of disaster
3. Adopted because of the recommendations of neighbour/builders
4. Adopted because it is a common method that everyone do

Reasons for not adopting DWF principles:

1. Because it is not applicable
2. Wanted to adopt but do not have enough money
3. Wanted to adopt but do not know how to do it
4. Wanted to adopt but none did in my community

For example, 45% of respondents confirmed that they adopted "Choose another location to avoid the full force of the wind or typhoon and flood" because it is an effective way to reduce the disaster impact and 18.7% of respondents confirmed that this was because it is suggested by the DWF project. 11% of respondent confirmed their not adopting this because do not have enough money. A similar finding showed that local respondents (62%) could not adopt building/reinforcing the house with RC roof structure because they do not have money. Thus some of DWF typhoon resistance techniques are locally evaluated as very effective in preventing and mitigating the impacts of disaster, but local people could not adopt them as they are too expensive to operate in the local context. It also means that it there would be more impact if the project could go further in designing intervention options which carefully consider the local context.

There are four main reasons preventing DWF beneficiaries from adopting effective typhoon resistant techniques:

- not enough money,
- not attractive,
- not applicable,
- no one in their community did it.

In order to overcome possible barriers that limit the impacts of DWF project, the study conducted many FGD and KII at community level. By doing so, the study found that for example one of the DWF recommended techniques is to use bracing on the roof to stiffen the entire roof structure but in reality not many did it spontaneously due to several reasons. These can be summarized as follows:

- First adopting this measure will show many people in their communities that their house is a DWF project house, because using vertical bracing in the roof (*Con Luon* in Vietnamese) is one of the symbols of this project.

- Second, the roof of any house is socially perceived as a very important part of the house reflecting their livelihoods and their prosperity. Thus, if they agree to build a cross bracing in the roof this means there may be bad luck to their house.
- Third, it is important to note that most but not all households built houses that already mobilized all possible resources even taking loans. Using any costly measure will exceed their capacity.
- For poor households, the roof structure (i.e. purlin and gable) was constructed using temporary materials, but with bracing on the roof. These houses are more prone to disasters than those with no cross bracing. They also could not reuse tiles under bracing if they rebuild or reinforce their house again.
- Living in typhoon – prone disasters, local communities have intensive experience in coping with this event. Local people tend to use stronger materials and permanent structures for their houses such as more steel and cement. They adopted other DWF principles such as using U shape steel plate for purlin and common rafter connection; avoiding wide roof overhangs; separating the veranda structure from the house; reinforcing the column and rafter connection (anchor belts/still bars/bolts embedded in concrete columns to connect the rafters) in order to reinforce their houses.
- Local participants and provincial staff confirmed that the DWF technique of using U shaped brackets and L shaped steel bar to connect iron sheets to purlins is very effective to protect their house with iron sheet roof. However, some of them explained that over time the rust of these bolts and bars damages the iron sheets after 2 – 3 years. This issue can be overcome.
- Housing is not a top priority of poor households as the demands on their income for daily needs are too great.

Ms. Vo Thi Do in Vinh Xuan Communes

Ms. Do is widow in Vinh Xuan commune, she had three children who are all grown up and get married living around this commune. They are all very poor children, so they could not help their mom to reinforce house. DWF project selected her in order to support her to reinforce the roof of her house in 2002. The project reinforced the house with new roof with cross bracing on the roof. Many people there understood that this is DWF project's house. However, the project just supports her half of cost of reinforcing house. She had to spend a little saving and borrow from neighbours. Thus, she is not really happy with local opinion about her house.
In 2008, the Government Solidarity Program from Ho Chi Minh city supported her VND 20 millions to build new house. She decided not to put cross bracing on the roof any more in order to stay away from social bias though there is still "small" poster hang on the corner of new house.

There remain constraints on local communities as well as public authorities to adopt some of DWF principles such as a lack of budget, social bias and households' priorities.

5.3 Evolution of Construction methods in Thua Thien-Hue and central Viet Nam

5.3.1. Evolution of Construction methods in Thua Thien Hue

The impact of typhoon N° 6 Xangsane (Category 3-4) which hit central Viet Nam on the 1st October 2006 highlights two important points. On the one hand, the intense preparation effort over the preceding 2-3 days, leading to a massive displacement of vulnerable people (about 300 000) to safe area-buildings, so there were very few mortalities (about 60 victims).
On the other hand, damage and consequent economic loss were huge in Danang City, Thua Thien Hue and Quang Nam Provinces : 25 000 houses destroyed, 300 000 unroofed and damaged, with losses amounting to 650 Million $. In the communes of Thua Thien Hue, the losses for private long-term investment in fishery, aquaculture, and tree plantation were very high.

After the typhoon, the immediate response (repair infrastructure, food, water, medical care…) was excellent, but very little response for medium-long term has been proposed to families who have suffered as a result of the typhoon. In the area most affected in Thua Thien Hue (coastal communes of Phu Loc District) the damage to housing resulted mainly from the failure to respect the basic principles of cyclone resistant construction, and in many cases because poor quality roofing materials had been used. In the communes where DWF has been working, the houses, whether reinforced or new, built with DWF help that were visited after the cyclone have been safe, and constitute a very good example of what can and should be done.

On the 17th October 2006, the Thua Thien Hue Provincial People's Committee issued a recommendation to all Districts and Organization to apply the 10 principles of cyclone resistant construction techniques that have been introduced by the DWF project

5.3.2. Analysis from Department of Construction of Thua Thien Hue

The department of construction acknowledges that DWF's programs have contributed to changing their understanding about the role that families and communes can play in reducing vulnerability in general and in reducing the level of damage to their homes in particular.
The interviewees from the department of construction responded that the ten safe construction principles are applicable with local materials and local builders can apply them. Since the typhoon Xangsane in 2006, the department of construction has requested all design companies to apply techniques and principles drawn from DWF experiences when designing and building public building in the province, stating that DWF principles had to be applied to houses and public buildings to avoid further damage. Work continues to ensure that this recommendation is being implemented.

According to the view from the department of construction, the policy and strategy related to DRR has changed gradually as the frequency and intensity of natural disasters increases, with the techniques and the approach recommended by DWF being adopted.

Furthermore, safe house designs and training have been applied by other NGOs working in Viet Nam. The provincial Department of Construction has undertaken a project on safe housing to disseminate the DWF techniques and develop guidance to design and build a typhoon resistant houses and it has asked DWF to train its young professional staffs in safe construction methods.

5.3.3. Others provinces

The survey focused on Thua Thien Hue – where DWF project has been active in the last 10 years. But the principles, and techniques promoted can be seen now in many others part of the country. In 2010, DWF organised the construction of 650 "safe houses" for the Red Cross (IFRC / VNRC) in 7 Provinces, where the appropriate models are being disseminated more widely.

VI. CONCLUSION

The survey concludes that the DWF project has had important impacts on local communities in the project study area and to local society. With the participatory approach used, the project has capitalized participation of different stakeholders from provincial level to household level. By doing so, the project has involved different stakeholders in sharing relevant information in order to create transparency in all decision making. It helped to increase responsibility of all stakeholders from designing components, site and target selections and delivering components to beneficiaries.

Local livelihoods in the project area are very simple and vulnerable to typhoons. Local communities are largely dependent on local resources based practices. Annual disasters, particularly floods and typhoons cause tremendous damage to livelihood and property. Annual per capita income is about 550 US$, against which there are increasing living costs and production input costs. There are few households in the project area with any savings, and those that do have savings can just cover urgent needs. This is nevertheless a main reason driving local decisions to adopt the DWF strategy to build or reinforce houses so that they are safe. Doing so saves money.

The study identifies that despite changes in construction materials and house structure, with an increase in the permanence of the home, houses in the study area are still vulnerable to extreme typhoons. Only 2% of houses are two-storey houses, a large number of houses are one storey houses without an attic and these are the most common housing types in the commune selected for the study, particularly in Hai Hoa commune, Vinh Phu and Huong Phong.

However, there has been considerable difference in local awareness of the risk of typhoon and current status of their house. The awareness of local respondents about typhoon resistant house construction increased with the length of time of DWF project work. The current status of local houses (main roof material and structure, door and windows, support column, foundation and main wall materials) in Phu Da, Vinh Phu and Vinh Xuan is significantly stronger than that of Huong Phong (no project) and Hai Hoa.

In terms of typhoon resistant techniques, the conclusion is that the most successful outcome of this project is that DWF has created a strong impact on local communities in providing them with knowledge and skills for typhoon resistant solutions. Local communities in the study area are now well aware of the importance of DWF principles in re-building/reinforcing houses. These principles, in many instances, have been adopted widely in both target communes and public buildings because of their effectiveness to mitigate and prevent damage from typhoons. Local communities in many project areas are willing to adopt the DWF principles for their future safety.

There are many DWF principles adopted in reality showing its effectiveness in mitigating against the impact of typhoons. This means that most of DWF typhoon resistance construction principles are socially and officially appropriated. However, there are still some techniques, particularly building cross bracing on the roof (i.e. *Con Luon* in Vietnamese) which were locally assessed as very effective measures but less adopted in reality. The study concludes that there are still constraints preventing local communities in DWF project areas from adopting all the proposed measures for safety. A lack of money, social bias, not the top priority of households, weak roof structure, are among the common factors constraining their effectiveness. This also means that that there would be even more impact if the project designed new intervention options taking into account careful consideration of local context.

In terms of economics, whilst it is difficult to estimate the economic benefits of this project, the study concludes that it has brought major economic benefit to the beneficiaries. This is confirmed by the fact that there have been no direct beneficiaries whose houses have collapsed and been damaged due to floods and storm in last ten years. On the contrary, many other households with houses collapsed or damaged due to typhoon and floods have had to spend a large amount of

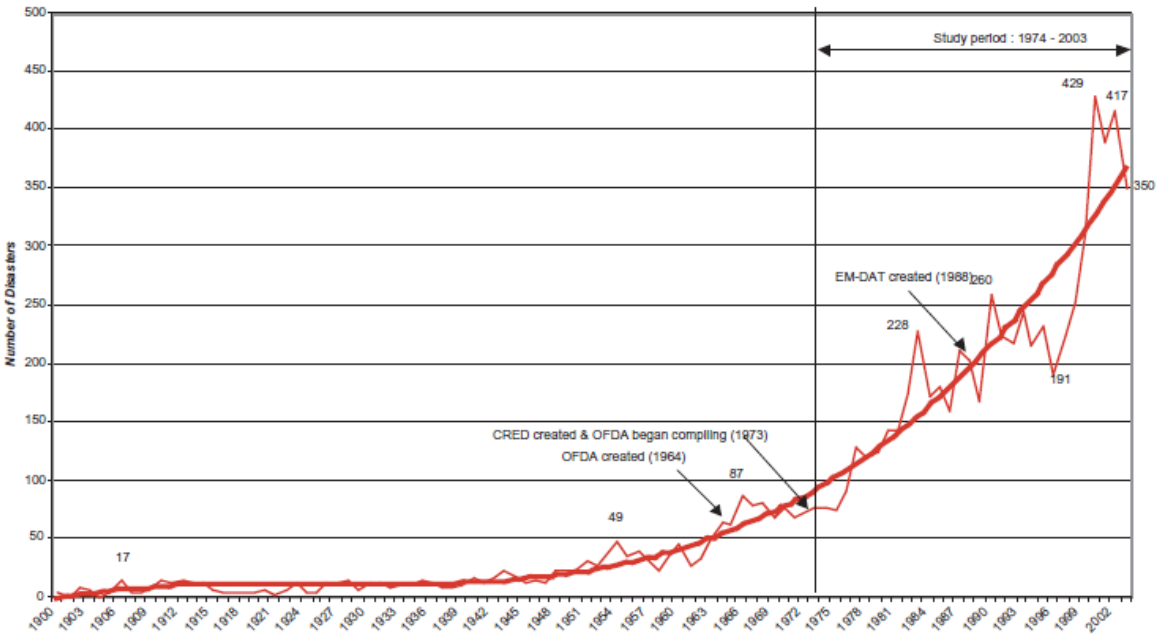
money building and repairing their homes. The indirect impact of this project is that for any local communities, direct beneficiaries with houses constructed/reinforced with an adoption of DWF principles will become a real demonstration in terms of resistance to typhoon for the whole community.

In terms of social aspects, DWF has created considerable changes in local awareness of the risk exposures and risk management for local communities in both households and amongst younger generations (i.e. pupils from primary and secondary school). The project has led changes in coping mechanisms against typhoons amongst local communities in the project area and to society as whole. DWF direct benefitted households, local builders, local governments, local teachers and pupils who will be pioneers/resource persons to widen the impacts of knowledge and skill in typhoon risk management. For instance, up to 98% and 91% of direct beneficiary households confirmed that construction material and knowledge and skill on reinforcing houses to resist typhoons learnt from the DWF project have made a big difference in their capacity to prepare for typhoons.

The study team recognizes that the local government staff and head of villages as well as DWF staff have played the most important roles in the operation of this project. The strong collaboration between these actors has made a significant contribution to the success of this study, particularly in the themes of DWF typhoon resistant techniques dissemination and local raising awareness practices. These are important lessons for project coordinators in the future.

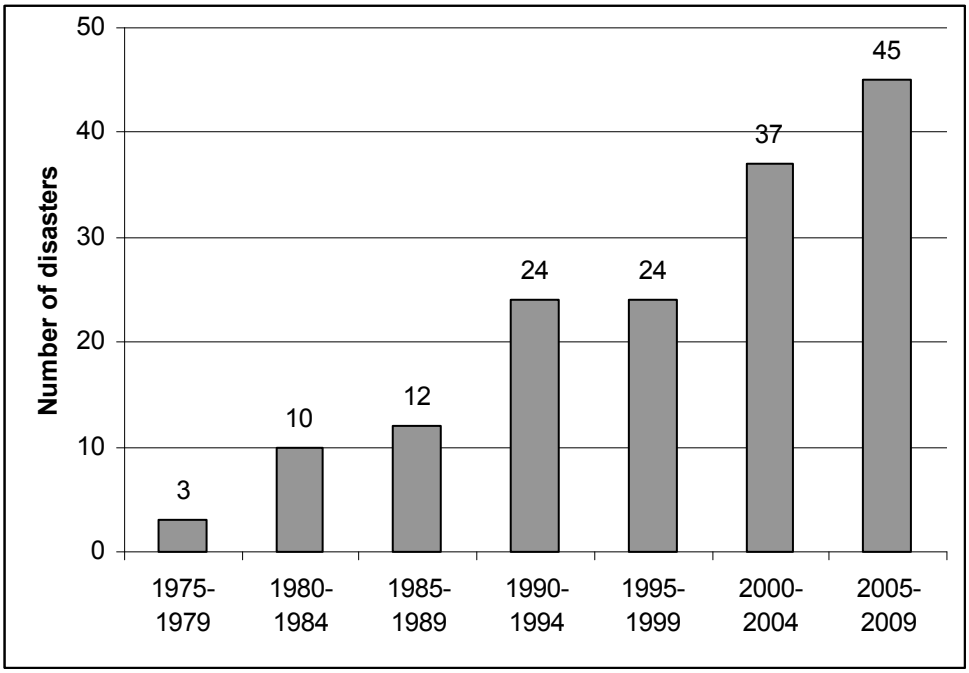
VII. APPENDICES

Appendix 1: Number of natural disasters from 1900 to 2003



(Source: D. Guha-Sapir, D. Hargitt and P. Hoyois, Presses universitaires de Louvain, 2004)

Appendix 2: Number of disasters occurring in Vietnam from 1975 - 2009



(Source: "EM-DAT: The OFDA/CRED International Disaster Database)

Appendix 3: Main roof materials * Type of households

	Type of households according to criterion of commune			Total
	Better households	Medium households	Poor households	Better households
Main roof materials - CGI	7.7%	20.3%	30.9%	22.0%
Main roof materials - cement fibred		10.4%	23.6%	12.8%
Main roof materials - Ceramic tiles	92.3%	52.7%	36.4%	51.2%
Main roof materials - cement tiles		15.4%	9.1%	13.2%
Main roof materials - Reinforced concrete		1.1%		0.8%
Total	100.0%	100.0%	100.0%	100.0%

(Source: DWF-Impact Survey in 2010)

Appendix 4: Ranking level of damage to agriculture due to Ketsana 2009.

commune	Level of damage	Frequency	Valid Percent
Phu Da	Less damage/loss	4	13.3
	Moderate damage/loss	6	20.0
	Fairly severe damage	15	50.0
	Extreme damage/loss	5	16.7
	Total	30	100.0
Vinh Phu	No damage/loss	5	10.0
	Less damage/loss	6	12.0
	Moderate damage/loss	9	18.0
	Fairly severe damage	18	36.0
	Very damage/loss	11	22.0
	Extreme damage/loss	1	2.0
Vinh Xuan	Moderate damage/loss	6	20.7
	Fairly severe damage	15	51.7
	Extreme damage/loss	5	17.2
Huong Phong	No damage/loss	3	13.0
	Less damage/loss	3	13.0
	Moderate damage/loss	3	13.0
	Very damage/loss	11	47.8
	Extreme damage/loss	3	13.0
Hai Hoa	Less damage/loss	3	10.3
	Moderate damage/loss	6	20.7
	Fairly severe damage	15	51.7
	Extreme damage/loss	5	17.2

Appendix 5: Ranking level damage to house due to Ketsana 2009

commune	Level of damage	Frequency	Valid Percent
Phu Da	Less damage/loss	1	3.3
	Moderate damage/loss	4	13.3
	Fairly severe damage	2	6.7
	Very damage/loss	17	56.7
	Extreme damage/loss	6	20.0
	Total	30	100.0
Vinh Phu	No damage/loss	4	8.0
	Less damage/loss	2	4.0
	Moderate damage/loss	5	10.0
	Fairly severe damage	15	30.0
	Very damage/loss	8	16.0
	Extreme damage/loss	16	32.0
	Total	50	100.0
Vinh Xuan	Less damage/loss	1	3.4
	Moderate damage/loss	4	13.8
	Fairly severe damage	2	6.9
	Very damage/loss	16	55.2
	Extreme damage/loss	6	20.7
	Total	29	100.0
Huong Phong	No damage/loss	3	13.0
	Very damage/loss	6	26.1
	Extreme damage/loss	14	60.9
	Total	23	100.0
Hai Hoa	Less damage/loss	1	3.4
	Moderate damage/loss	4	13.8
	Fairly severe damage	2	6.9
	Very damage/loss	16	55.2
	Extreme damage/loss	6	20.7
	Total	29	100.0

Appendix 6: Local rating of the risk of catastrophic floods

	Direct benefit with DWF project	Indirect benefit group with DWF project	Non-related to DWF project	
Average risk	30%	53%	94%	57%
Risk	65%	43%	6%	40%
Most risk	5%	4%	0%	3%
	100%	100%	100%	100%

Appendix 7: Local rating of the risk of typhoon

	Direct benefit with DWF project	Indirect benefit group with DWF project	Non-related to DWF project	
Risk	60%	42%	42%	45%
Most risk	40%	58%	58%	55%
	100%	100%	100%	100%

Appendix 8: Houses collapsed or damaged by Commune (25 year period)

	Semi-Permanent	Temporary house	
Phu Da	71%	29%	100%
Vinh Phu	71%	29%	100%
Vinh Xuan	0%	100%	100%
Huong Phong	30%	70%	100%
Hai Hoa	45%	55%	100%
	57%	43%	100%