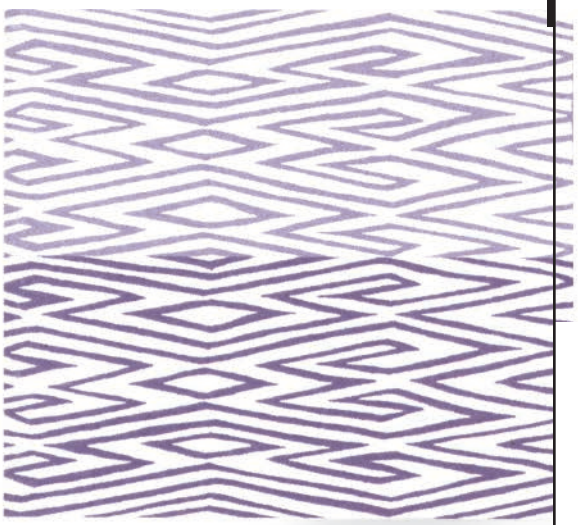

RESEARCH REPORT

No. 2011-RR10

Social Capital, Livelihood Diversification and Household Resilience to Annual Flood Events in the Vietnamese Mekong River Delta

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Floods are a familiar and frequent feature of life in the Vietnamese Mekong River Delta (MRD). Although these annual floods bring hardship to a great many people, they also bring a wide range of benefits, especially to farmers. Now a new EEPSEA study has looked at how the floods affect different social groups. It has also assessed how the resilience of households to the floods is affected by the way they make their livelihoods and the social connections and interactions they have.

The study is the work of Nguyen Van Kien from the Australian National University. It provides a comprehensive picture of how the people of the MRD cope with the floods. In particular, it shows that informal social capital (ie. relationships with neighbours) plays an important part in enhancing household resilience to floods. It therefore recommends that both the Vietnamese government and local community groups should encourage collective activities at the neighbourhood level to facilitate community solidarity and boost households' resilience to the floods.

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SOCIAL CAPITAL, LIVELIHOOD DIVERSIFICATION AND HOUSEHOLD RESILIENCE TO ANNUAL FLOOD EVENTS IN THE VIETNAMESE MEKONG RIVER DELTA

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December, 2011

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ABBREVIATIONS

AusAID	Australian Agency for Aid and Development
CTU	Can Tho University
GSOV	General Statistical Office of Vietnam
IHHD	Inverse Herfindahl-Hirschman Index
MRC	Mekong River Commission
MRD	Mekong River Delta
MSL	Mean Sea Level
VND	Vietnam Dong

SOCIAL CAPITAL, LIVELIHOOD DIVERSIFICATION AND HOUSEHOLD RESILIENCE TO ANNUAL FLOOD EVENTS IN THE VIETNAMESE MEKONG RIVER DELTA

Nguyen Van Kien

EXECUTIVE SUMMARY

Floods are a familiar and frequent feature of life in the Vietnamese Mekong River Delta (MRD). Although floods bring hardship to people, they also bring benefits, such as livelihood development. People in the MRD have experienced the impacts of floods for years, however some adapt well to the floods, while others are more vulnerable. Studying resilience to floods is useful as a way of assessing the capacity of rural households to cope with, and benefit from, annual floods. Social capital plays an important role in a household's ability to access technical information, resources and local knowledge during annual flooding. Livelihood diversity is known to be a vital strategy for coping with the risks of flood damage. However little is known about the effects of social capital and livelihood diversity on household resilience to floods in terms of securing their homes, securing food, and protecting income, as well as learning new flood-based livelihoods. This study explores the relationship between a household's resilience to floods in the MRD and levels of social capital (neighbourhood attachment, social supportive network, and participation in groups and associations) and livelihood diversification. These different forms of social capital were measured using the Inverse Herfindahl-Hirschman Index (IHHD).

Resilience in this context is defined as the ability of households to learn from, cope with, and benefit from, flood events. Household resilience was measured using expected levels of well-being, obtained from a household survey in 2010, using a five-point Likert scale to construct indexes of household resilience. The results from multiple regressions demonstrate that different forms of social capital have different effects on different forms of household resilience. Neighbourhood attachment has statistically significant effects on a household's ability to secure food, income, and a level of interest in learning new flood-based livelihoods, but it does not have a significant effect on the capacity of households to secure their home. Similarly, the social supportive network index has significant effects on a household's ability to learn new livelihoods during the flood season, but it does not have a significant effect on household capacity to secure the home, food and income. Besides social capital, the socio-economic condition of households (household income) is shown to have a significant effect on the three resilience factors – capacity to secure homes, secure food and income, and level of interest in learning and engaging in new livelihoods. Rich households are less likely to be interested in learning new livelihoods (negative effect). Rich households often own large areas of land so they are more likely to specialize in rice farming, which takes a break during the flood season. Poor and medium-income households often own less land or are landless, so they have to work harder to secure an income and food in order to survive during the flood season. Other socio-economic variables, such as the gender and age of respondents, have significant effect on the level of interest shown in learning new livelihoods (negative effect). Housing type also has a significant effect on household capacity to secure the home (concrete houses are less vulnerable). Regional flood factors also have a significant effect on the three resilience factors; people in the highest flood-prone region are less likely to be resilient in terms of securing their houses, food and income, but are more likely to learn new ways of living with floods. Surprisingly, the livelihood diversity index has no effect on household resilience to floods in this context.

1.0 INTRODUCTION

1.1 Research Issues

Flooding is well-known in Vietnam, especially in the Red River Delta, the Central coastal region and the Mekong River Delta (MRD) (Socialist Republic of Vietnam 2004). Among disaster events, flood frequency, damage and mortality were ranked as the second most severe after the impacts of typhoons in Vietnam (Imamura and Đặng Văn Tô 1997). Half of the MRD's area (2 million ha) is annually flooded and the majority of rural populations are vulnerable to the impacts of floods, including loss of human life, loss of crops and damage to property. There is additional evidence that a rise in sea level due to climate change will increase the risk of flooding in the MRD, which will affect the livelihoods of millions of people (Dasgupta et al. 2007; Eastham et al. 2008; Wassmann et al. 2004). Sea level is expected to increase by 75 cm by the end of the 21st century in Vietnam's Mekong Delta (Ministry of Natural Resources and Environment 2009). Consequently, the livelihoods of people in the MRD will be vulnerable if measures are not undertaken to cope with and adapt to future flooding.

Flooding in the MRD has both negative and positive effects. On the negative side, flooding always brings hardship to rural populations via such impacts as crop losses, submerged and destroyed houses, and loss of human life. On the positive side, flooding brings beneficial resources such as an abundance of fish, fertile sediment, and a huge amount of water that supports productive agriculture. However, not all of the population experiences similar benefits or losses in any given flood year. Some people are vulnerable, while some are resilient to flood events. Some social groups can turn floods, which are often perceived as a disaster, into resources that allow them to benefit and become more resilient.

Although it has been acknowledged that annual floods in the MRD bring both benefits and costs to rural populations, no study had demonstrated which social groups benefit from or are disadvantaged by the flooding. This study attempts to identify the winners and the losers from annual flood events, with the aim of providing a better understanding of the MRD floods.

Resilience is a useful concept in studies of adaptation to natural hazards and climate change. The resilience concept is important for understanding the capacities and livelihoods of resource-dependent communities and households when coping with and adapting to stress or shocks (Adger 1999, 2000; Adger et al. 2005; Adger et al. 2002; Armitage and Johnson 2006; Berkes 2001; Folke 2006; Folke et al. 2002; Klein, Nicholls and Thomalla 2003; Langridge, Christian-Smith and Lohse. 2006; Marshall and Marshall 2007; Walker et al. 2002). From an ecological point of view, resilience is defined as "the ability of a system to absorb change of state variables, driving variables, and parameters and still persist" (Holling 1973: 17). In a social system, Adger et al. (2002: 358) define resilience as "the ability of communities to absorb external changes and stress, while maintaining the sustainability of their livelihoods". Resilience has been discussed as the capacity of an ecological or social system to absorb changes but still maintain its core function. The concept of resilience has been discussed within a linked ecological-social system. One important aspect of resilience is the capacity to learn, to innovate, and to transform (Folke et al. 2002; Walker et al. 2004). Resilience in the context of living with flooding in the MRD is defined as the capacity of households to learn from, cope with, and benefit from floods.

Most researchers attempt to define the concept of resilience but very few studies conceptualize resilience. However, Marshall and Marshall (2007) developed items to measure

individual fishermen's resilience to institutional changes in the Australian context. Little is known about individual levels of resilience to natural hazards such as flooding. Additionally, most studies explain social and ecological resilience in qualitative ways; very few studies quantify resilience in the context of coping with natural hazards and climate change. This study continues to develop resilience theory and conceptualize the resilience concept in the context of living with flooding in the Vietnamese Mekong River Delta.

Livelihood adaptation is the key to resilience. Livelihood adaptation means either specialization or diversification of income sources. Livelihood diversification is also an important strategy for coping with risk (Ellis 2000; Ellis and Freeman 2005). Many studies have investigated the role of livelihood diversification in coping with drought and have suggested that diversification toward non-farm activities can help poor households to reduce their vulnerability to climate change (Eriksen, Brown and Kelly 2005; Smith et al. 2001). However, it is argued that poor households are more likely to diversify livelihood activities for survival, while rich households tend to diversify for development and wealth accumulation (Carswell 2000). This study examines whether diversification or livelihood specialization is better for coping with the flood season in the MRD.

Social capital is considered as important an asset as physical, natural, financial and human capital for coping with natural hazards and climate change. However, most studies examine the effects of social capital on adapting to climate change in qualitative terms (Airriess et al. 2008; Eriksen et al. 2005; Hawkins and Maurer 2010; Mathbor 2007). Some studies investigate the role of formal social capital, such as participation in formal organizations, but little is known about informal social capital, such as bonding and bridging social capital, especially in adapting to climate change (Pelling and High 2005). The effects of different forms of social capital on household resilience to natural hazards have been largely neglected in quantitative terms. This study examines the relationship between household resilience to annual flood events and livelihood adaptation, and different forms of social capital (neighbourhood attachment, social supportive networks, participation in groups and organizations) in the Vietnamese MRD, adopted from Li et al. (2005). Li et al. treated the neighbourhood attachment of individuals, social supportive networks and civic engagement as informal and formal social capital and assessed their effects on job attainment in the UK. The findings of this study provide insights into developing adaptive non-structural measures for coping with and adapting to future flood events in the MRD.

1.2 Research Objectives

The main objective of this study is to advance our understanding of the resilience of different social groups, and its relationship with different forms of social capital and livelihood adaptation in the context of living with flooding in the MRD. The report will explore three sub-objectives to support the key aim.

1. To examine the impacts of three levels of flooding on different households' livelihood activities and assets in the MRD.
2. To investigate the relationship between livelihood adaptation (diversification or specialization) and household resilience to floods in the MRD.
3. To examine the relationship between different forms of individual levels of social capital and household resilience to floods in the MRD.

1.3 Research Questions

The research will seek to answer three key questions in order to advance our understanding of the impacts of floods on different social groups, and to test the hypothesis

that there is a significant relationship between a household's resilience to floods, livelihood diversity, and different forms of individual social capital. The research also seeks to answer three sub-questions.

1. Are the impacts of annual flood events on household livelihoods considered "beneficial", or "disadvantageous" for different households in different geographically flood-prone regions of the MRD?
2. To what extent is there a relationship between livelihood diversification or specialization and household resilience to floods in the MRD?
3. To what extent is there a relationship between different forms of individual levels of social capital and household resilience to floods in the MRD?

1.4. The Mekong River Delta and Flooding

The Vietnamese Mekong River Delta is located on the south-western edge of Vietnam. The delta comprises 4 million hectares (ha) of land, accounting for 12.25% of Vietnam's total land area (Figure 1). Geologically, the average elevation of the delta is slightly (<2 m) above mean sea level (Võ Tòng Xuân and Matsui 1998). With a total population of 17.4 million and an average density of approximately 429 inhabitants per sq km, the delta is the second-most populated region within the country. Approximately 80% of the population live in rural areas and the livelihood of 77% of the population is based on agriculture, aquaculture and forestry (Australian Agency for Aid and Development (AusAID) 2004; General Statistical Office of Vietnam (GSOV) 2006). In addition, 13% of the rural population lives below the poverty line (GSOV 2006).

The delta has an important economic role. Rice is the main agricultural crop, amounting to 18.1 million tonnes of paddy, providing 50% of total rice production in Vietnam (GSOV 2006). Aquaculture is the second most important product in the Delta. Approximately 2 million tonnes of aquaculture products were produced in 2006 (GSOV 2006), of which shrimp production was estimated at 287.1 thousand tonnes (GSOV 2006).

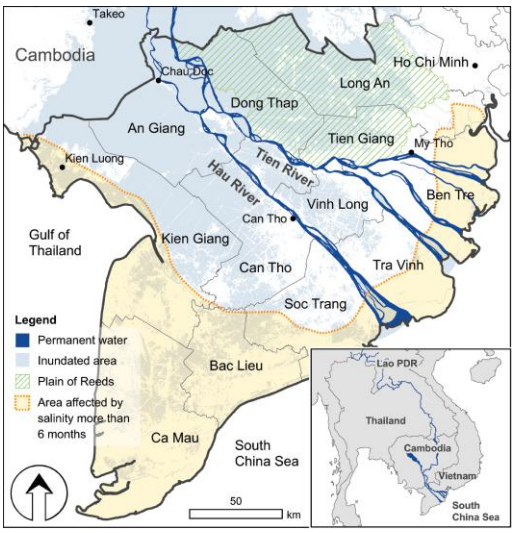

Figure 1. Map of the Mekong River Delta (Karonen 2008)

Annual flooding strongly affects the economic foundation and socio-economic development of the delta. Annually, about 1.2-1.4 million ha are flooded, causing severe difficulties for socio-economic development but maintaining productivity for agricultural

development in the region (Lê Anh Tuấn et al. 2007b). Floods are "good" but also "bad" for human society. Local people distinguish between flooding that is "moderate" and "big" (Đào Công Tiến 2001b). Floods bring fish, wash away farm residuals, deposit silt sediment, purify water, kill pests, and wash alum, which makes the soil of the delta fertile (Đào Công Tiến 2001b; Phóng Trần et al. 2008). It is estimated that the average fish capture in the delta is about 500 kg per household per year, providing a significant protein source for local people (Mekong River Commission (MRC) 2002 9; Nguyen Van Trong and Le Thanh Binh 2004). Every year, the flood deposits around 150 million tonnes of fertile sediment on paddy fields throughout the flood-prone areas of the MRD (Đào Công Tiến 2001b). Rice farmers achieve good yields after every flood season thanks to water and sediment brought by the flooding.

'Flooding' in the Vietnamese Mekong Delta is defined as riverine flooding, which is caused by upstream discharge, heavy rainfall in the Delta itself and variation in the tides of the East Sea and the Gulf of Thailand (Wassmann et al. 2004). Floods are an annual event that begin in June, gradually increase to reach a peak in September or October, and recede in November or December each year (Figure 2).

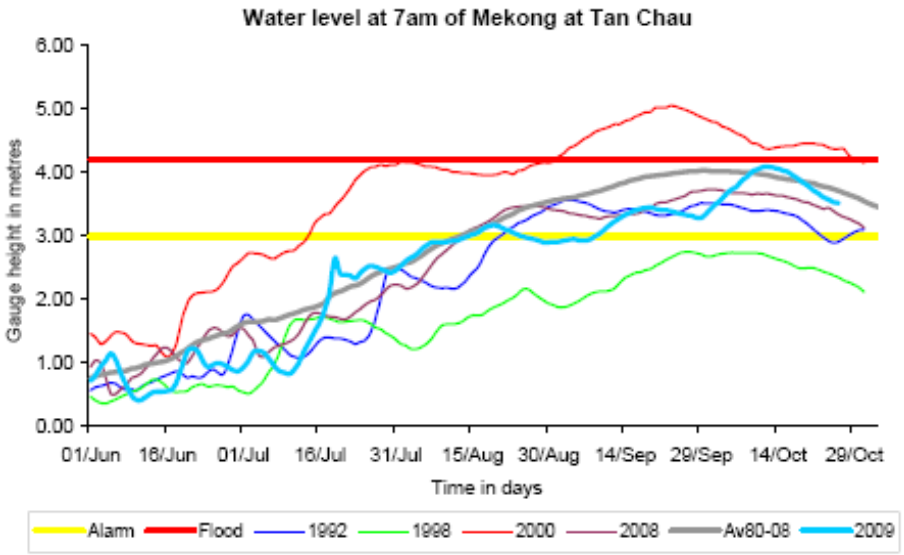

Figure 2. Water level at Tân Châu Gauging Station, MRD, (1992-2009)

Source: adapted from Mekong River Commission (2009)

Hydrologists classify floods into four main categories of severity (alarm level I, II, III, and over III). Based on information from the Tân Châu Gauging Station (Table 1), alarm level I occurs if the flood level at Tân Châu is less than 3.0 meters (m) above mean sea level (MSL). If the flood level ranges from 3.0 m to less than 3.6 MSL, it qualifies as alarm level II. Alarm level III is achieved if the floodwaters reach over 3.6 m but are less than 4.2 m. If the flood level exceeds 4.2 m, then over alarm level III, the most dangerous flood level, has been reached. Since 1978, there have been seven extreme flood events in the MRD, and the flood peak varies each year (Figure 2). In some years, floods are considered "big" such as the floods in 1996, 2000, 2001 and 2002, while the floods are considered "moderate or small" in other years.

Table 1. Flood characteristics of the MRD

Levels	Gauging Stations		Description
	Tân Châu (Tien River	Chau Doc (Hau River)	
I	≤3.0	≤2.5	Possible flood conditions – river water level is high; threat to low embankments; flooding of very low-lying areas; infrastructure safe.
II	≤3.6	≤3.0	Dangerous flood conditions: flood plain inundation expected; towns and cities still generally protected by flood defenses; high velocity of river flows pose danger of bank and dyke erosion; bridge foundations at risk; infrastructure generally safe.
III	≤4.2	≤3.5	Very dangerous flood conditions – all low-lying areas submerged, including low-lying areas of cities and towns; safety of river protection (dykes) in jeopardy; damage to infrastructure begins.
Over III	≥4.2	≥3.5	Emergency flood conditions – general and widespread uncontrollable flooding; dyke failure a certainty and probably uncontrollable; damage to infrastructure severe.

Source: Lê Anh Tuấn, et al. (2007a: 30)

Big floods bring costs to rural people. Recorded data show that big floods occurred in 1850, 1937, 1961, 1966, 1978, 1984, 1994, 1995, 1996, 2000, 2001, and 2002 (Can Tho University (CTU) 1995; Socialist Republic of Vietnam 2004). Costs included rice crop and house damage, livestock and human losses, injuries, and water-borne diseases (Đặng Quang Tính and Phạm Thanh Hằng 2003; Đào Công Tiến 2001b; Dương Văn Nhã 2006; Few et al. 2005; Nguyễn Văn Kiền 2006). The flood in 1994 killed 407 people and caused economic damage of around VND[1] 2,284 billion (USD 207.6 million) (Socialist Republic of Vietnam 2004). The next flood, in 1997, killed 607 people and destroyed 173,606 houses. The worst flood, in 2000, affected 11 million people living in 610 flooded communes, of which 4.5 million people lived in the 77 most affected sub-districts where flood levels exceeded more than 3 meters (Nguyen Dinh Huan 2003). In addition, more than 800,000 houses were inundated, 50,000 households had to be evacuated, 500,000 households needed emergency support, and 800,000 high school students had to stop their studies (Đào Công Tiến 2001a: 3). About 55,123 ha of rice crop was completely destroyed and an additional 159,260 ha of rice was inundated and so had to be harvested immediately (Đặng Quang Tính and Phạm Thanh Hằng 2003: 5). The total direct economic cost of the 2000 flood was estimated at VND[2] 4,000 billion (USD 289.8 million). Damage to homes, damage to health, and loss of income due to crop damage, fishing losses, and missed waged labour, were the most significant impacts at a household level (Table 2).

[1] One USD (in 1997) is roughly equivalent to 11,000 VND.
[2] One USD (in 2000) is equivalent to 13,800 VND.

Table 2. Impacts of floods on people, housing, crops and public infrastructure in the MRD

Year	Deaths	Child deaths	Rice area destroyed	Reduced rice yield	Collapsed houses	Damaged houses	Classrooms damaged	Clinics damaged
	People	People	ha	Ha	Number	Number	Number	Number
1991	143		72,140	61,482	2,977	278,546	5,136	
1992								
1993								
1994	407	265	26,865	202,186	2,807	779,119		405
1995	127	101	11,101	62,399	696	203,874	2,963	131
1996	222	166	60,368	132,309	42,358	836,773		11,953
1997	607	5	19,758	251,341	74,368	99,238	72	7
1998								
1999								
2000	481	335	46,402	197,652	4,093	891,406	12,909	397
2001	407	321	4,553	53,267	1,000	341,614	5,559	89
2002	170	151	335		960	286,660	2,694	
2003								
2004	38.0	34.0		115.0	193.0	690.0		
2005	44.0	39.0	185.0	2,723.0		4,472.0		
2006	22.0	21.0						

Source: Adapted from Department of Agriculture and Rural Development, flooded provinces (2008), MRC (2005), Socialist Republic of Vietnam (2004)

At the other end of the scale, small floods are rare. The flooding of 1998 is thought to have been the smallest flood in the past 80 years (Figure 3). A small flood often does not cause damage to property, houses, crops and other livelihood activities and assets. However, a small flood affects rural livelihoods in different ways. Poor people are more likely to lose their income from fishing as they cannot catch much fish during the flood season.

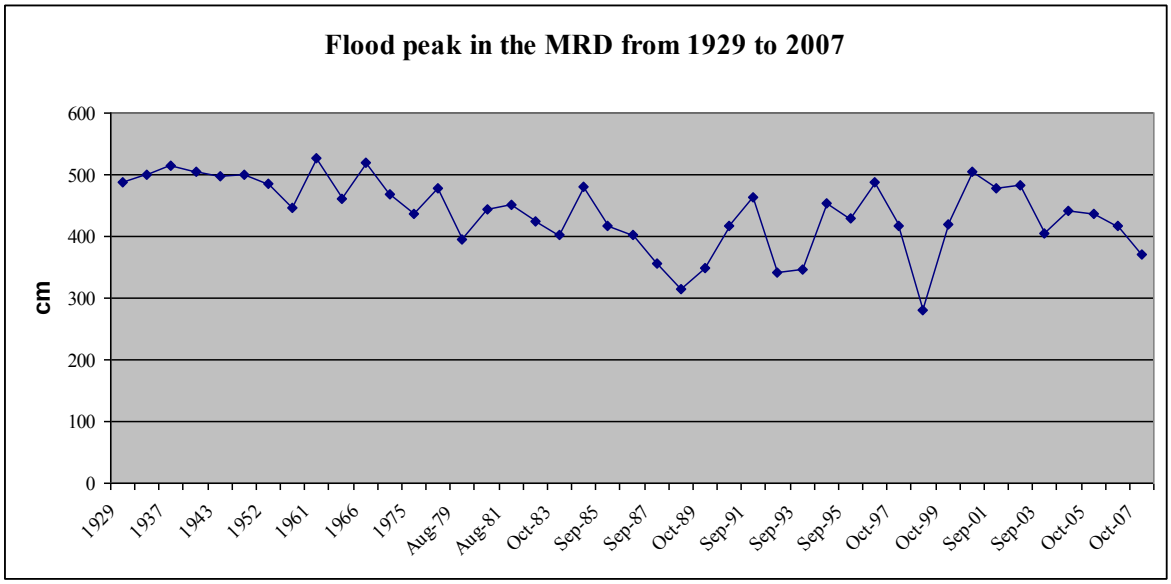

Figure 3. The highest water levels during different flood years in the MRD, (1929-2007)
Source: *An Giang Statistical Year Book* (2009) and Nguyen Anh Tuan et al. (2007[a])

2.0 REVIEW OF LITERATURE

2.1 Resilience, Social Capital and Livelihood Adaptation

Resilience has become a useful concept in the study of environmental hazards. The term "resilience" first originated in the field of ecology. Holling (1973: 17) defines resilience as "the ability of a system to absorb change of state variables, driving variables and parameters and still persist". This concept focuses on the capacity of an ecological system to absorb changes but still maintain its core function. In a social system, Adger et al. (2002: 358) define social resilience as "the ability of communities to absorb external changes and stress, while maintaining the sustainability of their livelihoods". Flood risk managers define resilience as the ability of a system to recover from floods, while "resistance" is the ability to prevent floods occurring (Bruijn 2004: 199). However, most resilience definitions address the capacity of a system to cope with stress and external change, but still maintain its function. The concept of resilience has recently been seen in a linked social and ecological system (Adger 2000; Folke 2006; Folke, Berkes and Colding 1998). The resilience concept also refers to the capacity for renewal, re-organization and development (Folke 2006: 253); creativity (Adger 2000; Maguire and Hagan 2007), and transformation within a social-ecological system (Walker et al. 2004).

Flooding in the MRD may not be an external change because most people experience its impacts on their livelihoods every year. Flooding can be seen as part of the ecological-social system since most people benefit from fishing and the fertile sediment left by the floods. In particular, farmers can develop flood-based livelihoods to maintain household income during the flood season. However annual flooding can also be seen as an "external shock", if the flood is either too big or too small and so exceeds the coping capacity of households and communities. A big flood often disrupts rural livelihoods so many people are affected. Therefore, the resilience concept in the context of living with floods in the MRD can be defined as "the capacity of households to cope with, adapt to, and benefit from the flood season".

2.2 The Relationship between Livelihood Adaptation and Resilience

Three main bodies of literature discuss the ways rural households adopt livelihood strategies to cope with climate change and other stresses. These include agricultural extensification, agricultural intensification and livelihood diversification (Ellis 2000; Ellis and Freeman 2005; Paavola 2008). Agricultural extensification refers to taking new units of land for low-input cultivation. Agricultural extensification can also increase productivity and reduce financial risks. However, the opportunity for extensification diminishes when the scarcity of land increases due to pressures of population growth (Boserup 1975: 15). Therefore, agricultural intensification can be a possible strategy for rural agricultural households to cope with stresses in developing countries. Agricultural intensification, as it was originally conceptualized by Boserup (1975: 28), involves the application of more labour to a unit of land in order to achieve greater productivity (because of population growth and a surplus of labour). However, agricultural intensification is placed at risk by market and climate variability. Ellis (2000: 60) states that rural livelihoods in developing countries are highly correlated with risks (market, climate variability, floods, and drought). Specialization in the agricultural sector makes it more vulnerable to droughts and floods (Cutter, Boruff and Shirley 2003). If there is a flood or drought in a particular locality, most farm income streams are adversely affected or disrupted.

Ellis (2000: 15) defines livelihood diversification as "the process by which households construct an increasingly diverse portfolio of livelihood activities and assets in

order to survive or improve living standards". This means that livelihood diversification is the creation of a livelihood portfolio comprising of farm, off-farm and non-farm income that is less reliant on agriculture. Non-farm income, such as remittances, may provide more advantages than farm income if adverse natural events disrupt farm income streams. Ellis (2000: 11) defines different types of income sources as follows:

> *Farm incomes as income generated from own-account farming, whether on owner-occupied land, or on land accessed cash or share tenancy, off-farm income as wage or exchange labour on [the land of] other farmers, and non-farm as "non-agriculture income sources such as remittances".*

A diversity of livelihood activities provides vital assets for buffering the effects of extreme hazards. The greater diversity of income is, the greater the resilience of livelihoods to disruption from particular sources (Adger 1999: 254). Livelihood diversity is a risk-spreading strategy used by farmers in Samoa to cope with annual cyclones (Colding, Elmqvist and Olsson 2003). There is more than one reason for this strategy. Firstly, diversification of farming activities often faces a high risk of market failure in developing countries. Secondly, agricultural sectors are very sensitive to climate variations, so it is not appropriate to diversify on-farm activities (Adger et al. 2003). Therefore, livelihood diversity from on-farm to off-farm and non-farm activities are important for achieving livelihood resilience (Ellis and Freeman 2005; Paavola 2008). Evidence shows that households with more income sources are less likely to be affected by floods in rural Bangladesh and by climate change in rural coastal northern provinces of Vietnam (Adger and Kelly 1999; Brouwer et al. 2007). Eriksen et al. (2005) found that remittances from rural-urban migration can help to reduce the level of vulnerability in drought-affected households in Kenya. However, it is argued that the poor diversify their livelihoods for survival, while the better-off are more likely to diversify for wealth accumulation (Carswell 2000).

Although livelihood diversification can be a promising strategy to reduce both market and climatic risks and alleviate poverty, the effect of diversification on household income is still debatable. It has been shown that engaging in a large number of activities may not be as economical as more intensive types of livelihood activities (Eriksen et al. 2005). Additionally, Anderson and Deshingkar (2005) argue that diversification of income sources does not necessarily increase a household's income due to the cost of diversification. An example is when a household in rural India changed from one to two income sources – their total income reduced by 15% because of the increase in the cost of diversification. It can be argued that specialization or intensification of livelihood activities is more important than diversity of income sources (Anderson and Deshingkar 2005; Eriksen et al. 2005). The average wage of a contract labourer is 25% higher than that of a casual farm labourer, while industrial wages are 90% higher than that of casual work. However, Anderson and Deshingkar (2005) did not take the issue of climate change into account. Eriksen (2005) argues that intensity of one income source (brick making) is more important than diversity of livelihood activities in coping with droughts in a rural context in Kenya. However, one of the most critical reasons for livelihood diversification is to achieve a low-risk (market risk as well as climate risk) income portfolio rather than an improvement in total income (Ellis 2000).

In the MRD rice is the main cash crop for most rural households so annual flooding often disrupts rice farming during the flood months that do not have flood controls. The question is "how can rural households maintain rural livelihoods during flood months without any farming activities?" More particularly, "how can landless poor households live safely without any income sources during the flood season?" Diversification of agricultural

activities on farms may allow rural households to improve their income, but they face market risks. Recently, some households have attempted to diversify their rural on-farm income using flood-based resources such as farming prawns, fish and vegetables in moderate and low-flood-prone regions. Another way of diversifying is shifting from off-farm fishing (more dependence on the flood season) to non-farm seasonal migration. Seasonal migration to Ho Chi Minh City becomes an emerging livelihood strategy that allows poor households to maintain their income during flood months.

2.3 Social Capital and Resilience to Environmental Hazards

In the relevant literature social capital plays an important role in economic development, health outcomes, educational achievement, migration, coping with natural hazards, disasters and climate change. The social capital theory first originated in the field of sociology. Bourdieu (1986: 248-249) defines social capital as:

> ...the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in order words, to membership in a group – which provides each of its members with the backing of the collectivity-owned capital, a "credential" which entitles them to credit, in the various senses of the word.

According to Bourdieu (1986) social capital can be actual or potential resources (symbolic or material goods) for group members, meaning that participation in groups may gain either symbolic or material resources. Social capital is formed by formal (institutional) or informal (less institutional) relationships, which exist by exchanges of symbolic or material goods to maintain network relationships. According to Bourdieu's theory, maintaining a social relationship is the key to developing social capital. Bourdieu (1986: 249) shows that social capital "is not a natural given, or even a social given.... It is the product of an endless effort at institution, of which institution rites – often wrongly described as rites of passage – mark the essential moments and which is necessary in order to produce and reproduce lasting, useful relationships that can secure material or symbolic profits". Some social networks are naturally created, such as kinship networks, but people have to invest in most other social relationships. Bourdieu further claims that social capital is a collective asset that is a product of group members as well as shared by group members. The amount of social capital available to a person depends on the size of his or her networks or membership of groups, or amount of capital (economic, cultural or symbolic) possessed by each of those to whom he or she is related.

According to Lin (1999: 35) social capital can be defined as "resources embedded in a social structure which are accessed and/or mobilized in purposive actions". Lin (1999: 39) argues that investment in social relations by individuals is the means through which they gain access to embedded resources to enhance expected instrumental and expressive returns. For Lin, benefits from social capital are an investment strategy. This is similar to Bourdieu's notion about the creation of social capital. Lin (1999: 36-41) demonstrates two types of benefit from social capital: (1) returns to instrumental action (economic, social, political returns); and (2) expressive return (e.g. physical and mental health and life satisfaction).

Social capital can be classified into different forms. Putnam (2000: 22) differentiates between bridging and bonding social capital. Bonding social capital describes the cohesion that exists between small groups of similar people such as family members (kinship), close friends and colleagues, and perhaps the members of religious groups or neighbourhoods. Bridging social capital describes the networks that link acquaintances (Meadowcroft and

Pennington 2008: 121). For Coleman (1988) social capital can be seen inside the social structure such as the family (bonding social capital), or outside the family or community (bridging social capital). Social capital can also be interpreted as vertical or horizontal (Grant 2001: 976). Horizontal social capital can be seen as bonding social capital that links members of a community. Vertical social capital can be understood as bridging or linking social capital that links communities with public institutions or governmental bodies.

While bonding social capital is good for understanding specific reciprocity and mobilizing solidarity, bridging social capital is important for mobilizing to external resources (Adger 2003; Mathbor 2007; Narayan 1999; Pelling 1998; Putnam 2000: 22). Narayan (1999) argues that if there is strong bonding social capital, groups can help their members; however, there will be a lack of bridging social capital due to the exclusion of external resources from strangers. Bridging social capital between groups can create economic activities for less powerful or excluded groups, such as the poor (Narayan 1999). Newman and Dale (2005) argue that networks comprising a diversity of bridging, bonding, and linking social capital, enhance a community's ability to adapt to change; however, a network which comprises only bonding social capital may reduce resilience. Pelling (1998) argues that bridging social capital allows communities to access external resources from government and financial institutions for coping with floods. Another typology of social capital is linking or networking social capital, which is important to link bonding social capital and state or public institutions in order to facilitate collective action to adapt to climate change (Adger 2003; Mathbor 2007).

Whether social capital is classified into bonding, bridging, linking or vertical and horizontal, it can be grouped into formal and informal social networks. The term social network was mentioned in Bourdieu's definition of social capital (Bourdieu 1986). Li et al. (2005) grouped social capital into formal and informal social networks in studies of job attainment in the UK in which social capital can be divided into three realms: neighbourhood attachment, social network and participation in formal organizations. According to Li et al. (2005) neighbourhood attachment refers to the degree to which people are attached to their neighbourhood. Social network is the extent of people's intimate interaction with those beyond the immediate family or supportive networks (weak ties or bridging social network). Informal social capital is defined as participation in civic organizations or linking social capital.

Different forms of social capital are important at different times. Family members in Kenya sent remittances back to households during drought years that helped to reduce vulnerability (Eriksen et al. 2005; Smith et al. 2001). Hawkins and Maurer (2009) found that close ties (bonding) were important for immediate support during disastrous events but that bridging and linking social capital were vital for long-term survival and wider community revitalization after a disaster. Airriess et al. (2008) found that co-ethnic social capital (bonding) was very effective for evacuation, relocation and recovery both during and after hurricane Katrina. Sanderson (2000) suggests that building social resources by enhancing neighbourhood relationships can help to save lives at risk from floods. Pelling (1999) suggests that social assets play a key role in shaping access to local, national and international resources for coping with floods.

So far, most researchers have examined the effects of neighbourhood attachment on health outcomes (Carpiano 2006; Caughy, Campo and Muntaner 2003; Veenstra et al. 2005; Ziersch et al. 2005) and job attainment (Li et al. 2005). In the MRD neighbours are vital for coping with and adapting to floods but little is known about the role of neighbours in living with floods. Local people say "relatives who live far away are not as good as closer

neighbours". Neighbours help to evacuate and they also lend food and money during floods and share local knowledge to exploit the benefits of the flood season. Neighbours help to repair houses and they share local knowledge to protect human life when fishing. Relationships among neighbours are cultivated through cultural and religious activities such as wedding parties and memorials to dead ancestors, and through recreational activities such as sport, chess, and having coffee together in the early morning. If people have good relations with their neighbours, they are more likely to mobilize resources when facing food, income and housing insecurity during or after the flood season. Besides relationships with neighbours, social supportive networks beyond the family such as friendships, religious associates or other supportive networks, play an important role in accessing resources for coping with floods. Flood-affected households are more likely to access relief or mutual assistance if they have wider supportive networks. For example, farmers can access technical knowledge for farming fish, *neptunia prostrate* (water mimosa), and prawns during the flood season using friendship networks. Finally, participation in local groups and associations can help rural households to access technical information on farming skills and relief resources for adapting to floods.

Additionally, while most natural hazard studies explore the effects of bonding and bridging social networks in coping with disasters and adapting to climate change in qualitative terms, little is known about the quantitative effects of neighbourhood attachment on household social supportive networks, participation in groups and associations and social capital.

The analytical framework shows the complex relationship between household resilience and social capital, livelihood adaptation, and the socio-economic conditions of households (Figure 4). Firstly, household resilience can be determined by attributes such as demographic characteristics, income status, housing characteristics and the location of households within the flood-prone regions. It is clear that poor households are less likely to cope with flooding because they worry about loss of income, food shortages, and their home collapsing during the flood season. The regional flood factor can be a determinant that affects household resilience to floods. Livelihood diversification can help rural households reduce risk from natural hazards, but livelihood diversity is often determined by the economic status of households and household location and access to land, financial resources and social assets. In particular, social capital via good relations with neighbours helps rural households to share local knowledge and technical information about livelihood strategies (Schwarze and Zeller 2005; Smith et al. 2001). Through social networks of friends or members of various local groups and associations, households may gain information about adapting to new ways of living with floods or how to receive emergency support, such as rice or money to survive during the flood season. Social capital may directly affect household resilience to floods by accessing material or non-material goods from their networks to cope with each flood season. However, different forms of household social capital are determined by the socio-economic conditions of households (Li et al. 2005).

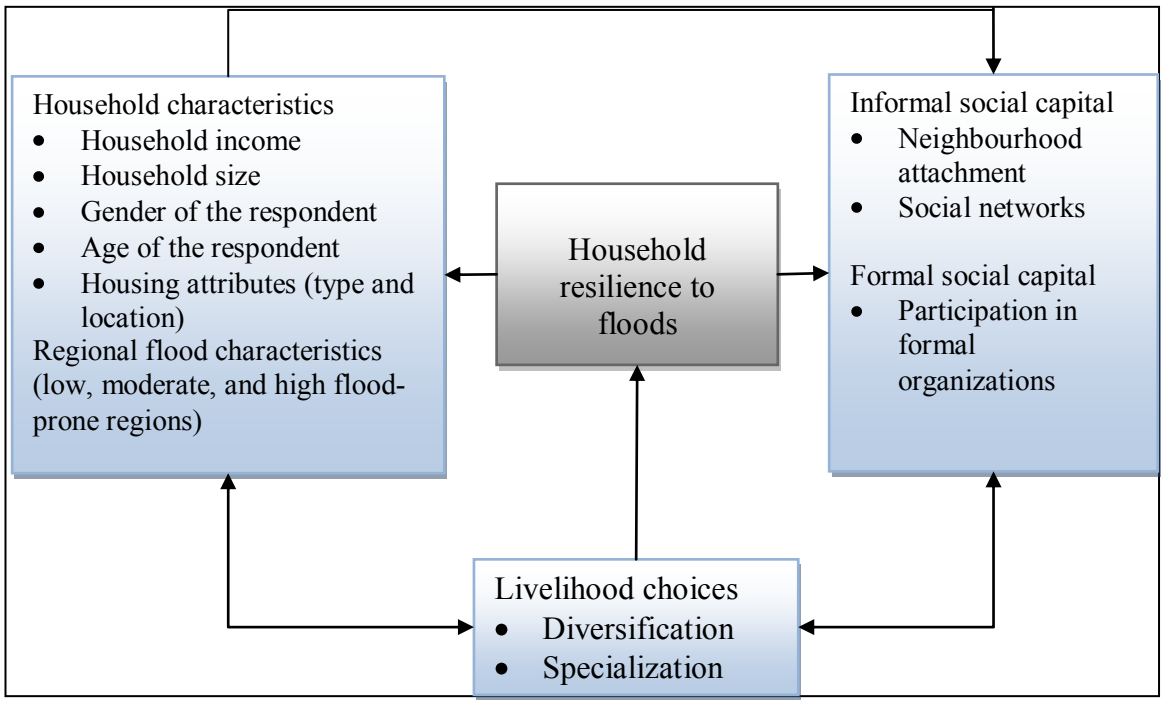

Figure 4. Analytical framework for examining the relationship between social capital, livelihood adaptation and household resilience to floods in the MRD

3.0 METHODOLOGY

3.1 Selection of Study Sites

Three communes were selected to represent different flood regions of the MRD. The first research site, Phú Đức commune in Tam Nông district, Đồng Tháp province, is located in the most flood-prone region. The second study site, Thạnh Mỹ Tây commune in Châu Phú district, An Giang province, is located in a moderately flood-prone area. The third study site, Trung An commune in Cờ Đỏ district, CầnThơ City, is situated in the region with the lowest risk of flooding (Figure 5). The socio-economic conditions and livelihood activities of the three locations are represented in Table 3.

Table 3. Socio-economic conditions and livelihood activities of the three study sites

Socio-economic, demographic and flood conditions	**Selected sub-districts**		
	Site 1: Phú Đức commune – Tam Nông district – Đồng Tháp province	**Site 2: Thạnh Mỹ Tây commune – Châu Phú district – An Giang province**	**Site 3: Trung An commune – Cờ Đỏ district, CầnThơ City**
Population (people)	6,940	25,100	13,606
Population density (people per sq km)	212	637	194
Households	1,586	5,141	2,362
Land area (ha)	5,170	3,656	1,197
Poverty (%)	11.4	11.5	12.0
Flood depth	>2.5 m (over 5 months)	1.5-2.5 m (4-5 months)	<1.5 m (<3 months)

Source: Thạnh Mỹ Tây People's Committee (2009), Phú Đức, People's Committee (2009), and Trung An People's Committee (2009)

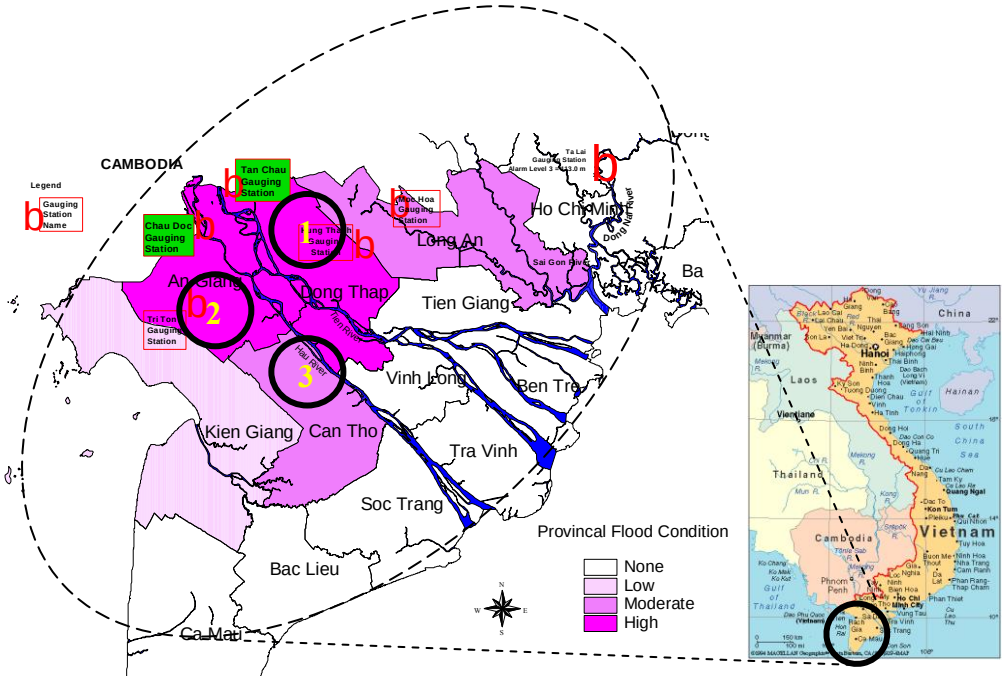

Figure 5: Location of the Mekong River Delta and the study sites

3.2 Data Collection

The study employed both qualitative and quantitative research approaches to investigate the relationship between social capital and household resilience to the floods in the MRD. The three key qualitative data collection approaches for this study included field observations, in-depth interviews with key informants and focus group discussions (FGDs), and field observation. Four FGDs were carried out in each commune, each covering a range of social classes and gender. Some 10 in-depth interviews were conducted with key

informants at the three study sites. Information from the qualitative research was used for designing the structured questionnaires for the household survey, which was conducted in August 2010. The questionnaire had nine sections. Section one comprised general information about the respondents. Section two collected demographic information about each household member. Section three explored respondents' perceptions of the natural characteristics of floods and of flood impacts on communities and household livelihood activities and assets. Section four was concerned with information about household income and income sources in the previous 12 months. Section five asked respondents to rate their level of agreement about neighbourhood attachment using five-point Likert scales. In addition, section five also asked questions related to social networks and about participation in groups and associations. Section six obtained information about expected levels of well-being that reflect household capacity to learn from, cope with, and adapt to floods. Both attitudinal and behavioural questions were used to ask about household resilience capacity using a five-point Likert scale. A face-to-face interview was conducted with the head of each household (husband or wife). The members of the faculty of Agricultural and Natural Resources of An Giang University were trained to conduct these interviews. The interviews were conducted during the flood months in order to encourage respondents to talk about their experience of living with floods. These were conducted at the farmers' homes, at a suitable time, in order to maximize the willingness of respondents to participate.

3.3 Sampling Procedures

The stratified sampling approach was used to divide the total population of the delta into sub-populations of "three communes", based on the existing socio-economic and natural flood characteristics of the delta. Within each stratum, five hamlets were randomly chosen and 30 households were randomly selected from the wealth ranking of households in each hamlet. The local classification of well-being was obtained from participatory research using focus group discussions and in-depth interviews with key informants. The samples were chosen on the basic of social class: poor, medium-income and better-off (Table 4). This approach has been widely used in rural development and natural hazard studies in developing countries (Phóng Trần et al. 2008; Smith et al. 2001). Through focus group discussions with respondents in the three study sites, the level of well-being was determined using the following criteria; access to natural resources (ownership of agricultural land); housing quality; level of income and primary occupation: income sources or primary livelihood activity. For example, a poor household was defined as one that was: (1) landless or has ownership of very little land (less than 0.5 ha); (2) average income per capita of each adult in the household is less than VND[3] 250 thousand per month (12 USD per month); (3) income source is mainly from daily off-farm agricultural labouring; and (4) owning a simple house. Medium-income households often own agricultural land (more or less 1 ha, but less than 2 ha), derive an income from a mixture of farm and off-farm labouring activities, and have semi-permanent houses. Better-off households often own more agricultural land (more than 2 ha), receive income from specialization in rice farming, are less likely to engage in off-farm labouring, and often have a good quality home. The total sample size in each case study was 150, as illustrated in Table 4. The exception was Thạnh Mỹ Tây commune, where there were 159 samples.

[3] One USD (in September 2011) is roughly equivalent to Vietnamese Dong (VND) 20,830.00.

Table 4. Distribution of types of households across the three study sites

Name of commune		Type of household			Total
		Poor	Medium	Better-off	
Phú Đức commune	N	69	40	41	150
Thạnh Mỹ Tây commune	N	56	50	53	159
Trung An commune	N	56	42	52	150
Total	N	181	132	146	459

3.4 Characteristics of the Respondents

Respondent (household) characteristics are presented in Table 5. The average age of respondents was 52 years old. The youngest respondent was 25 years old, whereas the oldest was 96. The proportion of male respondents was higher than that of female respondents (85.40% of respondents were male). Most male respondents were married (89.8%) and were the head of the household. Some 8.5% of the respondents were widowed and very few respondents were single or separated.

The education level of respondents was generally low. The majority of the respondents completed only primary education (53.60%), while 23.30% completed secondary education. The proportion of illiterate respondents was relatively higher, and very few respondents had completed a vocational education, or attended college or university. The sample illustrates that the education level of family members was relatively low. Some 10% of family members did not know how to read and write. Some 43.0% of family members completed primary school while only 29.0% of family members finished secondary school and 12.0% completed high school. A small proportion of family members completed vocational training (2.0%) and 10% of family members did not know how to read and write.

The average household size was 4.7. The maximum household size in the sample was eight, while the minimum size was one. The average number of children aged less than 15 in the household was 0.9 (1-4) while the average number of adults was 3.2 (1-7), and the average number of people aged more than 60 was 0.5 (1-3). The gender rate of households was equally distributed. The average number of females in a household was 2.3, and 2.3 for male members. Most respondents follow the Hòa Hảo Buddhism religion (61.40%), and Buddhism (31.20%), while very few respondents belong to the Cao Đài religion (3.5%) or are Catholic (2.0%).

Poor households account for 39.4% of the sample, followed by well-off households (31.8%) and medium-income households (28.8%). Nearly half of the respondents reported that they are landless[4] (45.32%), 14.6% of respondents own less than 1 ha of rice land and 28.32% of respondents own from 1 ha to less than 3 ha. Some 12.2% of the respondents own more than 3 ha of rice land. Average household income was VND 60.8 million (USD 2,918.86) per year. However, the average income of poor households was 15.9 million VND (USD 765.94) per year. For medium-income households it was VND 53.18 million (USD 2,553.04) per year, while better-off households had an average income of VND 123.1 million (USD 5,909.74) per year. The per capita income of each person was an average of VND 12.5 million (USD 600.09) per year. Per capita income in poor households was VND 3.5 million (USD 168.02) per year. In medium-income households per capita income was VND 12.0 million (USD 576.09), and it was VND 24.2 million (USD 1,161.78) in better-off households.

[4] Landless in this context means people who reported that they do not have agricultural land only. The ownership of residential land was not included in the local definition of landless.

Table 5. Respondent (household) characteristics

Respondent (household) characteristics	**Value**
Total respondents	459
Respondent average age (median value)	52 (51)
Minimum age	25.00
Maximum age	96.00
Percentage of male respondents in the sample	85.40
Marital status of respondents (%)	
Single	1.50
Married	89.80
Widowed	8.50
Separated	0.20
Literacy rate respondents (%)	
Never attend school (illiterate)	13.90
Primary education	53.60
Secondary education	23.30
High school	8.10
College	0.90
Undergraduate and above	0.20
Religion (%)	
Hòa Hảo Buddhism	61.40
Cao Đài	3.50
Buddhism	31.20
Catholic	2.00
No religion	2.00
Household level of reported well-being (%)	
Poor households	39.40
Medium-income households	28.80
Better-off households	31.80
Land area (%)	
Landless	45.32
Less than 1 ha	14.16
From 1 to less than 3 ha	28.32
More than 3 ha	12.20
Average household size (min-max)	4.73 (1-8)
Gender distribution in the household	
Percentage of females in the household (%)	49.00
Percentage of males in the household (%)	50.00
Educational level of household members	
Percentage of illiterate people in the household (%)	10.00
Percentage of people completing primary education in the household (%)	43.00
Percentage of people completing secondary education in the household (%)	29.00
Percentage of people completing high school in the household	12.00
Percentage of people completing vocational education in the household (%)	2.00
Percentage of people completing a college degree in the household (%)	1.00
Percentage of people completing a university degree in the household (%)	2.00

Average household income (mil. VND per year) (std.)	60.83 (USD 2,918.86)
Average income of poor households (mil. VND per year)	15.94 (USD 765.24)
Average income of medium-income households (mil. VND per year)	53.18 (USD 2,553.05)
Average income of better-off households (mil. VND per year)	123.40 (USD 5,924.15)
Average per capita income (mil. VND per year) (std.)	12.56 (USD 600.09)
Average income per capita of poor households (mil. VND per year)	3.51 (USD 168.51)
Average income per capita of medium-income households (mil. VND per year)	53.18 (USD 2,553.04)
Average income per capita of better-off households (mil. VND per year)	123.1 (USD 5,909.74)
Household type	
Policy households (%)	5.40
Households with one disabled or one acutely ill person (%)	8.90
Relief households (%)	6.10
Households belonging to an ethnic or minority group (%)	0.20

3.5 Methods of Analysis

3.5.1 Qualitative data analysis

Thematic analysis was used to compare the opinions, experience and perceptions of different social groups about the impacts of floods on household livelihoods, livelihood strategies for coping with floods, social capital, and resilience indicators in living with floods.

3.5.2 Quantitative analysis

Factor analysis was used in this report for combining related variables into "composite" variables for constructing indexes of household resilience and neighbourhood attachment social capital. Factor analysis helps us to identify patterns in responses to a set of questions (De Vaus 2002: 186-196). The purpose of this technique is to reduce the large amount of variables to a smaller set of underlying variables by creating a measure, or factors, such as resilience variables and social capital.

There are four main steps in forming scales using factor analysis: (1) selecting variables; (2) extracting an initial set of factors; (3) extracting a final set of factors by "rotation"; and (4) constructing scales based on the results at step 3 and using this further analysis.

When selecting variables to be factor analyzed, it is important to be able to assume that correlations between the variables will not be causal. It is important to ensure that the variables to be analyzed have at least reasonable correlations with some other variables in analysis. There are several ways of assessing whether a set of variables in a correlation matrix is suitable for analysis. KMO statistics were used for this assessment. KMO ranged from 0 to 1. KMO greater than 0.7 is reliable for analysis.

To extract factors, two decisions are necessary. Firstly, a decision must be made regarding which of a number of methods of extracting the factors is to be used (Kim and Mueller 1978). The principal component factor method is used in this analysis. Secondly, a decision must be made on how many factors to extract. To clarify which variables belong to

which factor, and to make the factors more interpretable, we processed the third stage, called factor rotation. There are a number of methods of rotation variables (Kim and Mueller 1978: 29) including the quartimax method, the equamax method and the varimax method. One of the most widely used methods is the varimax method, which attempts to minimize the number of variables that have a high loading on a factor. This rotation enhances the interpretability of the factors (Utomo 1997). The quarmax rotation often results in a general factor with high to moderate loadings on most variables. The equamax method is a combination of the varimax method, which simplifies the factors, and the quarmax method, which simplifies the variables (Norrusis 1993: 65). In this report, the varimax method has been chosen so as to maximize interpretation of the factors. Eigenvalue was used to determine the best factor. The eigenvalue is a measure that attaches to factors and indicates the amount of variance in the pool of original variables that the factor explains. The higher this value, the more variance is explained. To be retained, factors must have an eigenvalue greater than 1.

Communality is used to test which variables explain the variance. Communality ranges from 0 to 1. The higher the figure the better the set of selected factors explains the variance for that variable. If the communality figure is low, it means that the variance for that variable is not explained by the selected factors. Normally it is best to drop variables with low communalities.

It is important to look at each item to see if it really belongs to the scale. This process of assessing each item is called item analysis – there are two aspects to this analysis: uni-dimensionality and reliability (De Vaus 2002: 184). To do a uni-dimensionality test we need to calculate a correlation between responses on the item, with their responses on the set of items that make up the rest of the scale. Correlation coefficients range between 0 and 1. The higher the figure, the more clearly an item belongs to the scale. The rule of thumb is that if it is less than 0.3, then the item is dropped from the scale.

A reliable scale is one on which individuals obtain much the same scale score on two different occasions. An unreliable scale is the result of unreliable items so we need to test each item for its reliability. Item-item correlation is used to see the consistency of a person's response on an item compared to each other scale item. The index of this is given by a statistic Cronbach's alpha coefficient. This ranges between 0 and 1. The higher the figure, the more reliable the scale. As a rule of thumb, alpha should be at least 0.7 before we can say that the scale is reliable (De Vaus 2002; Marshall and Marshall 2007).

3.6 Constructing Indexes of Resilience, Livelihood Diversity and Social Capital

3.6.1 Constructing indexes of household resilience to floods

Measuring social resilience to environmental hazards is a complex process. Most studies attempt to construct social vulnerability indices to see whether different social groups or communities are vulnerable to natural hazards using a composite vulnerability index (Cutter et al. 2008; Cutter et al. 2003; Cutter, Mitchell and Scott 2000; Fekete 2009). Other researchers use specific vulnerability indicators as proxies to measure social vulnerability to climate change (Adger 1999). Pelling (1997) also attempted to identify determinants of social vulnerability to floods. Brouwer et al. (2007) measured household vulnerability to floods in Bangladesh using specific indicators such as income, income sources, distance from houses to rivers, the depth of flood water and economic losses. The limitation of measuring vulnerability is identifying a social group or community that lacks the ability to cope with stresses in terms of welfare losses. However, the concept of social resilience not only concerns the ability to respond positively to stresses but also addresses the innovative aspect

of resilience, or the capacity to learn and transform (Walker et al. 2004). Marshall and Marshall (2007) argued that the capacity of resource users to respond positively to change is related to levels of well-being. Marshall and Marshall (2007) used 17 items to represent expected levels of well-being. They used four-point Likert scales to ask respondents about their attitudes to coping with policy changes.

The resilience of individuals has also been measured using information from health studies (Wagnild and Young 1993: 168). Wagnild and Young (1993: 168) developed 25 items to measure individuals' resilience to stress, using seven-point scales. Higher scores reflect a higher level of resilience. Kathryn et al. (2004) developed the Connor-Davidson resilience scales, which measure the stress-coping capacity of individuals. The scales include 25 items with five-point scales, which were validated in Chinese societies (Yu and Zhang 2007).

As rural households in the MRD have experienced the impacts of annual flooding for years, the ability of households to live with, adapt to, and benefit from floods reflects their resilience to floods. Recognizing the advantages of Marshall and Marshall's approach in measuring the social resilience of resource users to policy changes, this report attempts to adapt and modify this approach in order to measure household resilience to floods in a Vietnamese context. If households have high levels of well-being, they are expected to be highly resilient to floods. Nine attitudinal statements, which reflect the expected well-being of rural households in flood-prone areas, were developed from qualitative data. Securing houses, food and income, and interest in learning new ways of adapting to floods were mostly perceived as the most important indicators of adaptation to living with floods. In other words, households that can secure food, income and their homes and are interested in learning new flood-based livelihoods are more resilient to flooding. Items were checked and pre-tested before the real survey. Data were checked for skewness and kurtosis or normality, and questions were modified or omitted if necessary. Respondents were asked to rate their attitude to each of the final nine items using a five-point Likert scale (Table 6).

After conducting factor analysis, a reliability test was conducted to select the best items for each underlying factor. Factor scores of factors that have eigenvalue greater than 1 were chosen as resilience indicators. Those factor scores were treated as latent variables (dependent variables) for further analysis in the multiple regressions.

Table 6. Proportion of respondents who answered five-point Likert scale questions (nine items)

Items	Statements	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
1	I can replace quickly when my house is affected by floods.	8.50	28.10	3.70	32.46	27.23
2	I am confident that my house will not be submerged by the highest floods in the last 20 years.	10.46	24.40	4.36	22.22	38.56
3	I am confident that my house will not collapse or be swept away by the highest floods in the last 20 years.	13.51	25.93	6.75	23.53	30.28
4	I am confident that my household has enough rice to eat during the flood season.	8.06	23.53	4.79	31.37	32.24
5	I am confident that my household will not need to borrow rice or money from informal sources during the flood season.	11.55	25.93	4.79	32.68	25.05
6	I am confident that my household can find a safe place to evacuate to if there is an extreme flood event in the future.	9.15	25.93	15.25	37.04	12.64
7	I am confident that children and elderly people are safe during the extreme flood.	1.53	6.97	10.68	48.15	32.68
8	I am confident that the health of my family members will not be negatively affected by the flood.	1.74	12.20	13.73	54.03	18.30
9	I want to learn new farming practices to cope with floods, such as fishing, prawn farming.	13.07	40.74	1.09	29.41	15.69

Five-point Likert scores (1) Strongly Disagree; (2) Disagree; (3) Neither Agree or Disagree; (4) Agree; (5) Strongly agree

Results from the factor analysis indicated that five out of nine statements reliably contributed to the scale, forming the basis for measuring household resilience to floods in this study (Table 7). The factor analysis showed that the responses to the statements were best described by three factors, representing three resilience factors. These total factors represented 88.79% of the variance. The first component, representing 46.79% of the variance, consisted of statements related to the level of future floods that households are confident will not affect their home (either via submersion or collapse), using the big flood of 2000 as an extreme benchmark. This resilience factor represents the capacity of households to secure their homes. Those items include; (1) I am confident that my house will not be submerged by the highest floods in the last 20 years, and (2) I am confident that my house will not collapse or be swept away by the highest floods in the last 20 years. The second component represents 22.0% of the variance, and includes statements relating to securing food and income during the flood season. This resilience factor includes; (1) I am confident that my household has enough rice to eat during the flood season, and (2) I am confident that my household will not need to borrow rice or money from informal sources during the flood season. The third component, representing 20.02% of variance, comprised only one statement, relating to interest in learning new flood-based farming practices as a means of

adapting to floods (I want to learn new farming practices to cope with floods, such as fishing, prawn farming.).

As a rule of thumb alpha should be at least 0.7 for the scale to be reliable. Reliability analysis for resilience factor one showed that Cronbach's alpha coefficient is reliable (0.89). Results from reliability analysis for factor two indicated that Cronbach's alpha coefficient is 0.73, so it is also reliable. Factor three has only one item. The resilience indexes derived from the factor analysis were used as dependent variables for further analysis to examine the effects of socio-economic variables, social capital and livelihood adaptation on household resilience. We used the standardized form of each factor as a latent variable, which was created by SPSS, for further analysis in the multiple regressions.

Table 7. Factor matrix of household resilience, MRD, Vietnam, 2010 (five items)

Survey items	Factor loadings			Communality
	Factor 1	Factor 2	Factor 3	
I am confident that my house will not be submerged by the highest floods in the last 20 years.	0.94			0.907
I am confident that my house will not collapse or be swept away by the highest floods in the last 20 years.	0.93			0.901
I am confident that my household has enough rice to eat during the flood season.		0.869		0.804
I am confident that my household will not need to borrow rice or money from informal sources during the flood season.		0.902		0.828
I want to learn new farming practices to cope with floods, such as fish and prawn farming.			0.999	0.999
Eigenvalues	2.33	1.10	1.00	4.43
% of variance	46.75	22.00	20.02	88.77

(1) Strongly disagree; (2) Disagree; (3) Neither agree or disagree; (4) Agree; (5) Strongly agree.
Selected factor having eigenvalue greater than 1.
Select variables with factor greater than 0.3.

3.6.2 Constructing social capital indexes

Neighbourhood attachment index

Neighbourhood attachment is considered an important form of social capital within local communities in terms of health outcomes and job attainment in Australia and the UK. Cauchy et al. (2003) used an individual's attachment to their community as an indicator of social capital that has an effect on the mental health of children. Cauchy et al. (2003) used 13 items with five-point Likert scales to measure perceived psychological sense of community as indicators of attachment to the community. Ziersch et al. (2005) measured several components of neighbourhood social capital in South Australia, including: (1) neighbourhood connection; (2) neighbourhood safety; (3) neighbourhood trust; (4) neighbourhood population; and (5) reciprocity. Ziersch et al. (2005) found that neighbourhood safety is positively associated with physical health, while neighbourhood connections and safety are positively associated with mental health. Li et al. (2005) found neighbours to be an important resource for individuals seeking jobs in the UK. Li et al. (2005) used neighbourhood attachment as an indicator of neighbourhood social capital. According to Li et al. (2005: 111) *"neighbourhood attachment means the degree to which people are attached their neighbours"*. Li et al. (2005) used both attitudinal and behavioural questions to ask

respondents about their level of local attachment to their neighbourhood. However, the effect of neighbourhood attachment social capital on resilience to natural hazards has been neglected in the literature.

In the MRD, neighbours are resources for coping with and adapting to annual flood events. Neighbours help their neighbours to evacuate and they lend them money and food. Neighbours also share information with each other about ways of exploiting the benefits of the flood season, such as farming techniques, collecting fish and snails, and growing vegetables. Neighbours also assist their neighbours in strengthening their houses for coping with floods before each flood season begins. Firstly, neighbourhood attachment was measured using twelve attitudinal and behavioural statements with five-point Likert scales. The items were generated from focus group discussions and in-depth interviews with key informants in the project areas. The aim when designing items for this study was to incorporate issues specifically related to living with floods into measures of neighbourhood attachment. In particular, the items cover several dimensions of neighbourhood life including: (1) daily social relationships with neighbours such as participation in recreational activities (playing Chinese chess, taking part in sport, drinking coffee with neighbours at local coffee shops; (2) receiving favours from neighbours; (3) giving favours to neighbours, such as helping when people are sick or affected by extreme floods; (4) participating in hamlet meetings to discuss issues connected to coping with floods, and religious ceremonies such as visiting Hòa Hảo temples or Buddhist pagodas every month. The neighbourhood attachment of a household is cultivated by daily activities in the community. To identify the underlying factors of social capital of neighbourhood attachment, a factor analysis was carried out using the principal components for extraction and the verimax rotation approach. The factor scores of factors that have eigenvalues greater than 1 were selected as indexes of neighbourhood attachment social capital. Households with higher scores are more likely to attach closely to their neighbours. The indexes were treated as latent variables to examine their effects on the three properties of resilience in the multiple regressions.

Factor analysis indicated that the responses to the statements were best described by two factors (Table 8). These total factors represented 38.3% of the variance. The first component, representing 26.5% of the variance, consisted of statements related to associational activities or the daily life relationships respondents have with neighbours and participation in informal institutions to discuss ways of coping with the flood season. These included: regularly drinking coffee or tea together; discussing with neighbours ways of living with floods; regularly participating in recreational activities in the neighbourhood; regularly participating in religious ceremonies such as visiting Hòa Hảo temples or Buddhist pagodas every month; regularly participating in hamlet meetings to discuss ways of coping with flooding; and regularly participating in important community events such as conflict resolution. The second component, representing 11.7% of variance, consisted of statements related to the perceived value of the neighbourhood. These included; (1) my neighbours mean a lot to me, and (2) advice is available from my neighbours when I face difficulties. Respondents were asked to state their satisfaction with, or level of agreement on, the value of their neighbourhood and the availability of resources (advice) they receive when in need.

The reliability test was used for testing the reliability of the scales. The result of the reliability analysis showed that Cronbach's alpha is 0.69 for factor one and 0.35 for factor two. The item-total correlations indicated that the coefficient of underlying items of factor one was greater than 0.3, which is reliable for forming part of a unidimensional scale. Factor two's Cronbach's alpha was too low so it was dropped. Only factor one was used for further analysis in the multiple regressions. The factor scores derived from neighbourhood attachment social capital were incorporated into the multiple regressions as independent

variables to see their effects on the resilience of households. By using indexes of different resilience factors, demographic variables such as the age of respondents, gender, household size, social capital of respondents, and willingness to adapt livelihood can be analyzed using both bivariate and multivariate analysis.

Table 8. Factor matrix of social capital (neighbourhood attachment, MRD, 2010, 10 final items)

Items (N=459)	Factor loading		Communality
	Factor 1	Factor 2	
My neighbours mean a lot to me.		0.75	0.56
Advice is available from my neighbours when I face difficulties.		0.74	0.55
I regularly have coffee/tea with my neighbours.	0.53		0.35
I discuss ways of living with the flood season with my neighbours.	0.63		0.42
I regularly participate in recreational activities in the neighbourhood.	0.53		0.28
I regularly participate in cultural and religious activities in the neighbourhood.	0.45		0.21
I regularly participate in hamlet meetings to discuss ways to cope with flooding.	0.61		0.37
I help my neighbours out with money or rice when they are affected by extreme flooding.	0.59		0.40
I am regularly invited to attend parties (weddings, birthdays, etc.).	0.57		0.32
I am regularly invited to participate in important events in the neighbourhood such as conflict resolution.	0.59		0.36
Eigenvalues	2.66	1.18	3.84
Percentage of variance	26.59	11.78	38.37

Statements were measured on a five-point Likert scale: (1) Strongly disagree; (2) Disagree; (3) Neither agree or disagree; (4) Agree; (5) Strongly agree.
Selected factor has eigenvalue greater than 1.
Selected variables have factor greater than 0.3.

Participation in groups and associations index

Most economists attempt to construct a composite index of social capital. Because social capital means both quality and quantity of membership of groups, an index is created as a proxy to measure activity in associations (Grootaert 2002; Grootaert, Oh and Swamy 2002; Maluccio, Haddad and May 2000; Narayan 1999; Narayan and Pritchett 1997; Nguyễn Văn Hà, Kant and MacLaren 2004). This type of social capital can be measured by a composite index of group membership, characteristics of groups that households were members of, levels of trust in various groups, and perceptions of social cohesion. However, Nguyễn Văn Hà et al. (2004) use the per capita of group and association membership in a household as a measure of association activities or participation in groups in a Vietnamese context. This research report adopted the approach taken by Nguyễn Văn Hà et al. (2004) to construct an index of participation in groups and associations. Respondents were asked whether or not they were members of 17 local groups and associations. This list of local groups and associations was put together with information given during focus group discussions (Table 9). If more than one household member belonged to a group or association, the study treated this as one membership only. No weighting was given to any group or association. The index of participation in groups and associations is the number of

different memberships a household has. If households have higher membership of local groups and associations, they are more likely to access a greater amount of formal social capital.

Table 9. Participation in formal groups and associations

No	Participation in formal associations (N=459)	Yes	No	%Yes
1	Farmers' association	78	381	17.00
2	Women's association	75	384	16.30
3	Youth union	41	418	8.90
4	Father's front	4	455	0.90
5	Retired soldiers	15	444	3.30
6	Red cross	49	410	10.70
7	Aged people's association	28	431	6.10
8	Farmers' club	18	441	3.90
9	Loan saving group	11	448	2.40
10	Flood response rescue team	20	439	4.40
11	Agricultural cooperatives	10	449	2.20
12	Religious groups	44	415	9.60
13	Fishery association	5	454	1.10
14	Recreational and art club	23	436	5.00
15	Snail collecting group	2	457	0.40
16	Hamlet security group	55	404	12.00
17	Local authority	2	457	0.40

Note: if a household had more than one member in a particular group or association, this study treated this as one membership.

Social supportive networks index

According to Li et al. (2005: 112) "social networks measure people's interaction with those beyond immediate family, and the extent to which people feel they have supportive networks". This report adopted its method of measuring social networks from Li et al. (2005). However, a modification was made with regard to the construction of the responses to the items that address issues of living with floods. Dichotomous choice (Yes, No) was used to ask respondents to check their support networks for coping with daily life and floods (Table 10). This study applied a weighted measure for each item in constructing a social network index. The weight used for each variable is the reciprocal of the proportion of respondents who answered "yes" they need a network of support. This approach was used by Utomo (1997: 105) when creating an index of sexual behaviour from a set of items. The approach demonstrates that the item with a higher level of frequency means "less important" because most people have the same access status. On the other hand, if an item has a lower level of response, it will be given a greater weight. Weighting was calculated by dividing the total number in the sample with the number of "yes" responses. Then each item was replaced by a weighted score if they said "yes". Otherwise, each item was replaced by 0 if they said "no". The index of social supportive networks for each respondent is the sum of those weighted scores. Respondents with greater weighted scores have more social supportive networks. This index was treated as a latent variable to examine the relationship between social networks and household resilience indexes.

Table 10. Social networks of respondents, MRD, 2010

No	Social network (n=459)	Yes	Weight
1	If you need VND 1,000,000 urgently, can you borrow it immediately?	337	1.36
2	Is there anyone who trusts you to advise them?	404	1.14
3	Is there anyone who helps you out when you have financial difficulties?	367	1.25
4	Is there anyone to help you to learn new skills for exploiting the benefits of floods?	89	5.16
5	Is there anyone to lend you money or rice during the flood season if you need these things in an emergency?	397	1.16
6	Is there anyone to lend you a boat during the flood season if you need one?	376	1.22
7	Is there anyone to help you to access public relief/assistance from the Government, NGOs, and local religious groups if you need it?	208	2.21
8	Is there anyone to help you move to a residential cluster if you want to move?	142	3.23
9	Is there anyone who invites you to participate in local cycling fund groups?	191	2.40

Weight is total sample divided by frequency of "Yes" for each item, e.g. weight of item one is 459/337, which equals 1.36. The total social supportive network index is the sum of the weight of nine items for each household.

3.6.3. Mean social capital indexes by the socio-economic conditions of the respondents

In general, respondents who have a lower household income, more females, and lower educational levels are more likely to have lower scores of neighbourhood attachment (Table 11). The F-test shows that there is a statistically significant difference between the mean index of neighbourhood attachment and income quintiles, the gender of the respondents and the education levels of respondents ($p<0.001$). Similarly, respondents who have a higher household income are more likely to have larger supportive networks ($p<0.001$). There is no statistically significant difference between the mean index of participation in groups and associations and household income. This means that social class does not necessarily determine the level of participation in groups and associations in the MRD. However, male respondents are more likely to participate in groups and associations. Indexes of social capital will be used as independent variables in the multiple regressions to examine their effect on household resilience.

Table 11. Mean indexes of social capital by the socio-economic conditions of the respondents

Socio-demographic variables	N	Neighbourhood attachment index			Social network index			Participation index		
		Mean	Std.	Sig.	Mean	Std.	Sig.	Mean	Std.	Sig.
Income quintiles				**			**			ns
1st quartile	91	-0.73	1.05		6.85	3.84		0.49	0.91	
2nd quartile	91	-0.18	0.86		8.63	3.67		1.14	1.37	
3rd quartile	93	0.10	0.99		9.17	3.96		1.02	1.30	
4th quartile	91	0.32	0.78		9.75	3.72		1.26	1.30	
5th quartile	93	0.48	0.85		9.78	3.83		1.29	1.39	
Respondent age group				ns			*			ns
From 25 to less than 40	81	-0.15	0.92		8.83	4.00		0.91	1.37	
From 40 to 60	255	0.06	0.99		9.33	4.00		1.12	1.29	
More than 60	123	-0.03	1.07		7.83	3.61		0.98	1.24	
Gender of respondents				**			ns			*
Male	330	0.18	0.93		8.99	3.98		1.12	1.37	
Female	129	-0.45	1.05		8.45	3.82		0.86	1.07	
Respondent education level				**			**			*
Never attended school	64	-0.62	1.20		6.79	3.71		0.53	0.84	
Primary education	246	-0.02	0.94		8.66	3.72		1.01	1.28	
Secondary education	107	0.30	0.83		10.10	4.03		1.29	1.32	
High school	37	0.24	0.98		9.78	4.03		1.32	1.62	
College	4	0.25	0.82		11.13	3.85		2.50	1.29	
Undergraduate and above	1	1.59	.		5.93	.		0.00	.	

Test of significant difference is based on F-test, **p<0.001, *p<0.05%; ns is not significant.
Neighbourhood attachment scores were standardized by SPSS software when running factor analysis.

3.6.4 Constructing the livelihood diversity index

The diversification of income sources is likely to be a viable livelihood strategy to maintain income during months of flooding. Most economists use the number of income sources as a proxy to measure livelihood diversity in studies of household vulnerability to floods and climate change. Adger (1999: 261) used diversity of income sources as a proxy of household vulnerability to climate change. Diversity was simply measured as the number of income sources reported by households (Adger 1999; Brouwer et al. 2007). The disadvantage of this approach is that the number of income sources does not necessarily reflect the distribution of each income source.

In rural livelihood studies, an inverse Herfindahl-Hirschman index (IHHD) is used to construct an income diversity index that reflects the level of livelihood diversification at household level. The IHHD is commonly used in studies of biodiversity and is also found in financial economics (Ellis 2000: 213). This approach, for example, was used to measure diversification of income sources at household level in rural Tanzania (Ellis 2000) and in rural India (Anderson and Deshingkar 2005). The index is calculated for each household using the entire range of income sources, rather than just group income sources. The IHHD is measured using the following equation:

$$\text{IHHDi} = \left[\frac{1}{\sum a_j^2}\right];$$

where, each aj represents the proportional contribution of each income source j to household j's overall income. The minimum value is 1 if all income is one source only, while the maximum possible value of this index is the total number of different income sources, which is attained if total income source is distributed equally between each source (Ellis 2000). For example, if a household has 25% for each of four income sources (rice, fish, livestock, and waged labour), then the IHHD is maximized. The advantage of this approach is that it can measure the diversity of household income, which reflects the proportional distribution of income sources. On the other hand, the simple approach of measuring the total number of income sources does not reflect the proportional distribution of income sources. However, this method requires well-designed questionnaires to capture the full range of livelihood activities of households during different periods of time. The limitation of this approach is that it cannot apply to a community with a single livelihood activity. If all the members of a community have only one income source, such as rice, then this index is not applicable.

This study uses the IHHD to measure livelihood diversity because it can reflect the distribution of each income source rather than simply measuring the number of income sources. If we use the simple measure of only the number of income sources as a proxy of livelihood diversification, it may not reflect the real distribution of each income source. Total income and the income sources of the households were measured for 12 months prior to the interviews. This approach has been commonly used to collect income data in developing countries, such as the Vietnamese Living Standard Household Survey. For production activities, such as rice and fish farming, the net benefit of each activity was estimated. The livelihood diversity index was plotted with household income quintiles to see whether there was a relationship between household income and the diversity index. The result showed that poor households are less likely to diversify income sources as they specialize on off-farm fishing or labour, while the medium household income quintile groups are more likely to diversify income activities as they have both land for farming and labour for off-farm fishing and labouring (Figure 6). Interestingly, the highest household income quintile groups are less likely to diversify income sources as they often own more land and specialize in agriculture or non-farm business. The livelihood diversity index was used in the multiple regressions as an independent variable.

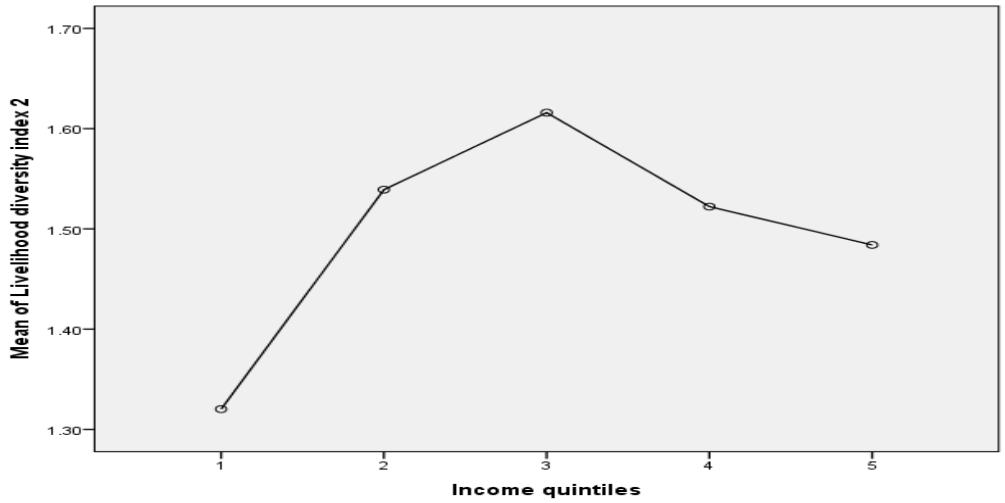

Figure 6. Relationship between livelihood diversity index and household income quintiles

3.6.5 Bivariate analysis

Several bivariate tests were conducted to identify the relationship between the perceived impacts of floods on rural livelihood activities and assets, the relationship between social resilience scores and livelihood diversity, and social capital scores. Cross tabulations (based on chi-square statistical analysis) were used to examine the relationship between two discrete variables. In this study, the chi-square test was used to investigate the relationship between flood impacts on household livelihoods and social groups. The F-test was used to determine the relationship between a discrete variable and a continuous variable if discrete variables have three or more categories. In case two variables both show continuous data, it is useful to use Pearson's correlation to examine the relationship between the two variables.

3.6.6 Multiple regressions

In multivariate analysis all factors concerning household demographics, social capital indexes, the livelihood diversity index, and livelihood specialization variables were included in the regressions as potential explanatory variables, whereas resilience factors (indexes) were treated as dependent variables (continuous variables). Multiple ordinary least square (OLS) regressions were employed to examine the effects of independent variables on resilience factors. Several variables such as gender, housing type, and regional flood factors, were used as dummy variables. The multiple regression models were as follows.

Resilience factor indexes = f(socio-demographic variables, social capital indexes, livelihood diversification index, livelihood specialization) + error

Most studies measure social capital using a composite index – very few studies disaggregate different forms of social capital. Nguyễn Văn Hà et al. (2004) used both disaggregated and aggregated forms of social capital to examine their effects on household well-being. Nguyễn Văn Hà et al. (2004) found that the composite index of social capital could not capture the full range of social assets in the Vietnamese context. Therefore, disaggregated measures of social capital are more persuasive to explain their effects on household income in Vietnam. This study examines the effects of three forms of social capital (neighbourhood attachment, social supportive networks, and participation in groups and associations) on household resilience to floods in the MRD.

3.6.7 Definition of variables

The latent variables obtained from the factor analysis used in the multiple regressions included household resilience indexes and neighbourhood attachment indexes. They are in standardized form, continuous values. Other socio-economic variables such gender, house type, and regional flood factors, were treated as dummy variables. Table 12 provides definitions of variables and their mean and standard deviation values.

Table 12. Definition of variables

Variables	Definition	Mean	Std.
Resilience indicators			
Resilience property one	The capacity of households to secure their homes in a flood event as big as the 2000 flood.	0.00	1.00
Resilience property two	The capacity of households to secure food and income during the flood season.	0.00	1.00
Resilience property three	The level of interest in learning new flood-based livelihoods in order to adapt to the flood season.	0.00	1.00
Social capital indicators			
Neighbourhood attachment index	Neighbourhood attachment index, measured by factor analysis from eight final items (continuous).	0.00	1.00
Social supportive network index	Social supportive network index, measured by sum scores of weighted nine items (continuous).	8.84	3.94
Participation in groups and association index	Number of groups and associations a household is a member of.	1.04	1.29
Socio-economic characteristics			
Household size	Number of household members	4.73	1.52
Sex	Gender of the respondents	1.28	0.45
Age of the respondent	Age in years	52.35	13.4
Ln (household income) in million VND	The log of household income in the previous 12 months	3.41	1.22
Pro. farm income	Proportion of farm income (ratio)	43.48	46.42
Pro. off-farm income	Proportion of off-farm income (ratio)	23.75	40.41
Pro. non-farm income	Proportion of non-farm income (ratio)	16.71	29.68
IHHD index	Livelihood diversity index (continuous) is measured by $\left[\frac{1}{\sum a_j^2}\right]$ where each aj represents the proportional contribution of each income source j to household j's overall income.	1.49	0.54
Housing types			
Permanent concrete houses	Houses built on concrete permanent stilts or on ground above the flood level of 2000, dummy; 1=yes, 0=no.	0.39	0.48
Simple houses on wooden stilts	Houses built on stilts, dummy; 1=yes, 0=no.	0.61	0.48
Houses in residential clusters	Houses located in a residential cluster, dummy, 1=yes, 0=no.	0.14	0.34
Houses located beside dykes or roads	Houses located beside dykes or road, dummy, 1=yes, 0=no.	0.55	0.49
Regional flood factor			
High flood region	Households located in a high flood region (dummy, 1=yes, 0=no).	0.33	0.47
Moderate flood region	Households located in a moderate flood region (dummy, 1=yes, 0=no).	0.35	0.47
Low flood region	Households located in a low flood region (dummy, 1=yes, 0=no).	0.33	0.47

4.0 RESULTS AND DISCUSSION

4.1 Impacts of Different Flood Levels

The findings show that flood impacts on household livelihood activities and assets are both good and bad. However, most people found that big floods have negative impacts, with fewer people experiencing negative impacts with moderate flooding. Interestingly, small levels of flooding were perceived to have slightly greater negative impacts on rural livelihoods than moderate flooding. The results indicate that 83.7% of the respondents thought that big floods brought negative impacts, 55.7% perceived the impacts of moderate flooding to be negative, whereas 58.3% viewed small floods as having negative impacts (Figure 7).

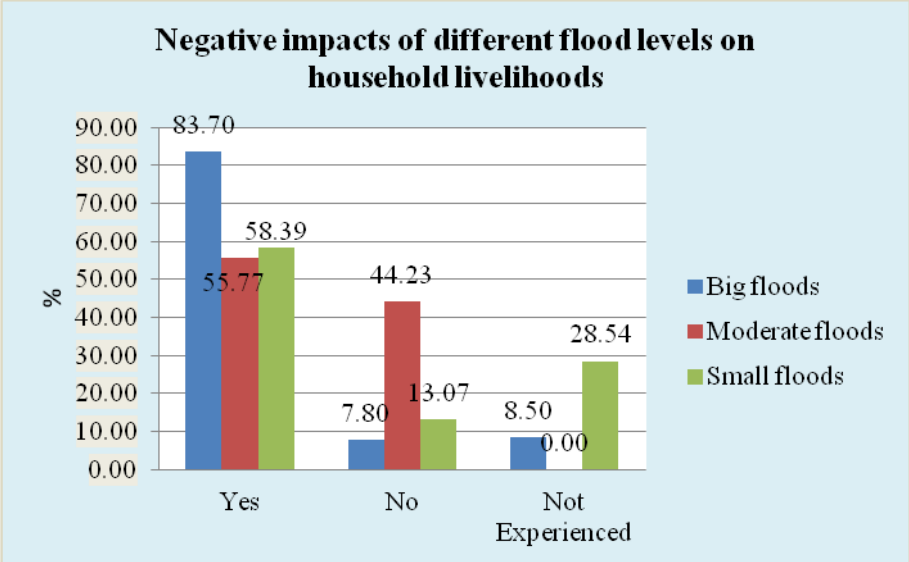

Figure 7. Negative impacts of different flood levels on household livelihoods

In contrast, annual flood events also provide benefits to rural livelihoods. In particular, 90.2% of respondents perceived moderate floods to have benefits; 84.7% of respondents thought that big floods also provide benefits, while only 62.7% of respondents pointed out the benefits of small floods (Figure 8). In summary, moderate floods can be judged to be best for rural livelihoods because they bring more benefits and less harm to local people.

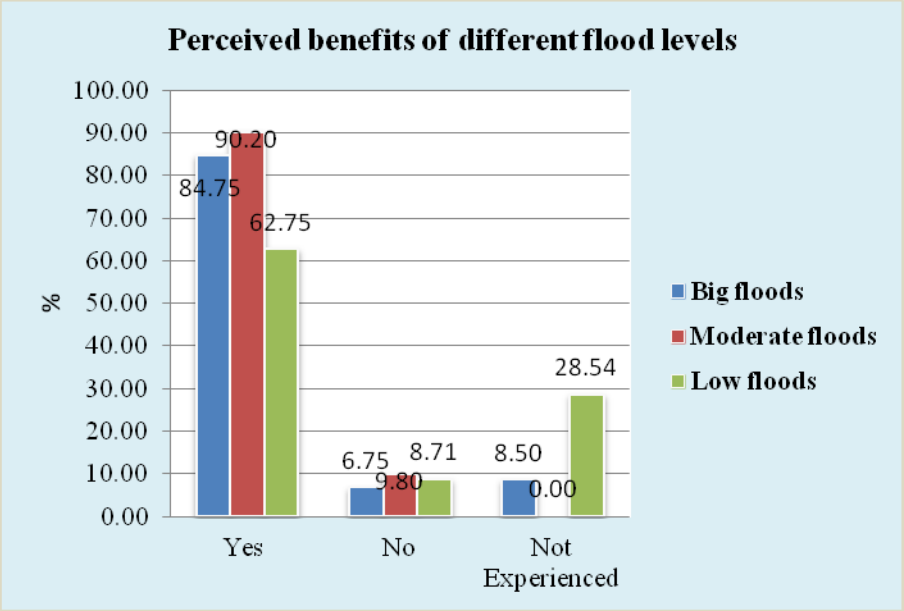

Figure 8. Perceived benefits of different flood levels

4.1.1 Negative impacts of big floods on household livelihood activities and assets

The negative impacts of big floods cover a wide range of livelihood activities and assets, from housing, food, income, anxiety, migration, and evacuation to education. However, more respondents experienced the difficulties presented by submerged houses, anxiety about flooding, a lack of rice to eat during the flood season, loss of jobs and destroyed homes. The results show: 61.2% of respondents reported that big floods submerge their homes; 60.5% of respondents experienced stress; 46.4% of respondents experienced a shortage of rice to eat during the flood season; 36.1% of respondents lost their jobs; 28.5% of respondents experienced the loss of their homes; 21.3% of respondents experienced disruption to their education; 15.9% of respondents lost crops; 15.4% of respondents had to seek jobs in non-flooded areas; 13.7% of respondents reported a reduced income from fishing in years with big floods; 9.3% of respondents had to evacuate during big floods. Around 5.0% of respondents reported total damage to their homes, the death of animals, and adverse effects on prawn and fish farming from a big flood event (Figure 9).

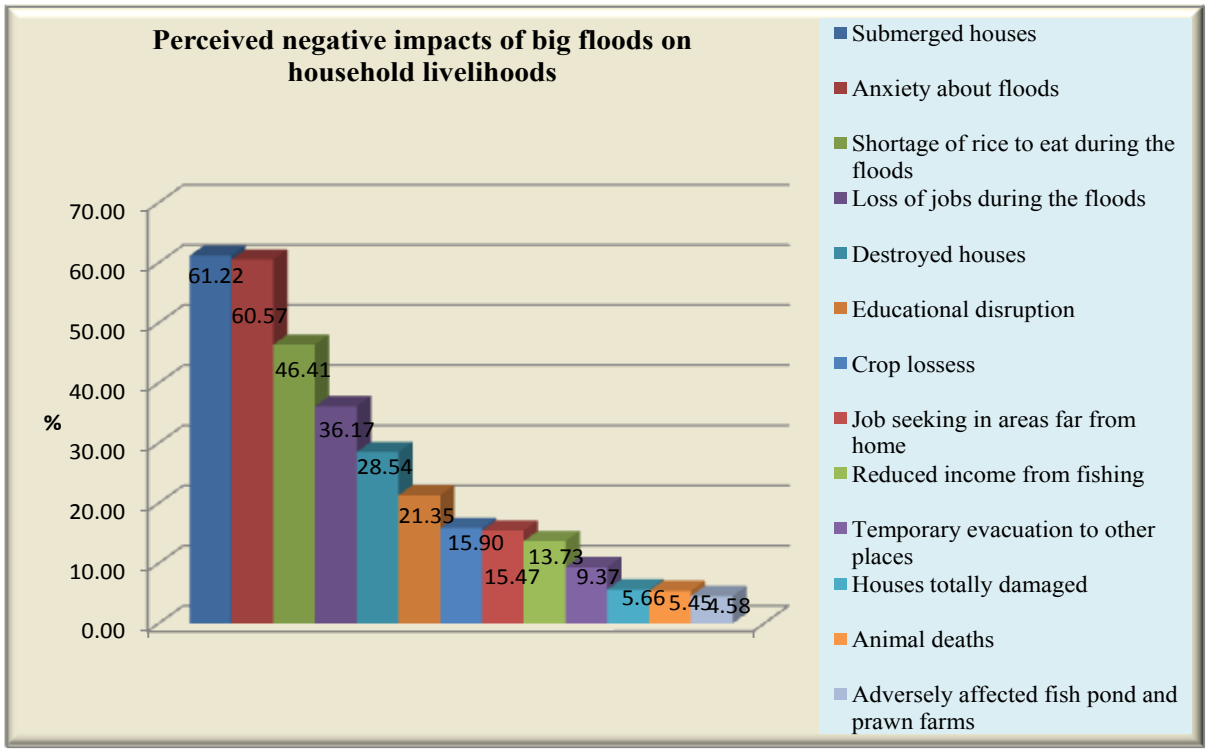

Figure 9. Perceived negative impacts of big floods on household livelihoods

The impacts of big floods vary according to social group (Table 13). However, poor people were more likely to experience submerged homes ($p<0.05$); job losses ($p<0.05$); destroyed houses ($p<0.001$); job searching far from home ($p<0.05$); reduced income from fishing ($p<0.05$); temporary evacuation ($p<0.05$) and total house damage ($p<0.05$) than medium-income and better-off households. Reasons for this include: poor households often have simple houses, and their primary income sources are dependent on unstable off-farm fishing and agricultural labour. When big floods occur over a long period of time, poor people are the most vulnerable group due to the extent of damage to their homes and the loss of income they suffer. However, medium-income and better-off households are more likely to experience a loss in rice crop than poor households because they own larger areas of rice-farming land.

Information from focus group discussions shows that the impacts of floods on houses vary among different social classes. Most respondents in the high and moderate flood-prone regions thought that big floods have negative impacts on the housing sector. However, most of the respondents who experienced submerged and destroyed homes in the big flood of 2000 were poor. A female group in the moderate and high flood-prone regions reported that the floods of 1978 and 2000 destroyed many poor households in Phú Đức commune. Many houses were not completely destroyed but they were submerged to the floor or roof level. Additionally, most poor households build their houses along internal canals that are subject to annual flooding. Typically, most poor households live in small and simple houses, which can easily be swept away by strong flood waves, winds and storms. In contrast, most medium-income and better-off households have houses constructed on concrete stilts, which are less likely to be affected by big floods.

Most houses in this village were submerged in the big flood in 2000. Most of the house walls were damaged. Because the walls were made of simple materials such as leaves and melaluca trees, it was easy for them to be damaged in a big flood year. Many houses were blown by strong winds from the other side of this canal to here in the 2000 flood.

[Mr Tiến, aged 34, a poor man, president of the youth union in Phú Xuân hamlet, Phú Đức commune, FGD_PD1]

Table 13. The impacts of big floods on household livelihood activities and assets by social group

Negative impacts from the big flood (%)	Social group			Total
	Poor	Medium	Better-off	
N	181	132	146	459
Submerged houses **	71.82	58.33	50.68	61.22
Anxiety about floods ns	65.19	58.33	56.85	60.57
Shortage of rice to eat during the floods ns	71.27	40.15	21.23	46.41
Loss of jobs during the floods**	46.96	28.03	30.14	36.17
Destroyed houses***	45.30	19.70	15.75	28.54
Educational disruption ns	23.20	18.18	21.92	21.35
Crop losses**	8.29	16.67	24.66	15.90
Job seeking in areas far from home**	25.97	8.33	8.90	15.47
Reduced income from fishing**	21.55	7.58	9.59	13.73
Temporary evacuation to other places**	16.02	4.55	5.48	9.37
Total house damage**	9.94	5.30	0.68	5.66
Animal deaths ns	3.87	6.06	6.85	5.45
Adversely affected fish pond and prawn farms ns	6.08	3.03	4.11	4.58

Test of significant difference is based on chi-square, ***p<0.001, ** p<0.05%; ns is not significant.

Housing is perceived to be the asset most vulnerable to flood events. Big floods may seriously affect the houses of the poor but there may be no or few effects of moderate and small floods on poor houses in a given flood-type area or region. However, housing is less likely to be vulnerable to the impacts of annual flood events if homes are moved to residential clusters. People who live in residential clusters are confident that their houses will not be affected by floods, even if they reach as high as the 2000 flood.

Now I have moved to a residential cluster so my house has not been submerged by floods in recent years. In 2000 my house was located in the internal canal (trong kênh nội đồng). When the flood submerged my house in 2000, I had to stay in the roof of the house (cánh én) for several days.

[Mrs Nước, aged 35, a poor woman, in Phú Xuân hamlet, Phú Đức commune, FGD_PD3]

4.1.2 Perceived benefits from big floods to household livelihood activities and assets

Big floods bring several benefits to rural households (Figure 10). A high percentage of respondents (84.7%) reported benefits as a result of big flood events. A total of 69.58% of respondents thought that big floods kill rats and mosquitoes. Rice farmers reported that they

gained good yields after each big flood season (51.6%). Nearly half of respondents asserted that a big flood event helps them to reduce input costs for the winter-spring rice crop (46.4%), improves the fish yield (42.2%), and allows them to take leisure time during the flood season (41.3%). Very few respondents mentioned the benefits of a big flood with regard to collecting snails and crabs (10.0%), or to farming fish and prawns (5.0%) and ducks (4.7%). Rice farming and fishing were perceived as benefitting the most from a big flood event.

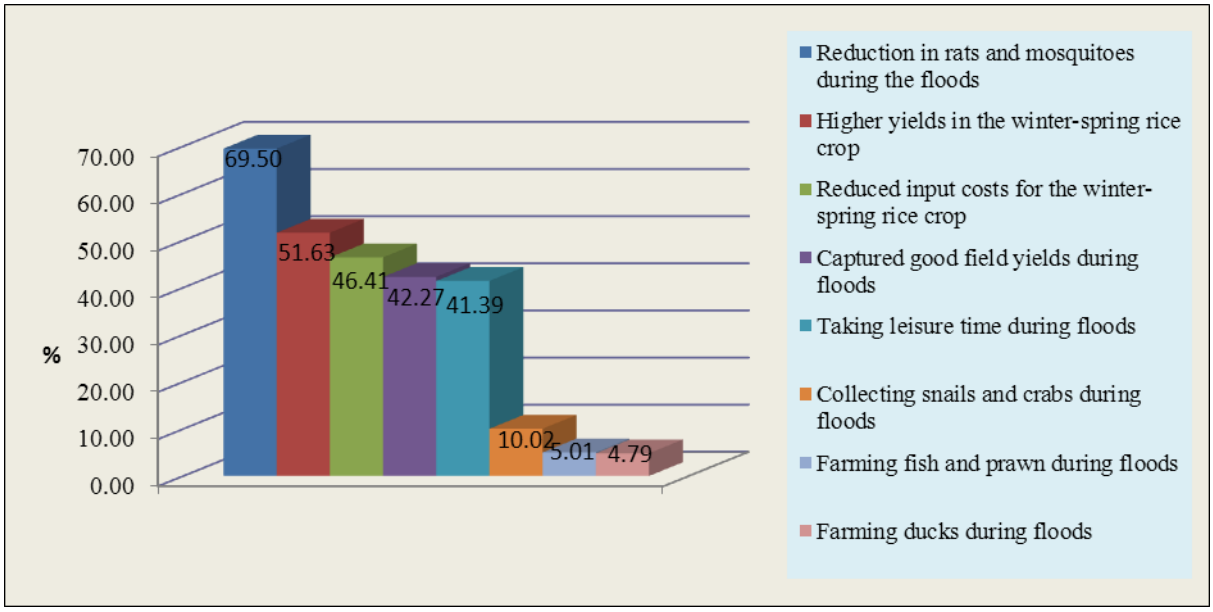

Figure 10. Perceived benefits of big floods on household livelihoods

Better-off households and medium-income households are more likely to benefit from a big flood than poor households in terms of improving rice yield as well as in terms of reducing the input for the winter-spring crop, while poor households are more likely to benefit from off-farm collecting. The chi-square test shows that according to social class there is a statistically significant difference in the perceived benefits of a big flood on the following: gaining a high yield after a flood ($p<0.001$); reducing input costs for the winter-spring rice crop ($p<0.001$); taking leisure time during the flood ($p<0.001$); and reducing the number of rats and mosquitoes during the flood ($p<0.05$) (Table 13). In contrast, poor households experienced more benefits of a big flood as "good" for collecting crabs and snails than medium-income and better-off households ($p<0.05$). This means that poor households were more likely to engage in off-farm fishing and collecting activities, so they were more likely to perceive such benefits. Interestingly, better-off households were more likely to report that a big flood gave them the benefit of leisure time, while poor and medium-income households were busier during the flood season because they have to work in order to survive (Table 14).

Table 14. Perceived benefits of a big flood to household livelihood activities and assets by social group

	Social classes			Total
Benefits of the big flood (%)	**Poor**	**Medium**	**Better-off**	
N	181	132	146	459
Reduction in rats and mosquitoes during the floods**	59.67	76.52	75.34	69.50
Higher yields in the winter-spring rice crop***	17.68	68.94	78.08	51.63
Reduced input costs for the winter-spring rice crop***	14.36	63.64	70.55	46.41
Good fish yield during the floods^{ns}	44.75	42.42	39.04	42.27
Taking leisure time during floods***	28.73	40.91	57.53	41.39
Collecting snails and crabs during floods**	14.92	10.61	3.42	10.02
Farming fish and prawn during the floods^{ns}	6.08	4.55	4.11	5.01
Farming ducks during the flood ^{ns}	4.97	6.82	2.74	4.79

Test of significant difference is based on chi-square, ***p<0.001, ** p<0.05%; ns is not significant.

4.1.3 Negative impacts of moderate floods on household livelihood activities and assets

Moderate flooding has fewer negative impacts on household livelihoods in general. However, worrying about a shortage of rice to eat, anxiety about floods, and job losses during the flood season were perceived by the respondents (Table 10). Some 55.7% of respondents have experienced the negative impacts of moderate floods in their lives. A total of 30.3% of respondents have experienced a shortage of rice during flooding, and 28.3% have experienced stress. Some 23.0% of respondents have suffered from job losses. Just about 17.0% of respondents have experienced disruption to fishing, destroyed homes (11.5%) and submerged homes (11.7%) (Figure 11).

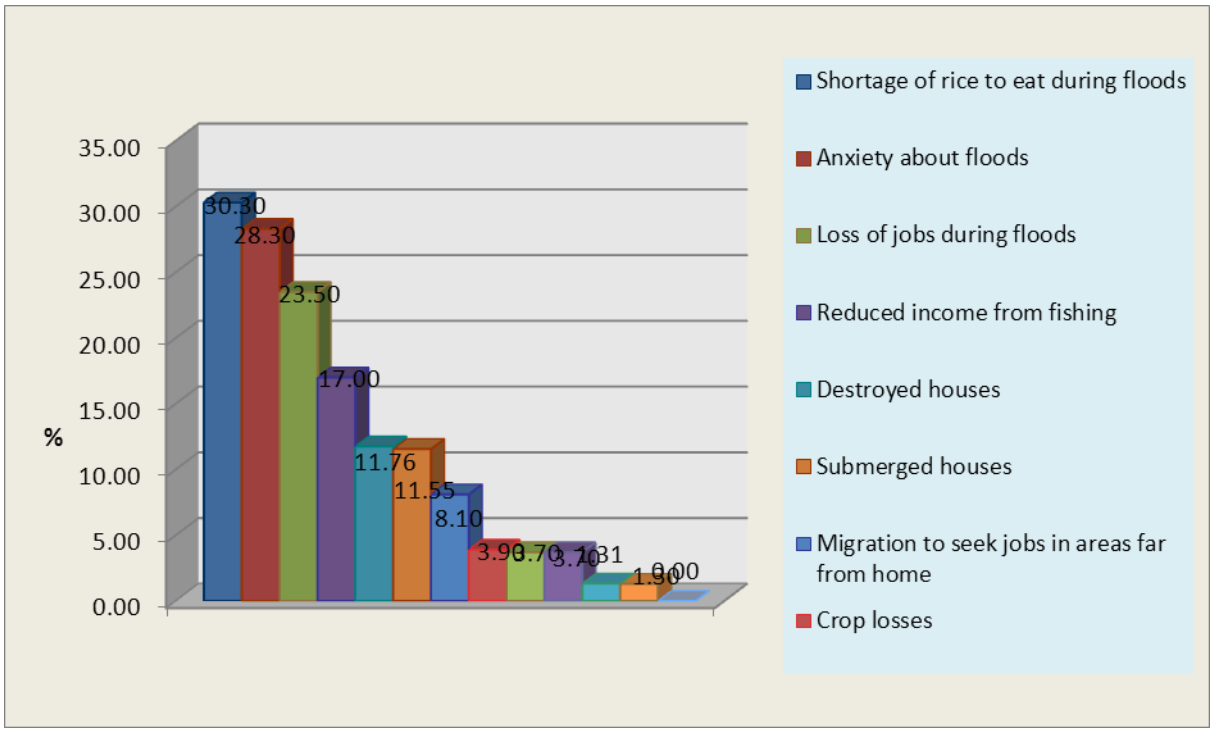

Figure 11. Perceived negative impacts of moderate floods on household livelihoods

None of the respondents have experienced total house damage as a result of moderate flooding. Very few respondents (just under 5.0%) have experienced crop losses, evacuation, animal deaths, seasonal migration or educational disruption during a moderate flood season.

Although moderate flooding was perceived to have fewer negative impacts on rural households' livelihoods than a big flood event, poor households were still more likely to experience a shortage of rice during the flood season ($p<0.001$); anxiety about floods ($p<0.001$); job losses ($p<0.001$); losses in fishing income ($p<0.05$); submerged houses ($p<0.001$); and destroyed homes ($p<0.001$) (Table 15). None of the respondents experienced total house damage. There was no statistically significant crop loss among the social groups.

Table 15. Negative impacts of moderate floods by social group

Negative impacts from moderate floods (%)	**Social group**			**Total**
	Poor	**Medium**	**Better-off**	
N	181	132	146	459
Submerged houses***	20.99	4.55	6.16	11.55
Anxiety about floods***	44.20	18.94	17.12	28.32
Shortage of rice to eat during the floods***	64.64	12.12	4.11	30.28
Loss of jobs during the floods***	35.36	12.88	18.49	23.53
Destroyed houses***	21.55	6.82	4.11	11.76
Educational disruption**	6.08	0.00	4.11	3.70
Crop losses [ns]	2.76	2.27	6.85	3.92
Migration to seek jobs in areas far from home***	18.78	1.52	0.68	8.06
Reduced income from fishing**	24.86	9.85	13.70	16.99
Temporary evacuation to other places [ns]	2.76	0.00	0.68	1.31
Total house damage	0.00	0.00	0.00	0.00
Animal deaths	3.31	3.03	4.79	3.70
Affected fish ponds and prawn farms[ns]	1.10	0.76	2.05	1.31

Test of significant difference is based on chi-square, ***$p<0.001$, ** $p<0.05$%; ns is not significant.

4.1.4 Perceived benefits to household livelihood activities and assets from moderate floods

Interestingly, most respondents perceived a gain in yields as a result of moderate flooding (90.2%). The second notable benefit from moderate floods was fewer rats and mosquitoes (60.1%), followed by reduced input costs (51.4%), increased fish yields (41.6%), more fish farming (33.6%), more leisure time (12.4%), better duck farming (8.7%), and increased collecting of snails and crabs (6.1%) (Figure 12).

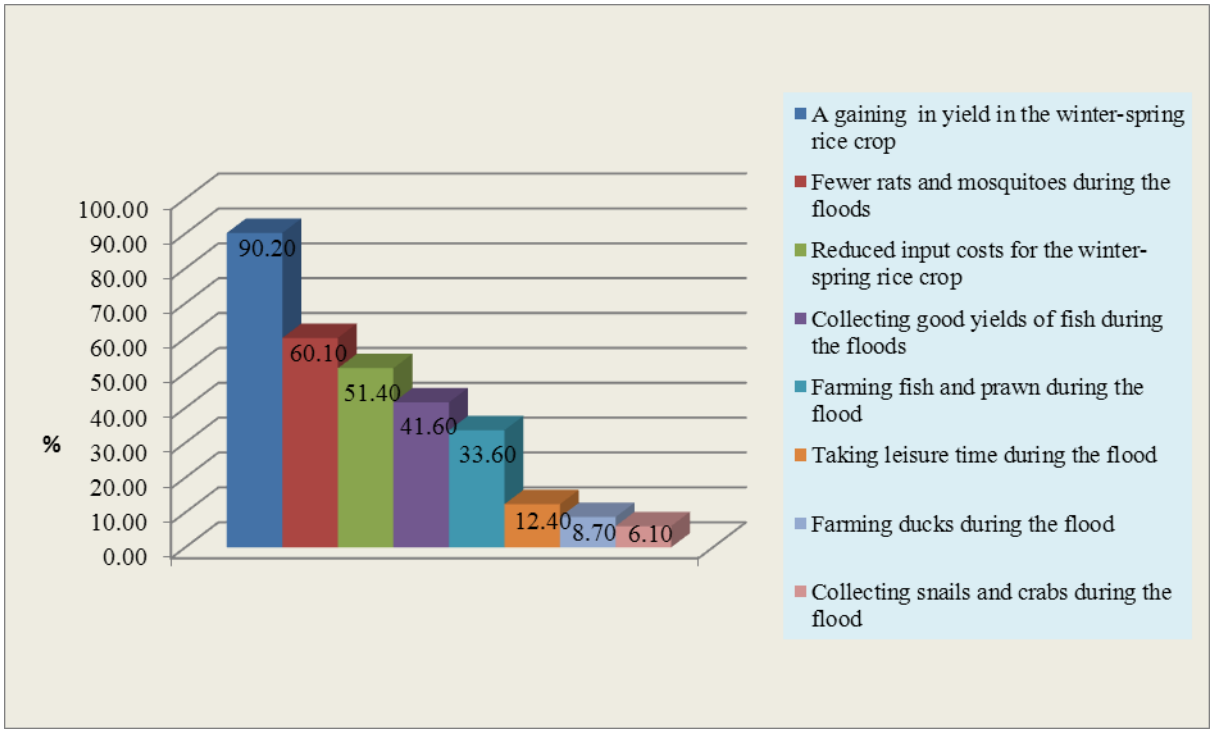

Figure 12. Perceived benefits of moderate floods on household livelihoods

The results from the chi-square test indicate that medium-income and better-off households are more likely to benefit from moderate floods in terms of gaining good rice yields ($p<0.001$); reducing input costs for the winter-spring rice crop ($p<0.001$); and taking leisure time during the flood ($p<0.05$). However, poor households also experienced good yields of fish ($p<0.05$) and more collecting of snails and crabs ($p<0.05$) (Table 16). Poor households were more likely to work harder during the flood in order to survive.

Table 16. Benefits of moderate floods by social group

Benefits of moderate floods (%)	**Social group**			**Total**
	Poor	**Medium**	**Better-off**	
N	181	132	146	459
Fewer rats and mosquitoes during the floods ^{ns}	54.70	67.42	60.27	60.13
A gain in yield in the winter-spring rice crop***	14.92	68.18	81.51	51.42
Reduced input costs for the winter-spring rice crop***	13.81	56.06	63.01	41.61
Collecting good yields of fish during the floods**	40.88	37.12	21.23	33.55
Taking leisure time during the flood***	29.83	40.91	58.90	42.27
Collecting snails and crabs during the flood**	17.13	12.88	6.16	12.42
Farming fish and prawn during the flood ^{ns}	7.18	6.06	4.79	6.10
Farming ducks during the flood ^{ns}	7.18	9.85	6.16	7.63

Test of significant difference is based on chi-square, ***p<0.001, ** p<0.05%; ns is not significant.

4.1.5 Experiences of the negative impacts of small floods on household livelihood assets and activities

Small floods were also perceived to bring costs to rural households. A total of 58.39% of respondents said that the impacts of small floods were negative, with the following negative impacts: 44.8% of respondents thought that small floods bring more rats; 44.2% of respondents reported an increase in mosquitoes; 31.1% of respondents reported an increase in input costs for the winter-spring rice crop; 29.1% experienced an increase in winter crop pests; 28.1% suffered from a reduced income from fishing; and 26.8% said they encountered reduced yields from the winter-spring rice crop. Fewer than 5.0% of respondents reported that small floods affected their agricultural labouring activities and fishing and prawn farming (Figure 13).

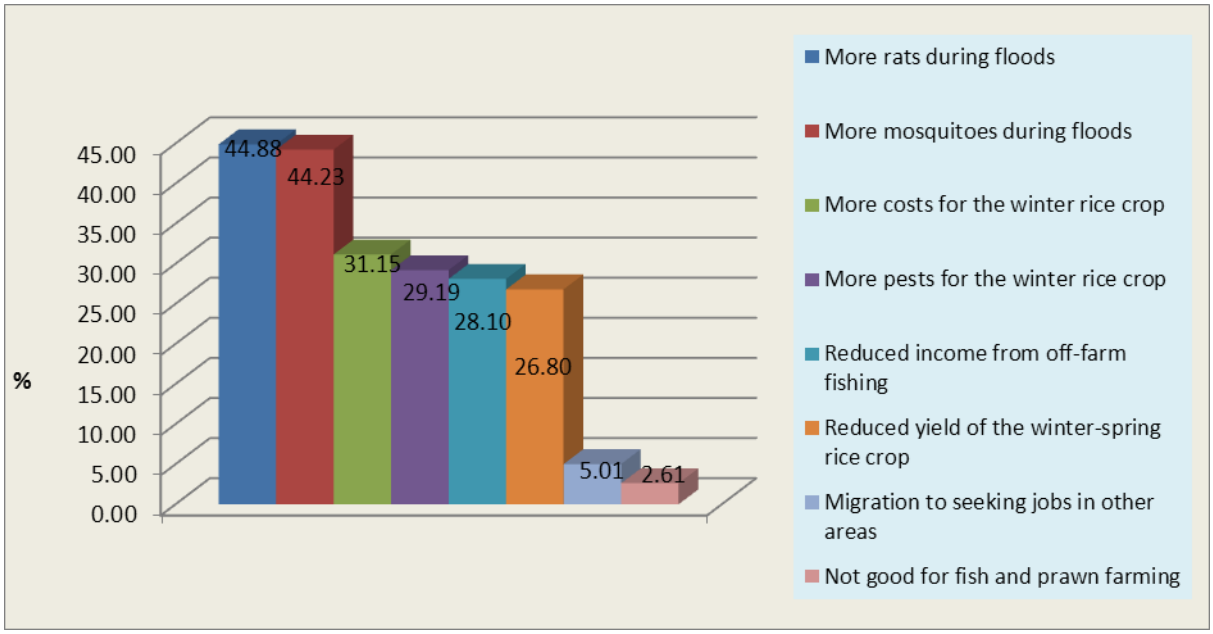

Figure 13. Perceived negative impacts of small floods on household livelihoods

Surprisingly, better-off households were more likely to experience an increase in input costs, reduced yields and more pests for the winter-spring rice crop. This can be explained by the fact that poor households are often landless or own little land, so they are less likely to experience such impacts from small flood events. The chi-square test also shows that there is a statistically significant difference in experience between social groups in the following: increased input costs for the winter-spring rice crop ($p<0.001$); reduced yield of the winter-spring rice crop ($p<0.001$); more pests for the winter-spring rice crop ($p<0.001$); more rats during the flood season ($p<0.05$); and seasonal migration to seek jobs during the flood season ($p<0.001$) (Table 17). However, poor households were more likely to experience seasonal migration to seek jobs as a result of a small flood than those from better-off households ($p<0.05$). This information was confirmed by qualitative information – there is no fish to catch in a small flood year, so most poor households migrate to seek jobs in order to survive.

Table 17. Negative impacts of small floods by social group

Negative impacts of small floods (%)	Social group			Total
	Poor	Medium	Better-off	
N	181	132	146	459
More rats during floods**	37.57	48.48	50.68	44.88
More mosquitoes during floods	41.44	44.70	47.26	44.23
More costs for the winter-spring rice crop***	11.60	43.18	44.52	31.15
More pests for the winter-spring rice crop***	9.39	40.15	43.84	29.19
Reduced income from off-farm fishing	34.81	28.03	19.86	28.10
Reduced yield of the winter-spring rice crop***	9.39	37.12	39.04	26.80
Migration to seek jobs in other areas***	12.15	0.76	0.00	5.01
Not good for fish and prawn farming	2.76	3.79	1.37	2.61

Test of significant difference is based on chi-square, ***p<0.001, ** p<0.05%; ns is not significant.

4.1.6 Perceived benefits of small floods

However, small floods also provide benefits for rural households in the MRD. Figure 14 shows that the two greatest benefits of small floods were thought to be convenient rural transportation and the fact that homes are unaffected by small floods. Some 47.0% of respondents said that they do not worry about their homes collapsing due to small floods. Respondents also said that small floods do not interfere with going to school (46.0%), and are good for animal rearing (6.9%).

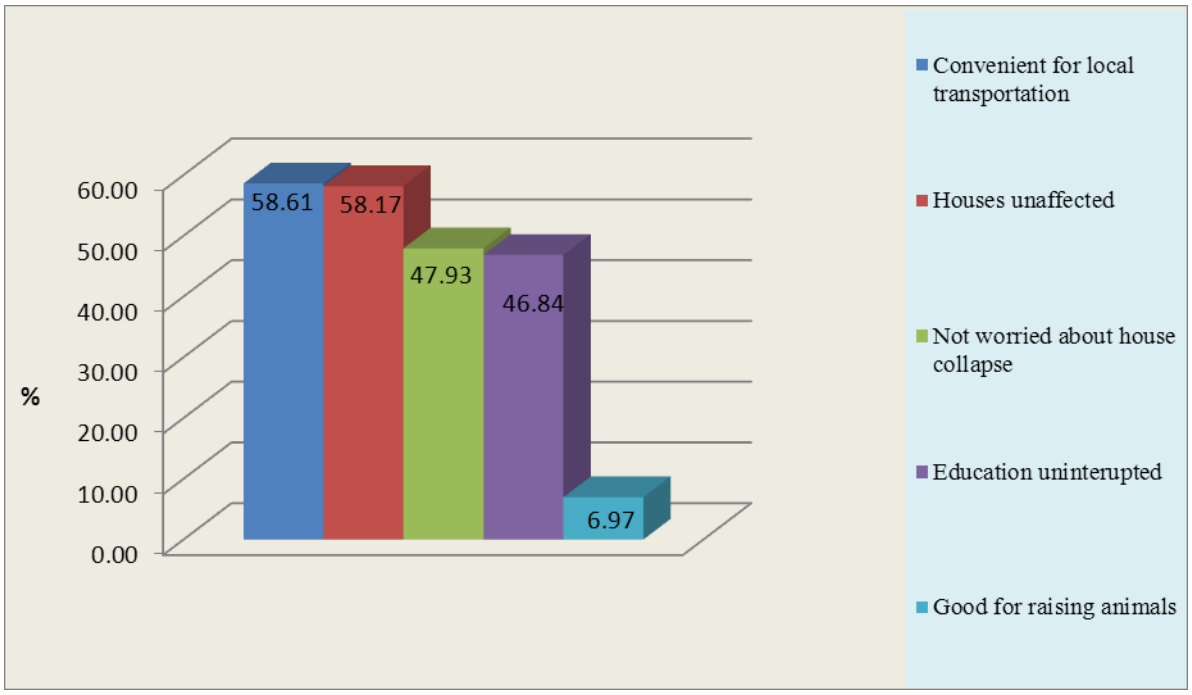

Figure 14. Perceived benefits of small floods on household livelihoods

With respect to the 62.0% of respondents who reported that small floods have benefits for rural households, according to social groups there was no statistically significant difference in the perceived benefits of small floods with regard to housing, transportation, education, and animal rearing. This means that all different types of households equally

benefit from small floods with regard to these four livelihood assets. The most notable benefit of small floods for poor households is the absence of worry about their homes being submerged or destroyed (Table 18).

Table 18. Perceived benefits of small floods to household livelihood activities and assets by social group

Benefits of small floods (%)		Social group		Total
	Poor	Medium	Better-off	
N	181	132	146	459
Convenient for transportation	61.33	60.61	53.42	58.61
Houses unaffected	61.33	61.36	51.37	58.17
Not worried about house collapse**	53.59	53.03	36.30	47.93
Education uninterrupted	43.65	52.27	45.89	46.84
Good for raising animals	4.97	7.58	8.90	6.97

Test of significant difference is based on chi-square, ***p<0.00, ** p<0.05%; ns is not significant.

4.2 Resilience Factor One and Socio-economic Variables, Social Capital, and Livelihood Diversity

Factor one reflects the level of flood at which households are confident that their houses will not be affected. Focus group discussions showed that people perceive securing their homes to be the most important indicator of living with flooding and the capacity to protect houses during big floods reflects the level of well-being of rural households in the MRD. Two items reflect levels of confidence including (1) I am confident that my house will not be submerged by the biggest flood within the last 20 years, and (2) I am confident that my house will not collapse or be swept away by the biggest flood within the last 20 years.

Results from the first multiple regressions show that households with a higher income are more likely to be confident that their homes will not be submerged or swept away by future flooding as significant as the floods of 2000 (Table 19). There is no statistically significant relationship between neighbourhood attachment, social supportive networks and resilience factor one, except for the negative effect of participation in groups and associations on confidence levels in coping with floods ($p<0.05$). An interpretation of this negative effect could be that respondents may not trust the support of groups and associations when they are in need. Housing type has positive effects on resilience scores ($p<0.05$). Households with concrete houses are more likely to be confident coping with big floods. By contrast, households with simple houses are less likely to be resilient to big floods ($p<0.005$ in models 2, 3 and 4). Interestingly, regional flood factors have significant effects on household resilience to big floods. Households in low flood regions are more likely to be confident that their house will be not submerged or destroyed by future floods (see models 3 and 4, Table 19).

Table 19. Multiple regressions for resilience factor one

Resilience factor one	Model 1		Model 2		Model 3		Model 4	
	beta	***Sig.***	***beta***	***Sig.***	***beta***	***Sig.***	***beta***	***Sig.***
(Constant)	-1.392	*0.000*	-1.103	*0.002*	-1.145	*0.002*	-1.140	*0.002*
LN total income	0.190	*0.000*	0.187	*0.000*	0.172	*0.001*	0.172	*0.001*
Size of household	0.008	*0.864*	0.010	*0.827*	-0.007	*0.888*	-0.004	*0.934*
Gender of respondents	0.087	*0.066*	0.085	*0.073*	0.085	*0.072*	0.086	*0.068*
Age of respondents	0.055	*0.228*	0.056	*0.224*	0.066	*0.149*	0.066	*0.145*
Neighbourhood attachment index	0.073	*0.191*	0.071	*0.204*	0.081	*0.145*	0.081	*0.146*
Participation in groups and associations index	-0.141	*0.004*	-0.140	*0.005*	-0.135	*0.006*	-0.135	*0.006*
Social supportive network index	0.088	*0.087*	0.090	*0.081*	0.100	*0.053*	0.101	*0.050*
House located in residential cluster	0.214	*0.000*	0.214	*0.000*	0.243	*0.000*	0.246	*0.000*
House located in side dykes	0.045	*0.328*	0.045	*0.326*	0.033	*0.476*	0.034	*0.448*
Concrete house	0.135	*0.004*						
Simple house			-0.142	*0.002*	-0.171	*0.000*	-0.173	*0.000*
Moderate flood region					0.019	*0.721*		
Low flood region					0.145	*0.008*	0.136	*0.005*
N=452	R^2=13.3***		R^2=13.5***		R^2=15.1***		R^2=15.0***	

Resilience factor one denotes confidence level of households in coping with big floods, housing sector.

4.3 Resilience Factor Two and Socio-economic Factors, Social Capital, and Livelihood Adaptation

Results from multiple regressions show that household income has the greatest effect on household confidence in securing food and income during the flood season, an indicator of resilience factor two ($p<0.001$) (Table 20). The more income households have, the greater their capacity to secure food during the flood season. Additionally, households who specialize in farm income are more likely to be confident about securing food and income ($p<0.05$). This can be explained by the fact that households who specialize in farm income are better-off, so they often have sufficient savings to get them through the flood season. Female respondents are less likely to be resilient in terms of food security during the flood season. The qualitative data confirms that women are jobless during the floods so they are less confident when it comes to securing food and income. Neighbourhood attachment social capital has a positive effect on household confidence in coping with food and income insecurity during the flood season ($p<0.001$ in models 3 and 4). Rural households are more likely to rely on bonding social capital for coping with stress. In particular, households that have a close connection with their neighbours can mobilize resources from their neighbours in order to cope. Social networks and participation in groups and associations indexes do not have a significant effect on confidence levels in securing food and income during the flood season. In FGDs many people asserted that it takes time to participate in local groups or associations and they don't see the benefit of participating. This finding is relevant to a study conducted by Nguyen Van Ha et al. (2004) that associational life social capital (participation in groups and associations) does not have a significant effect on household income in Vietnam. Nguyen Van Ha et al. (2004) explained that most people in Vietnam do not voluntarily participate in groups and associations. Interestingly, the results further confirm that the regional flood factor has a significant effect on capacity to cope with the flood season

($p<0.05$). In particular, people in the most flood-prone regions are less likely to be resilient to floods in term of securing food and income ($p<0.05$ in models 3 and 4). This means that people in the most flood-prone regions are more vulnerable to food and income insecurity. Surprisingly, the livelihood diversification index has no statistically significant effect on capacity to secure food and income. An interpretation of this from the literature is that livelihood diversification may help to reduce risk of income losses or crop damage. However, the resilience indicators used in this context reflect the confidence level of securing food and income, so the index may not directly affect the resilience index. The qualitative information may provide in-depth information about household resilience by diversifying farm income to off-farm and non-farm income in the MRD.

Table 20. Multiple regressions for resilience factor two

Resilience factor two	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	beta	***Sig.***	***beta***	***Sig.***	***beta***	***Sig.***	***beta***	***Sig.***
(Constant)	-0.918	*0.004*	-0.705	*0.034*	-0.053	*0.904*	0.199	*0.631*
LN total income	0.448	*0.000*	0.448	*0.000*				
Proportion of farm income (%)					0.318	*0.011*	0.289	*0.020*
Proportion of off-farm income (%)					-0.049	*0.653*	-0.054	*0.621*
Proportion of non-farm income (%)					0.046	*0.647*	0.035	*0.726*
An inverse Herfindahl-Hirschman index (IHHD)	0.012	*0.756*	0.012	*0.756*	0.082	*0.053*		
Size of household	-0.056	*0.180*	-0.056	*0.180*	0.025	*0.559*	0.030	*0.487*
Gender of respondents	-0.095	*0.024*	-0.095	*0.024*	-0.096	*0.028*	-0.097	*0.026*
Age of respondents	0.024	*0.552*	0.024	*0.553*	0.001	*0.973*	-0.001	*0.981*
Neighbourhood attachment index	0.146	*0.003*	0.146	*0.003*	0.242	*0.000*	0.244	*0.000*
Participation in groups and associations index	-0.052	*0.236*	-0.052	*0.236*	-0.049	*0.279*	-0.044	*0.326*
Social supportive network index	-0.012	*0.787*	-0.012	*0.787*	0.012	*0.792*	0.014	*0.772*
House located in residential cluster	-0.008	*0.853*	-0.008	*0.853*	-0.007	*0.878*	-0.013	*0.764*
House located in side dykes	0.070	*0.084*	0.070	*0.084*	0.048	*0.253*	0.044	*0.298*
Simple house	-0.107	*0.012*	-0.107	*0.012*	-0.110	*0.013*	-0.109	*0.014*
High flood region			-0.100	*0.038*	-0.143	*0.004*	-0.143	*0.004*
Moderate flood region	0.057	*0.236*	-0.045	*0.378*	-0.108	*0.038*	-0.109	*0.038*
Low flood region	0.100	*0.038*						
N=452	R^2=32.4***		R^2=32.4***		R^2=32.4***		R^2=26.6***	

Resilience factor two denotes household confidence in coping with floods in terms of food and income security.

4.4 Resilience Factor Three and Socio-economic Variables, Social Capital, and Livelihood Diversity

The statement "I want to learn new flood-based farming practices to cope with floods, such as fishing, neptunia fishing, and prawn farming" indicates a respondent's level of interest in learning new ways of living with floods (resilience factor three). In contrast to the first two resilience factors, the results from multiple regressions indicate that households with a higher income are less likely to be interested in learning new ways of living with floods ($p<0.05$ in models 2, 3 and 4, see Table 21). This finding may contradict evidence from in-

depth interviews and field observations as only rich families engage in prawn farming during the flood season in Tam Nông district and Thạnh Mỹ Tây commune. However, the number of prawn farmers is very limited and only a few of them were not included in the sample. Alternatively, this can be explained by the fact that that better-off households are more likely to concentrate intensely on a narrow range of income sources. Most richer farmers own a large area of rice land, so they are more likely to specialize in rice farming and take a rest during the flood season. Thus, they are less likely to be interested in learning new flood-based livelihood activities during the flood season. However, medium-income and poor households are more likely to diversify their income in an effort to adapt to flooding and maintain their income during the flood season.

Case study: Livelihood diversity, medium-income farmer in Thạnh Mỹ Tây commune, Châu Phú district, An Giang province

Mr Lước, a medium-income farmer, aged 45, spent five years in school. He has a wife and two children. He owns 1 ha of rice land. He grows two rice crops each year in the dry season, and collects golden snails during the flood season. He said that local staff call the rainy reason the flood season but local residents call it the water season. Local people often ask "what you are doing in this water season". This common question implies that people are very interested in livelihood activities during the flood season.

He and his wife collect golden snails on the floodplain at night. Every day, they go to the fields at 3 pm and come back at about 4 am. They use a small motorboat to travel to places in An Giang, Dong Thap and Kien Giang provinces to collect snails. After subtracting all of his costs, he can earn a net income of around VND 300,000 (USD 14.40) per night. Mr Lước reported that he started collecting snails five years ago. After each water season, he can save at least VND 10 mil (USD 480), which equals the net income from 2 ha of rice. Mr Lước said that the water season is wonderful for him. He really loves the water season because it is a time when he can improve his household income. Besides the benefits to Mr Lước of collecting snails, children, fishermen, prawn farmers, duck farmers and old people also benefit from his snail-collecting activities. Children and old people can earn about VND 50,000 (USD 2.4) a day to take off the snail shells. Fish, prawn and duck farmers can buy the snails as a cheap source of protein to feed their fish, prawns, and ducks (they can save input costs by using snails as a substitute feed).

However, poor people cannot afford to invest in boats, motors and materials. The estimated cost of all of these items is about VND 20 million, a large amount for the poor. Only farmers who have land and the financial capacity can engage in snail collecting. Poor people can find work taking off snail shells. Most poor people migrate to Ho Chi Minh City to seek non-farm jobs.

Source: In-depth interview, Mr Lước, 5 January, 2010

However, female respondents are less likely to learn new ways of living with floods ($p<0.001$ in four models). Male respondents are considered the key money earners in a household during the flood season, so they are more likely to make the livelihood choices for making a living during the flood season. Additionally, the size of a household has a positive effect on the level of interest in new livelihood activities, which confirms that new flood-based livelihoods require more labourers.

Again, there is no statistically significant effect of participation in groups and associations on levels of interest in trying new things to live with floods. This means that the current role of groups and associations is weak in facilitating local people to engage in different livelihoods during the flood season. However, neighbourhood attachment and supportive social networks have a statistically significant effect on interest in learning new

flood-based livelihoods ($p<0.001$ and 0.05). Households that want to learn new flood-based livelihoods often have a greater level of neighbourhood attachment and wider social networks. Through connections with neighbours, these households can access local knowledge and information about flood-based farming practices that allows them to exploit the benefits of floods. Several case studies derived from in-depth interviews and FGDs demonstrate that prawn, fish and neptunia farmers use networks of neighbours and friends to learn from each other (see below). Significantly, households in moderate-risk and high flood-prone regions are more likely to be interested in learning new flood-based livelihoods, while people in low flood regions are less likely to do so.

Case study: Using neighbour networks to develop flood-based neptunia farming in Thạnh Mỹ Tây commune, Châu Phú district, An Giang province

Mr Cai is a medium-income farmer aged 63. He has a wife and two children. He owns 1.5 ha of rice land. He started to grow neptunia more than 10 years ago. He only grows 0.4 ha of neptunia in the flood season and shares the remaining land with his relatives. He reported that this farming practice is very resilient to annual floods, "real living with flood". Annually, he grows neptunia after harvesting the summer rice crops, when the floodwater rises 0.4 meters above the paddy field. This kind of farming is not only of benefit to farmers but also creates many jobs for local labourers – women in particular pick the stems to sell at the local market. A woman can earn 7,000 VND (USD 0.33) per hour of collecting. On average, each labourer can earn about 50,000 VND (USD 24) per day.

Importantly, neptunia keeps the sediment fertile via its root system so farmers use less chemical fertilizer in preparation for the next rice crop. Farmers gain double benefits from this flood-based system, which is more ecologically and socially resilient to floods. In this hamlet, more than 200 households grow neptunia. According to Mr Cai, growing neptunia needs a community of neighbours. Neighbours meet at a local coffee shop to share market information and their knowledge of vegetable growing.

Source: In-depth interview, Mr Cai, 6 January, 2010

Table 21. Multiple regressions for resilience factor three

Resilience factor three	Model 1		Model 2		Model 3		Model 4	
	beta	***Sig.***	**beta**	***Sig.***	**beta**	***Sig.***	**beta**	***Sig.***
(Constant)	0.545	*0.210*	0.881	*0.059*	1.280	*0.005*	1.183	*0.006*
LN total income			-0.155	*0.011*	-0.156	*0.010*	-0.163	*0.007*
An inverse Herfindahl-Hirschman index (IHHD)			-0.034	*0.450*	-0.033	*0.470*		
Proportion of farm income (%)	-0.168	*0.196*	-0.069	*0.628*	-0.062	*0.662*	-0.044	*0.751*
Proportion of off-farm income (%)	-0.134	*0.245*	-0.118	*0.315*	-0.113	*0.333*	-0.103	*0.374*
Proportion of non-farm income (%)	-0.183	*0.079*	-0.113	*0.300*	-0.109	*0.315*	-0.103	*0.341*
Size of household	0.103	*0.023*	0.128	*0.006*	0.131	*0.004*	0.128	*0.006*
Gender of respondents	-0.189	*0.000*	-0.195	*0.000*	-0.194	*0.000*	-0.195	*0.000*
Age of respondents	-0.131	*0.005*	-0.136	*0.003*	-0.135	*0.003*	-0.136	*0.003*
Neighbourhood attachment index	0.177	*0.001*	0.214	*0.000*	0.214	*0.000*	0.215	*0.000*
Participation in groups and associations index	0.039	*0.411*	0.046	*0.326*	0.046	*0.333*	0.046	*0.332*
Social supportive network index	0.103	*0.039*	0.114	*0.023*	0.115	*0.021*	0.112	*0.025*
House located in residential cluster	-0.123	*0.008*	-0.131	*0.005*	-0.126	*0.006*	-0.127	*0.006*
House located in side dykes	-0.053	*0.229*	-0.057	*0.198*	-0.055	*0.213*	-0.056	*0.203*
Simple house	0.074	*0.108*	0.071	*0.124*	0.069	*0.135*	0.072	*0.121*
High flood region	0.207	*0.000*	0.192	*0.000*				
Moderate flood region	0.237	*0.000*	0.218	*0.000*			0.021	*0.692*
Low flood region					-0.203	*0.000*	-0.194	*0.000*
N=452	R^2=19.8***		R^2=21.2***		R^2=21.2***		R^2=21.1***	

Resilience factor three denotes the level of interest in learning new flood-based livelihoods for adapting to floods.

5.0 CONCLUSIONS

The study findings confirm research question one, that flood impacts vary according to different social groups and according to different flood levels. Floods have both negative and positive impacts on household livelihood activities and assets. However, poor households are more likely to be affected by big floods in terms of reduced fishing income and damage to their homes. Small floods affect the livelihoods of better-off and poor households in different ways. Poor households lose their fishing income as a result of small floods, while better-off and medium-income households have to pay more costs towards their rice crop as a result of small floods. On the other hand, medium-income and better-off households are more likely to welcome big floods as their rice crop benefits from the fertile sediment deposited by floods. Big floods also kill insects and rats and this too is good for rice farmers. Moderate levels of flooding are of the most benefit to most social groups, as they bring fewer costs and more benefits to rural livelihoods.

The findings do not confirm that the livelihood diversity index (or livelihood diversification) has a significant effect on household resilience to floods when securing food and income, as well as the capacity to learn about livelihood transformation. However, the results do confirm that specialization in (rice) farming income has a significant effect on a

household's capacity to secure food and income during the flood season (this is resilience factor two). This reflects a measure of resilience as household levels of confidence in coping with the flood season, in terms of food and income security rather than flood damage, is another vulnerability indicator in the literature (Adger 1999; Brouwer et al. 2007).

The findings confirm that some forms of social capital have a significant effect on particular resilience factors; however, other forms of social capital do not have significant effects. For resilience factor one, there is no statistically significant effect of informal social capital (neighbourhood attachment and supportive network indexes) on a household's capacity to secure their home during big flood events, but the participation index shows a significant effect (negative effect). This may explain the weak role of local groups and associations in enhancing resilience for households in flood-prone regions. However, the role of bonding social capital (neighbourhood attachment) is very important if households are to secure food and income during the flood season, as well as learning new flood-based livelihoods to cope with flood events.

It is important to disaggregate the measure of household resilience to floods into different resilience factors that reflect the expected well-being of households. The findings of this study demonstrate that using disaggregated measures of household resilience provides a comprehensive picture of living with floods. This technique allows researchers to identify different dimensions of household resilience to natural hazards.

Disaggregated analysis of social capital allows us to see the effects of different forms of social capital on household resilience to floods. The findings confirm the research hypothesis that there is a statistical relationship between social capital and household resilience to floods. However, the results only demonstrate that neighbourhood attachment has positive effects on confidence to secure food and income during flooding and levels of interest in finding new ways of living with floods, while participation in groups and associations shows negative effects on the capacity to secure homes during a flood. Social supportive networks do not show a positive relationship when securing food, income and houses, but are more likely to show that they have a significant effect on the level of interest in doing new things.

The socio-economic conditions of households have different effects on the three factors of household resilience to floods. Household income shows significant positive effects on resilience factors one and two, but has negative effects on resilience factor three. The gender and age of the respondents have negative effects on resilience factor three, but no effect on resilience factors one and two. Other demographic factors, such as the age and gender of the respondents and household size, only have a significant effect on resilience factor three. However, female respondents and old people are less likely to learn new things to adapt to living with floods. Larger households are more likely to learn new flood-based livelihoods.

Regional flood factors have different effects on the three properties of resilience. People in high and moderate flood-prone regions are less resilient to floods when coping with the housing sector and food security, and they are more interested in learning new ways of living with floods.

Using multiple items of household resilience to floods to measure expected well-being as indicators of household resilience to floods captures a range of issues that are directly related to household capacity to learn from, cope with, and adapt to floods. This has been done with the support of the factor analysis technique to identify underlying factors of resilience.

The disaggregated measures of the household resilience indexes provide us with different dimensions of resilience, such as resilience within the housing sector, food security, maintenance of income, and livelihood transformation. Qualitative research can be subjective so using subjective indicators for constructing indexes must be done with caution.

The advantages of using disaggregated measures of social capital show that different forms of social capital have different effects on different resilience factors.

6.0 POLICY IMPLICATIONS

Maintaining informal social capital via relationships with neighbours is important for enhancing household resilience to floods, e.g. the government and communities could provide collective activities at neighbourhood level to facilitate community solidarity, which is an important asset for adapting to natural disasters. At present, rural households do not benefit from participation in local groups or associations in terms of enhancing their levels of resilience to secure food and income during flood events. Groups and associations should be strengthened so that rural people can experience more benefits from participation.

Diversification of livelihoods can be vital for reducing the risks of flood damage, but diversification does not necessary enhance levels of confidence for securing food and income during the flood season in the MRD. The study results also confirm that very few people have experienced crop damage in previous floods, instead a negative impact of flooding is more likely to be the disruption of income stream during the flood season. Specialization in farming income or non-farm income may enhance levels of household resilience, thus ensuring a supply of food and income during the flood season.

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