

# Flood risk management in Central Viet Nam: challenges and potentials

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**Abstract** This article explores the impacts of floods on the economy, environment, and society and tries to clarify the rural community's coping mechanism to flood disasters in Central Viet Nam. It focuses on the social aspects of flood risk perception that shapes the responses to floods. The research findings revealed that flooding is an essential element for a coastal population, whose livelihood depend on productive functions of cyclical floods. The findings also revealed that floods, causing losses and damages, often inhibited economic development. The surveyed communities appeared to have evolved coping mechanisms to reduce the negative impacts of the floods, yet these coping mechanisms are under pressure due to environmental degradation. Integrated flood risk management is considered as a suitable paradigm for coping with flood disasters.

**Keywords** Floods impact · Perception · Coping mechanism · Vulnerability · Risk management

## 1 Introduction

Floods in Viet Nam are well-known phenomena and occur in all regions of the country, especially in the Central Coast region, Mekong delta, and Red River delta (CCFSC 2006). People had to learn to live with floods, particularly those whose livelihood depend on the

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productive functions of annual flooding. Severe floods are well known and embedded in the Vietnamese culture, as ancestors of the Vietnamese nation regarded flooding as one of the four biggest dangers to people, along with fires, robbers, and invaders.

Since ancient times, a large system of river and coastal dykes has been constructed to control flooding. For many centuries, this flood control measure achieved results all over the country. However, this structural approach to flood control is now under pressure because the conditions inducing flooding are intensifying, both at the local and global level (CCFSC 2006). For example, population increase, rapid urbanization, high demand for natural resource exploitation, environmental pollution, and degradation are coupled with global threats, such as climate change. Catastrophic floods are increasingly causing losses of human lives, assets and infrastructures. As an example, the Central Viet Nam's flood of November 1999 killed 780 people, affected around 1 million residents, and sunk and damaged more than 2,100 boats. This flood caused damage worth US\$364 million (CCFSC 2006).

Indeed the negative impacts of floods are often so prominent that their benefits are underestimated or even ignored in flood management planning (Ogtrop et al. 2005). In fact, floods are also an essential component of agricultural and ecological systems, because floods provide the basis for the growth of crops, plants, and aquatic life (Wisner et al. 2004; Few 2003). Thus, it is important for Viet Nam to adjust its current flood management strategy both to protect the livelihoods of people, who survive because of annual flooding, and to reduce the property and economic loss caused by the floods. Many researchers have, therefore, called for a broader approach to the flood phenomena (Dutta and Herath 2004; Werritty 2006; Ogtrop et al. 2005; Wong and Zhao 2001; Dixit 2003).

This research project explored the impacts of floods on economy, environment, and society in Central Viet Nam to understand the coping mechanisms developed by rural communities. It focuses on social dynamics, such as flood risk perception and social capital that shape the responses to flood. The findings helped to formulate an appropriate flood risk management model for Central Viet Nam.

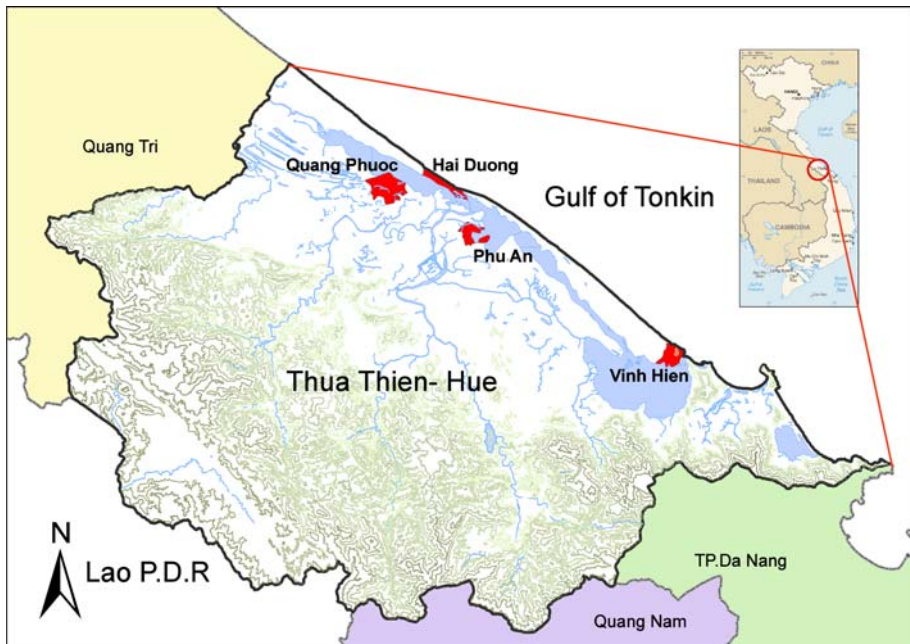
## 2 Research scope and methodology

### 2.1 Characteristics of surveyed areas

The study was conducted in Tam Giang—Cau Hai lagoon of Thua Thien Hue province (Fig. 1). Tam Giang—Cau Hai is the largest lagoon in the South East Asia, with an area of 22,000 ha, and length of 68km along the coastline of the province. It is located at the intersection of the Northern climate and Southern climate, and within the region of the West Pacific typhoon, one of the greatest tropical cyclone regions of the world. The lagoon itself is the region of nation-wide highest rainfall. For this reason, it is frequently affected by various types of natural disasters such as storm, flood, cyclone, and coastal erosion.

There are about 280,000 people living around the lagoon in 236 villages (from 32 communes in 5 districts) who earn their living by directly or indirectly using natural resources in and around the lagoon. Lagoon communities generally depend on three main income-generating activities: agriculture (including livestock), capturing fisheries, and aquaculture. Other complementary occupations include trade, seasonal work, construction and service (IMOLA 2006).

During the rainy seasons, crops, infrastructure, natural environment, and the inhabitants around the lagoon suffer losses due to disastrous floods and storms. Loss and damage to



**Fig. 1** Study areas

property and homes coupled with insecurity to human lives caused by disasters keep many households trapped in a cycle of poverty. Moreover in the dry season, low rainfall, and saline-water intrusion around the river estuary also badly affect agriculture, lagoon, and aquatic resources. This cycle of natural disasters inhibits the social and economic stabilization and growth of Thua Thien Hue Province (TTHPPC 2002, 2005).

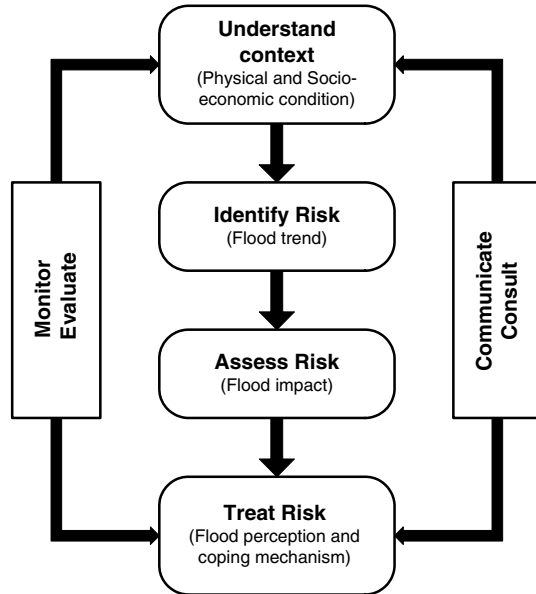
## 2.2 Research methodology

Effective flood risk management requires understanding of the environmental context, the identification, analysis, evaluation and monitoring of hazard, as well as the development of risk management policies, procedures and practices. Accordingly, this research applied the AS/NZS 4360: 1999 Risk Management Framework (Standards Australia 1999), as the standard analytical process to achieve greater insights into flood management in Central Viet Nam. There are four main steps in this process as shown in Fig. 2.

The main purpose of this framework is to help decision makers more effectively to achieve flood risk reduction. When treatment options are found to lower flood risk effectively and in a cost-efficient manner, and appear acceptable to those affected, they may be undertaken. In this risk management framework, flood disaster is considered as a product of hazard and social vulnerability. Thus, structural measures to reduce the hazard factors and non-structural measures to mitigate the social vulnerability are considered.

The surveyed sites and the interviewed residents were selected according to geographical location, economic status, and main livelihood activity. The four studied communes were requested to provide a list of all households within the commune together with their village location, main livelihood activity, and economic status that includes three

**Fig. 2** Flood risk management framework adapted from the Risk Management Standard AS/NZS 4360: 1999



levels: poor, medium, and better off. From these lists, households were randomly selected. The final number of questionnaires gathered was 401 (average 100 per commune). Knowing the inherent shortcoming of the non-random nature of the sampling procedure, the investigators were consciously cautious in the selection of the survey sites and respondents. Prior to the selection of survey villages, the investigators conducted a reconnaissance visit to some of the most vulnerable communes in coastal areas. During the visit, the staff of commune people's committees informed the investigators about the magnitude and impact of the flood and the commune's socio-economic situation. After careful deliberation, four communes were selected as the survey sites: Phu An, Hai Duong, Vinh Hien and Quang Phuoc (Fig. 1) which best presented the socio-economic and physical conditions of the whole lagoon area.

The research used both qualitative and quantitative data with the standard methodology shown in Table 1. Qualitative data were analyzed using textual analysis, and quantitative data were analyzed using the Statistical Package for Social Scientists (SPSS) software. Indirect data were obtained from published academic and consultancy work, internal documentation from governmental and non-governmental organizations. Direct data, or primary data were collected through focus group discussion, questionnaires survey and semi-structured interview. Forty focus group discussions with community leaders and local people, and 401 household questionnaire surveys were conducted. Questionnaires were carried out by staff of the Hue University of Agriculture and Forestry, who have experience in survey techniques and were involved in the piloting and final draft of the questionnaire. Several semi-structured interviews with key informants (for example public officers, village heads, knowledgeable persons, and chiefs of mass organizations) were also carried out to validate and complement the information.

The questionnaires used a multiple-choice format and were compiled into four sections: the general information of respondent's household, disaster risk perception, flood impact, and coping mechanism. The household interviews were conducted in September 2006. The main occupations of respondents were agriculture, fishing, small business, or elderly who

**Table 1** Research methodology

Risk management process	Research aim	Data sources	Method	Data analysis
1. Understand the context	Describe the socio-economic conditions that may influence or be influenced by flood disasters Assess physical conditions including natural, built environment of case study areas	Published books, journals, reports Key informants	Literature review Interviews with local scientists and commentators	Qualitative analysis using discourse and text analysis
2. Identify risk	Identify flood trend	Published books, journals, reports Key informants Community leaders Published books, journals, reports Meteorological dataset from province Disaster record data from province and nation Key informants	Review the secondary data Transect walk Interviews with local scientists and leaders Review the secondary data and reports from Intergovernmental Panel on Climate Change (IPCC) Review the historical records of floods Interview with local academics	Qualitative analysis using discourse and text analysis Quantitative analysis Qualitative analysis using discourse and text analysis Quantitative analysis by SPSS
3. Assess risk	Examine the flood impacts on social, economic and environmental conditions of case study areas	Households Community leaders Key informants	Focus group discussion with community leaders and key informants Questionnaire survey of 401 households	Qualitative analysis using discourse and text analysis Quantitative analysis by SPSS
4. Treat risk	Identify the flood risk perception and flood coping mechanism of case study community	Households Community leaders Key informants	Focus group discussion with community leaders and key informants Questionnaire survey of 401 households	Qualitative analysis using discourse and text analysis

were no longer working. The majority of the respondents were males (74.3%) and most of them were the head of household (79.8%). They belong to two main age groups: 35–60-year-old (67.4%), and 60–95-year-old group (22.9%). Most of respondents had primary and secondary education (74.8%), though more than 16% of respondents had no formal education.

### 3 Results of empirical survey

This section presents the findings of the four stages of flood risk management process stated in Table 1. The findings support the argument that in Central Viet Nam, flooding is an essential element in the economic sustainability of coastal communities, yet it also causes losses and damages to humans and the natural environment. People had evolved sophisticated coping mechanisms, yet these mechanisms are under pressure.

#### 3.1 Context of the Tam Giang: Cau Hai lagoon

##### 3.1.1 *Socio-economic conditions*

The survey shows that in the studied area there was 52% of the surveyed population in the working age (from 18 to 55-year-old), but only 35% of them had a well defined and permanent job, and 65% of the population was under-employed or dependant. In fact, due to the short duration of agriculture and aquaculture production activities, high percentage of population in the working age was under employed. In addition, the utilization of new techniques in cultivation significantly reduced the human labor for these sectors. As a result, under employment is growing.

Almost all the surveyed population has skills in agriculture, aquaculture, and fishing. However, the level of education in these communes is still relatively limited. Most of the population received primary and secondary education (73%), while about 10% of the population over 6 years of age never attended school. Only 17% of the population attended high school or higher education. This low educational level is closely related to the stagnant local economy (IMOLA 2006).

##### 3.1.2 *Physical conditions*

This study noted that there was development of the road network and public buildings all around the lagoon after 1986 when Viet Nam moved from central planning to a market economy. However, many households live in weak houses<sup>1</sup> and semi-solid houses<sup>2</sup> located far from the main roads and public facilities. They face additional difficulties to evacuate to safer areas such as two-story public buildings and higher places. The weak houses are gradually being replaced by semi-solid and solid houses,<sup>3</sup> but paradoxically the improvements that have been made in the built environment have contributed to

<sup>1</sup> Bamboo or mixed material frame house, roof covered by thatch or corrugated metal or tiles.

<sup>2</sup> House built with reinforced concrete materials but some parts are insecure due to improper construction techniques.

<sup>3</sup> Reinforced concrete house with thick brick or block cement walls, secure doors and windows.

increased vulnerability to disasters and increased economic losses (computed in terms of the cost to recover or rebuild a damaged house after a disaster). Furthermore, despite the large amount of investment in housing, 78% of housing stock is classified as semi-solid houses, 19% of the housing are weak houses, and 3% of housing is classified as solid houses.

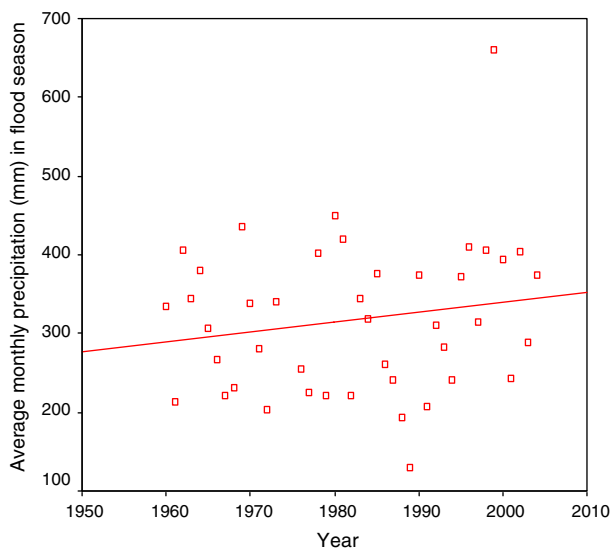
The experience of the 1999 flood was the most traumatic to the villagers, particularly for those who live in simple houses, as they did not have any refuge when the water level rose up to many houses roofs. In addition, the strong wind caused fierce waves, which made mobility difficult. A common reaction of villagers was to take out loans to repair and strengthen the houses, hoping to lower their vulnerability to future floods and typhoons. This is likely to cause future problems for many households, who have invested beyond their capacity to pay back.

### 3.2 Risk identification: flood trends

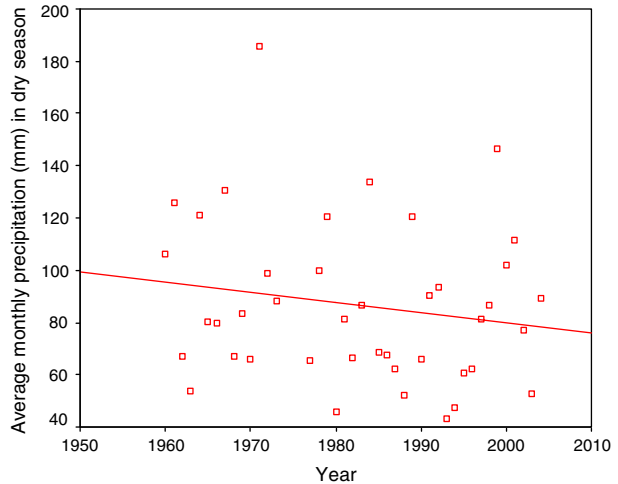
In the past few decades, in the Thua Thien Hue Province the frequency and severity of disasters increased significantly. In fact, during the 19th and the first half of the 20th century from 1804 to 1945, there were only 38 floods and typhoons in the historical record. In contrast, between 1975 and 2000, there were 41 disasters with one storm, 18 floods, and 22 storm-floods (Do 2002). These severe disasters included events such as the severe flood of 1983, a destructive storm in 1985, and the historic flood in 1999. There is also a tendency for the flood season to start earlier than before (Tran and Shaw 2007)

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007) states that warming of the climate system is now unequivocal. At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include the frequency of heavy precipitation events that have increased over most land areas, consistent with warming and observed increases of atmospheric

**Fig. 3** Average monthly precipitation in rainy season (Aug–Dec) from 1960 to 2004 (Source IMH 2006)



**Fig. 4** Average monthly precipitation in dry season (Jan–Jul) from 1960 to 2004 (Source IMH 2006)



water vapor, and more intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics (IPCC 2007).

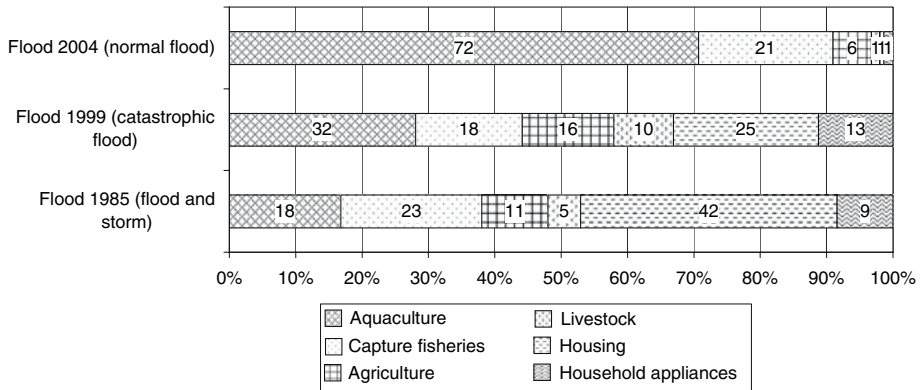
The analysis of precipitation data, which was obtained from the databases of the Institute of Meteorology and Hydrology (IMH) of the Vietnamese government for the study area from 1960 to 2004, shows that there is a significant increase of the rainfall in the rainy season, from August to December, and a decrease of the rainfall in the dry season from January to July (Figs. 3, 4). This trend implies that there will be very likely more floods and drought in the future in Thua Thien Hue.

Moreover, according to the observation of Thua Thien Hue Provincial Committee for Flood and Storm Control (PCFSC 2000) the numbers of floods increased significantly during ENSO conditions, 7 floods in 1996 and 6 floods in 1998. In the last 10 years, along with increasing precipitation, the daily maximum and monthly maximum precipitation increased. Particularly, the precipitation on November 2, 1999 was 978 mm, when the total precipitation in November 1999 was 2451.7 mm against the annual mean of 2849.4 mm (data from 1928 to 2001), the highest monthly precipitation in the historical record (IMH 2006). Indeed, flooding in the region tends to last longer and be more unpredictable than before.

### 3.3 Risk assessment: flood impacts

In Thua Thien Hue province, flood is widely considered to be the factor directly causing impediments to economic development, environmental degradation, and intensifying poverty. It intensifies the poverty gap in the population and rapidly increases the poverty rate, especially in flood-prone areas. However, flooding is by no means a phenomenon solely of negative consequence. For example, floods irrigate and fertilize fields, flush out salts and toxins from soils and watercourses, and recharge the reservoir. In order to incorporate these dimensions into a general flood reduction plan further investigation is necessary to improve the understanding of the role of human activities and local environment in natural hazards. This section presents three main impacts: economic, environmental and social with both negative and positive aspects.





**Fig. 5** Percentage productivity loss and damage caused by three major floods

### 3.3.1 Economic impacts

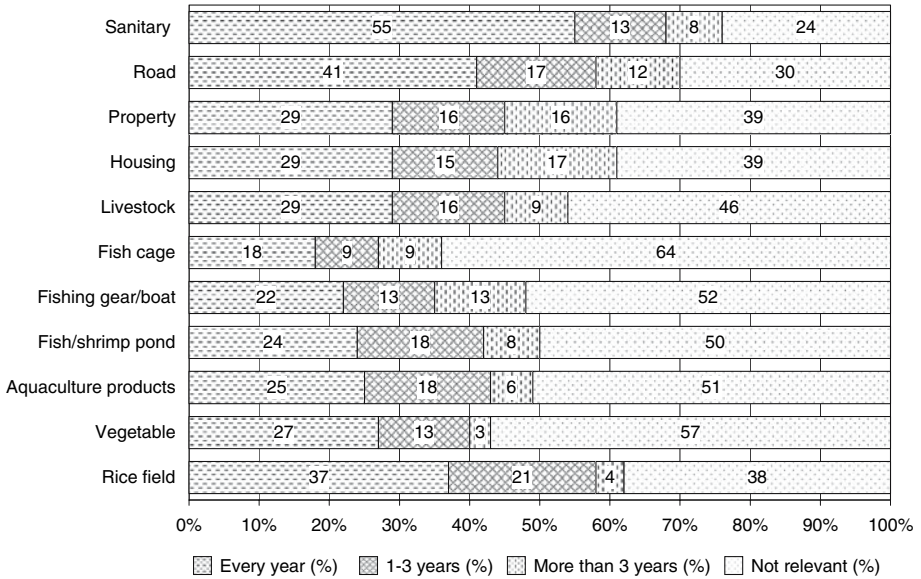
Drought often occurs in summer from June to August and floods and storms happen between August and December (Do 2002). For aquaculture activities, the second crop has limited time because the flood after the dry months does not allow proper pond preparation. In the flood season, rain and overflowing limit transport, impacting on the local economy.

The entire area around the lagoon is prone to annual floods and low-lying areas are particularly vulnerable. The frequency of catastrophic flood is almost every 10 years; e.g., the flood of 1983, 1985, and 1999.

In November 1999 a severe flood occurred in Thua Thien Hue inundating 90% of the lowlands. The province was isolated. This flood lasted for one week, broke five new floodgates and created a new river mouth near the lagoon. Strong winds caused fierce waves, which made mobility even more difficult. The flood caused 352 deaths and damages for US\$177 million (PCFSC 2000). Figure 5 shows the percentage productivity loss and damage caused by the last three major flood events.

Annual floods, which are more frequent and of lower magnitude, also bring significant damage to agriculture and aquaculture, e.g., destroying crops in the rice field, or sweeping away aquaculture products or ruining the fish and shrimp ponds. Although annual floods have a lower severity of impact than catastrophic ones, they can isolate villages by disrupting community roads, prevent access to services, suspend business activities and exacerbate health risk in the built and natural environment. Thus, many economic opportunities are lost due to the isolation caused by annual floods. This study showed that 55% of respondents claimed that annual floods caused serious damage to sanitation systems, and 41% of surveyed households experienced serious damage to community roads. In short, most income generating sources and infrastructures were affected by these ‘normal’ floods every year (Fig. 6).

Since Viet Nam started its *doi moi* policy in 1986, which moved Viet Nam from central planning to a market economy, thousands of hectares of agricultural land were converted into aquaculture ponds and farming cages have mushroomed around the lagoon. According to TTHPPC (2005), aquaculture helped to increase the income of local people. However, aquaculture production is very vulnerable to flood. As can be seen from Fig. 6, some 25% of respondents claimed that their aquaculture has been affected every year, and only 6% of them experienced flood impacts at a lower frequency (every 3 year or more). However,



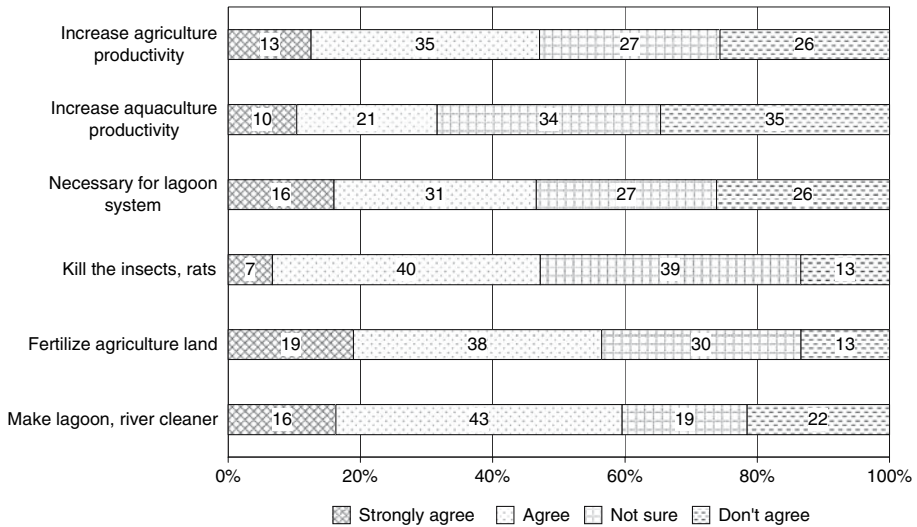
**Fig. 6** Respondents’ perception of the type of damages caused by annual floods since the year 2000

there is a difference between well-anticipated events and unanticipated ones with the same intensity. For example, a flood that always occurs at the same time of year (annually predictable flood) has very different effects to a flood that occurs at different times each year or only in certain years. The former, because expected and thus planned for, may be beneficial, while an unexpected flood may be disastrous, particularly to a large investment such as the aquaculture sector.

Despite these negative impacts, floods are essential components of human lives in coastal areas of Thua Thien Hue province. Not surprisingly, the survey revealed that a high percentage of respondents think that floods help to clean the environment (e.g., rinse lagoon and rivers). Floods also bring alluvium to agricultural land and kill insects and rats. Respondents even claimed that every 3 years, a big flood is needed to refresh the lagoon environment. Many respondents agreed that the production of aquaculture, and agriculture increase after a large flood (Fig. 7)

### 3.3.2 Poverty impacts

The results show that poverty and vulnerability to floods are integrally linked and mutually reinforcing. For example, Table 2 shows that although most Viet Nam coastal houses are built with elevated ground floor (higher than the garden level) most of the poor and the medium households have the ground floor erected at a lower level compared to that of better-off households. Hence, the poor are more exposed to flood water. There is a statistically significant difference in impact during the 1999 flood event in better-off, poor, and medium households; it can be said that in absolute terms the flood caused less economic impact and damages to the better off, while the poor suffered more from the floodwater.



**Fig. 7** Positive impacts of annual flood on environment

**Table 2** Average of 1999 flood level and current level of plinth by household category

Household category	Height reached by water during the 1999 flood (cm from ground floor)	Elevation of current ground floor from garden level (cm)
Better-off	122.77	88.82
Poor and medium	162.15	66.32

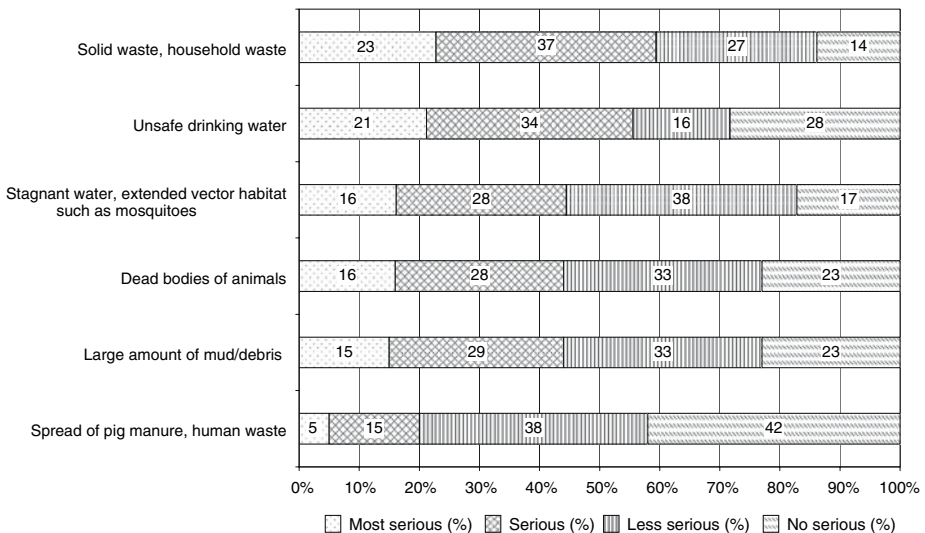
*Note:* statistical significant at 95% of level of confidence

At the household level the poor have fewer resources upon which to draw to counteract the impacts of flooding. In the study areas 24% of the surveyed households was under the poverty line with an average per capita monthly income of US\$11 or less. Flood disasters make production activities and livelihoods of the poor become unstable. The survey shows that most of the poor household have only from two to five different sources of income, such as agricultural production activities (46%), hired labor (25%), or fishing (18%). In addition, the vulnerability is often cyclical with regard to flood hazards, because disruption to assets and livelihoods by one flood event often make households more vulnerable to future impacts. After each flood, the same families tend to lose their houses, possessions and livelihoods, thus finding themselves forced to heavily exploit environmental resources for survival, for example, the necessity for the poor to go fishing in dangerous areas during the flood season or the need to get sand for construction along the river during the dry season. These activities accompanied with unregulated destruction of mangrove and coastal forest for shrimp farming, augment both the risk of, and exposure to, flood disasters. Increased population pressure in recent years is also causing over-exploitation of agricultural and aquatic resources on vulnerable areas. For example, rice-growing areas are intensively farmed flushing greater and greater quantity of fertilizers and pesticides into the lagoons. These practices directly affect the natural environment, and may hurt the very resource base on which many poor people survive. As a result, the rural communities, which depend on resource-based activities, are those who pay the direst consequences.

### 3.3.3 Environment impacts

One of the most significant effects of floods is the impact on human health, particularly in those communities with limited access to safe drinking water. Floodwater can also increase the risk from water-borne pathogens, and insect-borne infection. The surveyed areas were located in the down stream of the river basin, and were often recipients of solid waste, dead animals, mud and debris from upstream communities. As can be seen from Fig. 8, there are three factors: solid waste, unsafe drinking water and stagnant waters that are interlinked and cause serious environmental problems during the flood season due to the downstream and lowland areas of the lagoon. The study also found that the lack of ability and experience to deal with the ‘new garbage,’ such as industrial wastes, emissions, mineral exploitations, pesticide, and waste from aquaculture and agricultural production brings new environmental hazards, making living conditions for many people uncertain. For example, villagers dump waste collected in settlement areas into ponds or along the banks of rivers within or around the village. As a result, open drains that carry storm water and domestic wastewater into neighboring rice fields are likely also to carry industrial pollutants such as grease and oil from equipment, acids, and heavy metals from plating liquors, organic wastes from food processing, as well as pig manure. Ponds that were used to raise fish and retain storm water have been filled in for the construction of houses and shops. Thus, villages that have been able to deal with the new pollutants within their settlement areas have increased pollution in the adjacent areas that were used as sources of water for irrigation, vegetable farming, and aquaculture. Figure 8 shows the responses about the environmental issues arising during the flood season.

Fortunately, no severe epidemics were reported so far in the surveyed areas even in the presence of epidemic agents. This was not due to mass vaccination or emergency health campaigns, but more likely to both inbuilt local immunization (i.e., biological adaptation through bodily defense mechanisms) and social-cultural practices such as hygienic practices, treatment of injures, sewage control, etc.



**Fig. 8** Environmental problems during the flood season

### 3.3.4 Social impacts

Flood disasters and their aftermath significantly impact on social systems, both within the household and with the community at large. Many villages in the surveyed areas have been recognized by provincial and local governments as “Cultural villages.” One of the criteria for this recognition is a good relation among villagers. Community members helped each other to overcome day-to-day difficulties, and appeared motivated to participate in social and cultural activities in order to promote good traditional cultural values (IMOLA 2006). When the people were asked what had been the sense of community after the severe consequence of the flooding, most responders were positive that community cohesion was stronger, and people tended to help each other (79.9%). However, 10% of them claimed that community cohesion was stronger at first, but then broke down due to the stress of the flooding and the recovery process. Furthermore, according to the socio-economic survey of IMOLA (2006), there was a high rate of out-migration, particularly during the flood season when the main laborers migrated to cities to search for jobs. This left the people at home living more “at risk,” especially the infirm and elderly, and the communes remained without adequate human resources for flood response and recovery. In addition, annual flood prevents many children from going to the school during the flood season (see Table 3). This might cause a large number of children to permanently drop out of school (323 children out of 401 surveyed households)

Another impact of floods on local communities is that after a disastrous flood some external helps may inhibit inbuilt recovery processes. The survey revealed that after the 1999 flood some villages delayed their construction efforts when they learnt about the massive external relief efforts and aid undertaken in nearby communities, or even worst, that in some cases social cohesion had been degraded due to the jealousy over relief distribution.

## 3.4 Treating risk: flood risk perception and flood coping mechanism

Risk perception plays an important role in shaping the flood coping mechanism and flood management. As previously mentioned, risk perception can influence both the design and operational aspects of flood risk management. If flood disasters were perceived as hazardous events, then the coping and management mainly focused on the physical aspects, structure measures, and external relief. In contrast, if flood disasters were considered as a product of hazard and vulnerability, then the mitigation measures recognized human behavior as important aspects and the copying and management focused on non-structural measures. Thus, understanding how people perceive the flood risk is important to formulate a flood mitigation policy and plan (Marincioni 2001).

**Table 3** Impacts of annual flood on child education

Children cannot go to school due to annual flood	Frequency	%
Not applicable	25	6.7
Less than 1 week	293	79.0
1–3 weeks	49	13.2
More than 3 weeks	4	1.1
Total	371	100.0

**Table 4** Relationship between flood risk perception and level of education

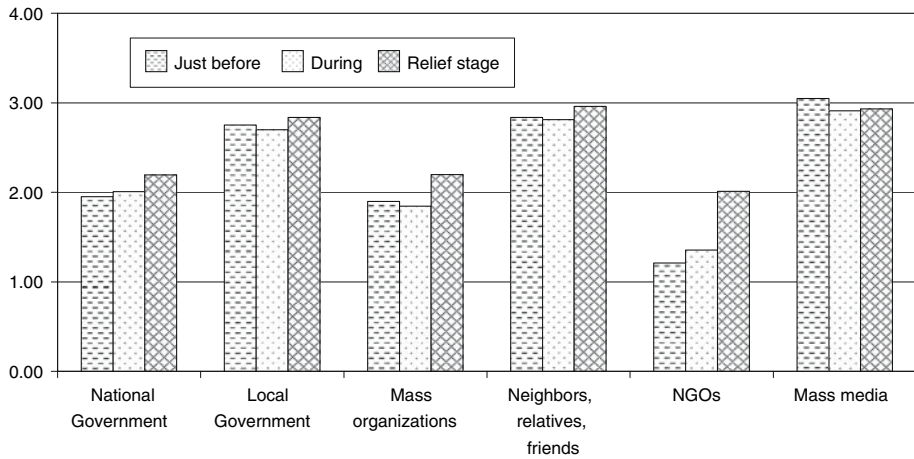
Flood risk perception	% Among all respondents	% Within the highest level of schooling			
		No schooling	Primary school	Secondary school	High school
Flood disaster is an act of god	47.3	45.3	50.6	51.6	19.4
Flood disaster is the result of hazard and vulnerability	47.8	45.3	45.5	42.6	80.6
No comment	5.0	9.4	3.9	5.7	0
Total	100	100	100	100	100

The results of this study showed no significant statistical difference (with a level of confidence of 95%) in flood risk perception among respondents with level of education below high school, whom, as shown in Table 4, tended to perceive floods as caused only by natural phenomenon (hazard-led events). Conversely, respondents with a higher level of education believed that flood disasters are the combination of natural hazards and social vulnerability. Only 19.4% of respondents with higher-level degrees perceived floods as hazard-led event with no relation to human vulnerability. On the whole, 40% of all respondents claimed that they could do a little or nothing to avoid destruction from severe floods. As a result, the common flood coping strategy was to “live together with the flood.” Houses were often constructed in elevated areas or high foundations to avoid normal floods. Production activities have been adjusted to avoid the adverse impacts of the flood as much as possible, and people have been aware the flood risk by moving livestock or property in a higher places before the flood season.

Beyond the household and village level, at the commune, district or province level, the disaster management planning process (mainly flood and storm control) takes place every year, but it is mainly prepared by technical experts without the community’s participation. Once the plan is approved, the commune authorities disseminate the decision to people before the flood and storm season on loudspeakers or through hamlet leaders during community meetings. This annual plan on flood and storm control is not-detailed and mainly focuses on organization, structure, roles and responsibilities of members, rather than a comprehensive preparedness, mitigation and response plan. At the provincial level, a detailed plan for preparedness, mitigation, response and drilling is prepared only for high-risk areas. The disaster preparedness and response plan from commune to provincial level also requests relevant sectors and organizations to reserve material for responding to emergencies. At the national level, the latest national strategy for natural disaster prevention, control and mitigation have pointed out the increasing trend of natural disasters, and tried to integrate disaster risk management into the overall socio-economic development plan as well as the national strategy on poverty reduction plan.

Different results were found in regard to the level of involvement of stakeholders during the three different phases of flood disasters: just before the flood when the early warning information is issued, during the flood, and throughout the relief and recovery stage (Fig. 9). The data shows that the national government (province and district committee of flood and storm control, army, and police); local government (commune and village committee of flood and storm control, civil defense force, and village leaders); special interests organizations (fatherland front, women union, farmer union, veteran union, and youth union); neighbors; and NGOs organizations, put more emphasis on the relief and recovery stage of disasters. Conversely, mass media are more active before the impact.





**Fig. 9** Average level of involvement (1. Not responsible; 4. Very responsible) of stakeholders in the different phases of flood disaster

The social capital available in a local community for dealing with flood risk includes bonds with neighbors, relatives, friends and other mass organizations. This social capital increases the responsiveness of local institutions such as village committees for flood and storm control (VCFSC), commune committees for flood and storm control (CCFSC), or mass organizations (e.g., Youth Union). The crises usually lead to mobilization of organizations at all levels. The village and commune organizations become more active in organizing mutual support to help households. Pre-existing mass organizations effectively mobilize people to help each other build or repair housing. Villagers hold numerous public meetings to establish ways of coping with the crisis after the disastrous floods.

#### 4 Challenges of flood risk management

The study found four main challenges to flood risk management in Thua Thien Hue: (i) changes resulting from moving a planned to a market economy; (ii) substantial environmental degradation; (iii) the region may already be experiencing the effects of climate change; and (iv) the traditional methods of flood risk mitigation are less effective than they used to be.

First, the move of Viet Nam from central planning to a market economy had three prominent impacts on disaster management. Social capital such as cohesion or bonding, which is very important in disaster management, has been gradually reduced due to the rapid processes of urbanization and privatization. As mentioned in Sect. 3.3.4, most communities already had wisdom and social institutions to cope with traditional risks, yet with the current shift of government policy, which speeds up the privatization process and gradually moves from central planning to a market economy, these practices have broken down in many areas (e.g., lack of mutual help among people due to out-migration, and privatization).

Moreover, although Viet Nam’s transition from state–central planning is often heralded as a macroeconomic success story, the policy transition had negative impacts on social vulnerability. For example, whereas each community previously had to donate labor, equipment and material towards the maintenance and emergency repairs of the flood

protection infrastructures, it now receives payment for these efforts from the government. Unfortunately, with fewer and fewer voluntary contributions and limited capacity of the government to pay for it, less money will be available for upgrading and maintaining infrastructures. As flood protection work is perceived more and more as a government's duty, fewer people will become identified with the program of maintaining the flood protection infrastructure. It is already becoming increasingly difficult to mobilize the population for maintenance and emergency preparedness during the dry season, and emergency repairs during the floods, and this indicates that the public support for infrastructure monitoring and repair is gradually reducing.

The *doi moi* moved Viet Nam towards a market economy, and one effect was that for many families their financial situation improved. A visible effect of this was that families progressively began to rebuild their houses with more durable and costly materials. However, changes of housing construction materials and techniques to "modern" styles without appropriate adaptation of the safety measures, have threatened integrity of the built environment. Few of these new houses have been built with safety designs to enable them to resist floods or typhoons. The unfortunate result was an increase vulnerability of the built environment. The survey shows that to avoid the damage of normal floods to housing, most of the houses were constructed on a high plinth elevating the ground flood an average of 71 cm from the garden level. This was not enough to prevent damages during the catastrophic flood of 1999, when floodwater reached an average height of 153 cm. For that disaster the average loss to housing was about US\$290 per household, whereas the GDP per capita of the province was only US\$193. However, high percentage of population still do not prepare for a disastrous flood. The survey show that only 19% of responders think that a flood with the same severity of that of 1999, or higher, is likely to happen in a very near future; 16% of them believe it will happen within next 50 years; 35% say that it might happen but chances are rare; and 30% of all responders think that a flood so destructive will never happen again. Indeed, changing these perceptions is an important challenge to any flood risk mitigation and reduction projects and programs.

In addition, along with economic growth substantial investment has been made in developing urban centers without addressing flood vulnerability. The flood mitigation measures to protect these areas are, therefore, sometime undertaken at the expense of rural agricultural sectors. These measures are usually implemented without consultation or public deliberation among affected communities and regions. In Viet Nam, the national priority is to protect urban centers, given that floods are often seen as loss of property and investment, rather than as loss of livelihood and environmental assets (Hoang et al. 2007; Manuta and Lebel 2005). Indeed this puts another challenge in the face of flood management in the lagoon areas.

Second, the natural environment in Central Viet Nam has been significantly degraded thus exacerbating the vulnerability to flood disasters. For example, under the cycle of flood impacts, the poor to survive have been forced to intensively exploit natural resources by expanding the agriculture and aquaculture to vulnerable areas, sometimes destroying mangrove and coastal forest for shrimp farming (see Sects. 3.3.1 and 3.3.2). These practices degraded the natural environment further increasing the vulnerability to flood. This degradation of the natural environment is intensifying the factors and risks of flooding and other natural disasters.

Third, the study showed that human induced global change has likely impacted not only the climatic variability, but also the frequency and intensity of extreme events that have damaged the development of the region (see Figs. 3, 4). Nevertheless the perception that disasters are an act of God (hazard-led disasters) is still dominant among local people as



shown in Table 3. Thus identifying adaptation options to long-term human-induced climate change is a real challenge.

Fourth, this research revealed that in the studied areas besides the traditional risks, such as flood, storm and drought, new risks are rapidly increasing, for example, environmental, and epidemic problems. However, while floods had been a part of human life for centuries in Viet Nam, and local communities have evolved ways of coping with flood's annual cycle, they completely lack experience to deal with the new risks. In addition, in the past floodwater quickly drained away through the network of rivers and canals built in the flood prone area. In recent years, the increasing degradation of the natural environment through deforestation and the conversion of agricultural land to urban areas have made the impact of floods more serious and longer lasting in the lowland areas. For example, because of the expansion of the road network and other barriers to drainage, the flood level has increased beyond people's anticipation. Fatefully, although most interviewed households (65%), agreed that floods are becoming worse both in severity and frequency, they were still preparing for floods at a level commensurate with the worst disaster they experienced, and not for the greater floods that are likely to strike in the future. In the 1999 flood, for example, individual and collective preparation for the flood was all based on previous water levels. Some respondents admitted that they did not begin to make any preparations until the floods were virtually upon them. As a result extreme losses and damage occurred.

Furthermore, the flood management methods in villages still follow 'old customs' mostly dependent on large-scale infrastructure once implemented by the government, but too costly to maintain nowadays. However, while these old practices are under pressure, the new methods necessary to deal with the modern risks have yet to be materialized. This phenomenon is visible not only in rural villages, but also in the cities where most households and industries are not well prepared to cope with the increasing level of floodwaters.

Ultimately, the worsening environmental problems of Viet Nam appear to be the outcome of many different interacting factors including the natural setting, traditional practice, and institutional structure. These factors provide a backdrop for the more recent rapid environmental change brought about by the expansion of the market economy, population pressure, urbanization and industrialization, inappropriate or poorly implemented disaster mitigation policies, and lack of adequate knowledge and understanding of the environment. Hence, as Viet Nam is entering this new critical phase, traditional hazards remain high, new risks are rapidly appearing, and traditional disaster coping mechanisms are becoming inadequate. Without scaling up existing programs and initiating new and more innovative ones, the future of many cities and rural regions will be subjected to severe environmental deterioration and increased vulnerability to disasters.

## 5 Potentials of a total flood risk management in Central Viet Nam

Undoubtedly, flood disasters are not simply a product of physical geography, climatic, and environmental processes, but a combination of many interrelated factors, including demographic, technical, economic and social factors, which are continuously changing. The findings of this study revealed a few potentials to tackle the above-mentioned challenges. Indeed, the lagoon area is one of the key areas for aquaculture production of the country. With proper planning this sector can boost economic growth and help the poor to get out of poverty and possibly reduce their vulnerability to flood. This is a good opportunity to integrate flood risk reduction programs into poverty alleviation, socio-economic

development and capacity building programs. It is important to note that helping the poor to get out of the poverty cycle “is a necessary but not sufficient condition” to reduce vulnerability, which beside economic growth requires good disaster mitigation and planning strategies, as well as a paradigm shift, in disaster perception, namely from hazard led to hazard vulnerability.

Likewise, the overall changing economic structure of Viet Nam holds potentials for an integrated flood risk management. Along with the transition to a market economy, the process of decentralization is underway in Viet Nam. New laws are being introduced to give greater powers to local authorities thus enhancing local autonomy to mobilize resources to address the challenges of flood risk mitigation. The role of local communities has been recognized; community based disaster management approaches are widely used. This new institutional framework has also facilitated the formation of civil society that could mediate between the individual and state, thus promoting increased government responsiveness and accountability in disaster management.

Another important potential is that the community still has strong social capital and rich local knowledge to cope with natural disasters. This, coupled with the rise of civil societies and private sectors in the region will likely foster good partnership for flood risk mitigation. With the increasing flood hazards and the limited resources of the government to prepare and respond to disasters, partnerships among private and public sectors carry the potential to mobilize the capacity of all sectors of society, including households, private sector, and civil organizations in order to supplement the decreased collective action for risk management supported by the government.

## 6 Conclusion and way forward

This study provided further support to the notion that flood disaster is not a pure hazard-led disaster, but has deep roots in social vulnerabilities. It also revealed that floods, although cause losses and damages (that often inhibit economic development), are also essential elements for the subsistence of the coastal populations of the Hue Lagoon. The livelihood of many coastal communities depends on the productive functions of cyclical floods. Thus, over time these communities developed coping mechanisms to reduce the negative impacts of floods, and take advantage of their positive effects. Unfortunately, these coping mechanisms are under pressures due to environmental degradation and improper development of the built environment around the lagoon. These pressures have been increasing since Viet Nam moved from a planned to a market economy. Furthermore, the region may already be experiencing the effects of climate change. Hence, an integrated flood risk management approach that considers all above findings both to maximize the beneficial aspects of annual floods and to reduce the socio-economic loss in the region is needed in central Viet Nam.

Such an approach should consider social vulnerabilities as a core risk component of flood disasters. Indeed, this requires more involvement of state, civil society, private sector, and local communities. The later should not be passive recipients or victims, but partners with a real voice, and thus with some power. The first step to achieve this result requires increasing disaster education and disaster awareness within flood vulnerable communities. Second, pre-existing local knowledge and concerns should be kept central in the decision-making process and the incentive structures should encourage a larger degree of local ownership and responsibility. At the local level, participatory flood risk assessments should be carried out before formulating any development projects in the region. These

assessments need to be considered in the planning processes and implementation stages. This can be done through small-scale and community-based development projects. For example, a participatory flood risk mapping could be developed for all communes in the region (mapping is one of the effective tools to raise flood disaster awareness among communities). Maps are also very important in spatial planning for land use management and flood evacuation strategies. These participatory processes help local authorities and local people increase their sense of ownership over the process of planning and implementing the flood prevention projects. Third, since the traditional coping mechanisms are becoming less effective, new initiatives of integrated flood risk management are becoming necessary. For example, beyond the traditional practices on raising housing foundations or reducing production activities during the flood season to reduce the flood loss, new risk transferring and financing strategies should be introduced in the region. These financial tools should not be used only for housing but also for the production sectors. For example, in the housing sector, those who apply flood resistant designs when building their homes should be given access to credits and loans with low interest, as well as access to affordable flood insurance programs. In the production sectors, those who follow flood reduction calendar for their agriculture and aquaculture activities as well as applying flood resistant seeds should be made eligible for crop insurance programs. Finally, all those activities that in the past have been known to make good sense from all perspectives of flood risk management, for example wetland conservation and coastal reforestation, should be reintroduced and promoted.

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