# The Flood Insurance Market in Vietnam: Challenging but Potentially Profitable

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Front cover photo: A typical farm home for a family growing rice in the Vietnam Mekong Delta. This photo was taken about a week before the planting of the next rice crop, so the paddy is flooded but fairly low. Photo by Colin Dawson, sourced from www.flickr.com.

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February, 2017

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# THE FLOOD INSURANCE MARKET IN VIETNAM: CHALLENGING BUT POTENTIALLY PROFITABLE

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## ABSTRACT

This research estimated farmers' willingness to pay (WTP) for insurance against flood hazards using a choice experiment with special attention given to attribute non-attendance and the effects coding method. In addition, the research identified some challenges and opportunities to provide policymakers with new insights into the design of a flood insurance market. A random sample of 374 households in the Vietnam Mekong River Delta was collected in 2015. The results indicate that a large proportion of respondents do not favor a flood insurance scheme, possibly due to the existence of the cluster effect, loss aversion, wishful thinking (i.e., the belief that flooding will not happen again), and moral hazard. In particular, the younger generation of farmers is ignoring flood insurance. The opportunities for the development of the flood insurance market are promising for all potential providers because WTP is high enough to earn a profit.

## 1.0 INTRODUCTION

Buying insurance is considered an effective means of spreading and segregating flood risks due to the increased impacts of climate change (Akter *et al.* 2011; Botzen and van den Bergh 2008; Bouwer and Vellinga 2005; Mills 2005). It possibly plays a significant role as a complementary flood mitigation mechanism (Huber 2011; Botzen *et al.* 2009; Bouwer and Vellinga 2005; Kabat *et al.* 2005). Specifically, flood insurance is likely to provide loss-reducing incentives for policyholders to undertake mitigation measures, which are rarely implemented voluntarily by flood-prone communities (Brouwer and Akter 2010; Botzen *et al.* 2009; Botzen and van den Bergh 2008; Kunreuther 1996).

Under well-designed arrangements, the insurer can require his clients to adopt certain mitigation measures, either to save money on premium payments or to get a lower level of deductibles (Botzen *et al.* 2009; Kunreuther and Pauly 2006; Kleindorfer and Kunreuther 1999). Consequently, this conditional adoption helps the insured to reduce their vulnerability, thus also reducing financial damages if a catastrophic flood occurs (Bubeck *et al.* 2012a; Botzen *et al.* 2009). Empirical evidence indicates that total economic losses suffered by the insured are much less than those of the uninsured (Botzen and van den Bergh 2008; Hoff *et al.* 2003). In addition, flood insurance also provides the private sector with an opportunity to monitor the strategic behavior of policyholders under information asymmetries (Botzen and van den Bergh 2008). Given its importance, there have been an increasing number of studies on the demand for flood insurance in order to provide insights into how flood insurance programs could be better designed.

In the literature, empirical studies of flood insurance demand the use of either actual data or hypothetical data, depending on whether a flood insurance market exists or not. The factors determining demand for flood insurance can be classified into three groups: economic variables, risk-related variables, and demographic variables. Economic variables include price and income (Atreya *et al.* 2015; Petrolia *et al.* 2013; Kriesel and Landry 2004; Browne and Hoyt 2000; Bauman

and Sims 1978). Risk-related variables are flood experience (Bauman and Sims 1978; Browne and Hoyt 2000; Zahran *et al.* 2009; Atreya *et al.* 2015; Petrolia *et al.* 2013; Lindell and Hwang 2008; Dumm *et al.* 2015), flood mitigation efforts (Atreya *et al.* 2015; Zahran *et al.* 2009; Kousky 2010; Burby 2006), hazard proximity conditions (Atreya *et al.* 2015; Michel-Kerjan and Kousky 2010; Kousky 2010; Zahran *et al.* 2009), and disaster relief via public compensation (Kunreuther 1996). Demographic variables consist of education, age, risk perception, risk attitude, social capital, and race (Atreya *et al.* 2015; Lo 2013a; Petrolia *et al.* 2013; Kriesel and Landry 2004; Kunreuther 1996; Bauman and Sims 1978). Some studies have also tested hypotheses of charity hazard, adverse selection (Petrolia *et al.* 2013; Lo 2013b; Browne and Hoyt 2000), and availability heuristic (Atreya *et al.* 2015) using actual data.

Some other studies (Brouwer and Akter 2010; Botzen and van den Bergh 2012; Reynaud and Manh-Hung 2012; Brouwer *et al.* 2013) investigate the demand for flood insurance using hypothetical data. These studies use different methods to identify other factors that influence the demand for flood insurance due to the increased impact of climate change. Botzen and van den Bergh (2012) introduce a risk-seeking index for measuring risk aversion, a risk ladder technique for communicating risk probabilities, and different proxies for risk perception. For developing countries, flood-prone households are said to favor central government as a fundamental insurance provider. In terms of the demand for flood insurance, these studies show mixed results. Botzen and van den Bergh (2012) use the contingent valuation method and conclude that flood-prone homeowners in the Netherlands do not want to buy flood insurance. In contrast, they find evidence of demand for flood insurance demand using choice experiments (Botzen and van den Bergh 2012). There are currently two studies on Vietnam using choice experiments (i.e., Reynaud and Manh-Hung 2012 and Brouwer *et al.* 2013). Reynaud and Manh-Hung (2012) find that households in the north-central area of Vietnam favor the status quo (i.e., respondents do not favor flood insurance). On the other hand, Brouwer *et al.* (2013) find a substantial demand for flood insurance in the central area of Vietnam. Brouwer and Akter (2010) employ a choice experiment in Bangladesh and find that most households are strongly interested in micro flood insurance. However, Akter *et al.* (2011) use the contingent valuation method in Bangladesh, indicating that only half of the interviewed households are interested in a flood insurance program.

We think there are at least five possible explanations for the contradictory findings so far. First, the contingent valuation method may not have been able to provide the respondents with enough information for them to decide on 'new' insurance products. Second, unclear coding of the alternative specific constant (ASC) in the choice experiment may have led to misinterpretations. For example, Reynaud and Manh-Hung (2012) state that the significantly positive ASC implies the favor of no insurance whereas Brouwer and Akter (2010) conclude the opposite. Third, there seems to be evidence of the so-called 'lexicographic preference'[1] (i.e., dominant insurance provider attribute) in the case of central Vietnam because the *t*-statistic of the insurance provider is extremely high (t-stat. = 23). This means that respondents may not make a trade-off when making the choice among offered alternatives. Fourth, dummy coding of attributes may cause multicollinearity among these variables and the ASC (Bech and Gyrd-Hansen 2005). Finally, there could be mistakes in experimental designs. Specifically, either they violate the mutually exclusive rule, apply irrelevant levels for the insurance provider, and set inappropriate levels for insurance premiums, or do not describe a complete set of endpoints.

To overcome some of the above-mentioned weaknesses, this study used expert judgment and focus group discussions to define relevant attributes and levels, and carefully controlled attribute non-attendance situations. Our purpose is to provide useful information on the demand for flood insurance in Vietnam by answering the following research questions:

[1] Lexicographic preferences imply that certain attributes are always preferred to other attributes, no matter what level they are supplied at (Colombo *et al.* 2013; Scott 2002).

- First, is there a demand for flood insurance from Vietnamese flood-prone households?
- Second, is this demand profitable enough for insurance companies to join the market?
- Third, what are potential challenges for the implementation of a flood insurance program in Vietnam?
- Finally, for the methodology, is the effects coding method better than the dummy coding method for a flood insurance choice experiment study?

The paper is structured as follows. The choice experiment is presented in Section 2. Section 3 describes data collection. Section 4 presents and discusses the research results. Conclusions and policy implications are presented in Section 5.

## 2.0 THE CHOICE EXPERIMENT

The choice experiment was implemented through the following steps. First, we prepared a list of attributes commonly used in previous studies to discuss with insurance experts. Previous studies used nine attributes: (i) insurance policy, (ii) insurance provider, (iii) insurance cover, (iv) damages, (v) insurance premium, (vi) flood return period, (vii) probability of fatality, (viii) length of social disruption, and (ix) monthly payment.

Second, we worked with insurance experts to identify relevant attributes and their levels for a typical flood insurance product in a developing country context. The insurance experts included a representative of BaoViet Insurance Corporation in Dong Thap province and a representative of Saigon-Hanoi Insurance corporation in Ho Chi Minh City. These advisors excluded attributes describing the status of the surrounding environment because they do not affect the design of flood insurance arrangements. In high flood-risk situations, insurers would put some constraints on insurance contracts, e.g., the insurance policyholder must implement self-protection measures or pay extra premiums. Consequently, a deductible (i.e., cost sharing between the insurer and policyholder) was recommended (i.e., the part of the damages not covered by the insurer) to be an attribute of a flood insurance option.

Because people living in an urban environment are offered various insurance programs such as housing, property, health, and fire, it is advised that the flood insurance program should be introduced to rural households. For that reason, the advisors suggested that we use the value per unit of land area (VND per 1000 $m^2$) as the unit of measurement for the insurance cover and the insurance premium. For the insurance provider, the experts said that both government and state-owned companies no longer provide insurance services. Accordingly, the levels of an insurance provider are organized as a joint-stock company, private company, or international company. Finally, we were advised to use a shortlist of five attributes: (i) insurance policy, (ii) insurance provider, (iii) coverage, (iv) deductible, and (v) premium (Table 1) to describe the attributes and their levels used in this study.

Third, we conducted two focus group discussions (16 participants) at the study sites to check the feasibility of the attributes proposed by the advisors and to determine appropriate levels for each attribute. With regard to an insurance policy, farmers were very much interested in combined natural disaster insurance, i.e., flood insurance plus insurance against other natural disasters such as waterlog (which means 'inundation status') and whirlwinds. Two advisors from the BaoViet Insurance Corporation approved four levels of insurance policy: (i) flood insurance

only, (ii) flood with waterlog insurance, (iii) flood with whirlwind insurance, and (iv) flood with waterlog and whirlwind insurance.

**Table 1.** Description of attributes and their levels

| Attributes | Description | Levels |
|---|---|---|
| Insurance policy | Single flood insurance policy or combined insurance policy. | Policy 1: Flood insurance<br>Policy 2: Flood plus waterlog insurance<br>Policy 3: Flood plus whirlwind insurance<br>Policy 4: Flood plus waterlog, and whirlwind insurance |
| Insurance cover | The loss paid directly to the insured by the insurer for first-party coverage. It is measured in terms of VND million per 1000 $m^2$. | VND 2 million per 1000 $m^2$<br>VND 3 million per 1000 $m^2$<br>VND 4 million per 1000 $m^2$ |
| Insurance provider | The insurance providers. | Joint-stock insurance company<br>Private insurance company<br>International insurance company |
| Deductible | Part of the damage due to flood hazard is initially borne by the insured. | Low deductible level: 10%<br>High deductible level: 25% |
| Insurance premium | The cost per 1000 $m^2$ paid by the insured to the insurer at a given time before the flood season. | VND 15.000 per 1000 $m^2$<br>VND 30.000 per 1000 $m^2$<br>VND 40.000 per 1000 $m^2$<br>VND 50.000 per 1000 $m^2$<br>VND 65.000 per 1000 $m^2$ |

For coverage, all participants paid attention to the time of flooding (i.e., early or late floods). Early floods inflict cultivation costs on farmers, e.g., land preparation, seeds, fertilizers and pesticides, labor, and pumping expenses. The average costs of cultivation and harvesting varied from VND 2.2 million to VND 2.5 million per 1000 $m^2$ (Ngo 2013). After extracting a harvesting cost of about VND 0.3 million per 1000 $m^2$, we chose the minimum level of VND 2 million per 1000 $m^2$ for the insurance cover. Late floods had an impact on net revenue from harvesting, costing farmers approximately VND 4 million per 1000 $m^2$. The third level of VND 3 million per 1000 $m^2$ was used in between these two extreme cases.

The three levels of insurance provider were joint-stock company, private company and international company. For the levels of the deductible, the participants agreed to a maximum level of 25%, because this is equivalent to the profit per 1000 $m^2$ of agricultural land if there is a good harvest.

To set up the bid levels for the cost attribute, we used information from the pilot agricultural insurance program in the Mekong River Delta. Advisors from BaoViet Insurance Corporation revealed the prevailing premium rate (VND 37,000 per 1000 $m^2$ after 60% of premium support from the government) and the premium rate that could represent a break-even point profit for the insurer (VND 20,000 per 1000 $m^2$). The farmers in the focus group discussions were told that VND 14,000 per 1000 $m^2$ (i.e., the premium that they pay after receiving financial support from both the government and An Giang Plant Protection Joint-Stock Company) is cheap. After in-depth discussion and after considering expert advice, we decided to set the maximum level of the

premium at VND 65,000 per 1000 $m^2$ of agricultural land. A description of the attributes and their levels is presented in Table 1.

Fourth, the choice sets were generated from orthogonal main effects design using SPSS 22 software. At first, the software generated 64 choice sets. By manual checking, we found that 13 choice sets contained a dominant choice option, and they were excluded. Out of the remaining 51 choice sets we randomly selected 48 choice sets for two purposes, and randomly divided them into eight groups of six choice sets.

In addition to these six 'real' choice sets respondents were presented with two given example choice sets and one repeated choice set (randomly drawn from the six 'real' choice sets). The example choice sets aimed to make respondents familiar with choice decisions, whereas the repeated choice sets aimed to check stable preferences.

We presented each respondent with nine choice sets. In each choice set the respondents were asked to choose the most preferred one among three alternatives, i.e., two generic flood insurance alternatives and one base alternative (opt-out). The base alternative indicated "none of the offered insurance alternatives" was chosen.

Immediately after the choice experiment, the survey presented the respondent with follow-up questions to check their understanding of the choice experiment scenario, attribute non-attendance, difficulty of choice decisions, and creditability of flood insurance programs. The general card describing attributes and levels, and an example choice set are presented in Appendix 1.

# 3.0 DATA COLLECTION AND DESCRIPTIVE STATISTICS

## 3.1 The Questionnaire

The questionnaire (Appendix 4) included the following sections.

- The first section asked general information about the respondent and his/her family. Three variables were generated: (i) age of household head, (ii) household size, and (iii) membership in agricultural cooperative.

- The second section included questions about perceptions and flood risk experience. Five variables were generated: (i) risk perception, (ii) wishful thinking, (iii) disaster relief, (iv) status of inundation (waterlog), and (v) health insurance purchase experience.

- The third section evaluated flood control management.

- The fourth section featured a game to assess the respondent's risk attitude, in which the respondent was asked to choose between a certain outcome and an expected outcome. The respondent is considered risk averse if s/he chooses option A in either scenario 4 or scenario 5 (Appendix 2).

- The fifth section was a choice experiment.

- The final section was about household economic activities. Four variables were generated: (i) agricultural land size, (ii) yearly income per capita, (iii) share of income from agricultural

cultivation activities on total household income, and (iv) unprotected area. These variables entered the random parameter logit models in terms of interactions with either the ASC or the attributes. A summary of interaction variables used in the model are presented in Table 2.

**Table 2.** Interactions with ASC and attributes

| Variable | Description | Expected sign |
|---|---|---|
| **Flood exposures** | | |
| ASC x Tan Hong district | High risk area, Dong Thap province | + |
| ASC x Tan Chau district | High risk area, An Giang province | + |
| ASC x Cao Lanh district | Medium risk area, Dong Thap province | + |
| ASC x Cho Moi district | Medium risk area, An Giang province | + |
| ASC x Unprotected areas | Farms are unprotected by August dike | + |
| ASC x Inundation status | Farm was inundated by a recent flood | + |
| **Risk perceptions, opinion** | | |
| ASC x Risk perception | Flood is the most catastrophic disaster | + |
| ASC x Wishful thinking | Flood will never happen here again | - |
| ASC x Disaster relief | Government should provide victims with post-flood relief | - |
| **Socio-economic charateristics** | | |
| ASC x Age of household head | Age of household head | ? |
| ASC x Household size | Number of people living as part of the family during the last six months | ? |
| ASC x Income per capita | Total yearly income per capita | + |
| ASC x Agricultural land size | Total area of agricultural production | - |
| ASC x Purely agricultural activities | Income share from agricultural activities | ? |
| ASC x Agricultural cooperative | Member of agricultural cooperative | - |
| **Insurance experience** | | |
| ASC x Health insurance | Bought health insurance | + |
| **Interactions with attributes** | | |
| Cover x Risk averse | Risk aversion from risk attitude game | + |
| Premium x Income per capita | Total yearly income per capita | + |

## 3.2 Sample Characteristics

The study sites consist of five districts (Figure 1) from three of the most representative provinces in the Vietnamese Mekong Delta. These are:

1. Tan Chau (a high-risk district) on the left bank of Hau river;
2. Tan Hong (a high-risk district) on the right bank of Tien river;
3. Cao Lanh (a medium-risk district near protected wetland areas) on the right bank of Tien river;
4. Cho Moi (a medium-risk district with a modern Vam Nao dike system) between the Tien and Hau rivers; and
5. Vi Thuy (a low-risk district nearby Xang Xa No canal) on the left bank of Hau river.

These districts are located along the two main rivers of the Mekong River Delta. Cantho University flood risk experts recommended the selection of these districts for the study.

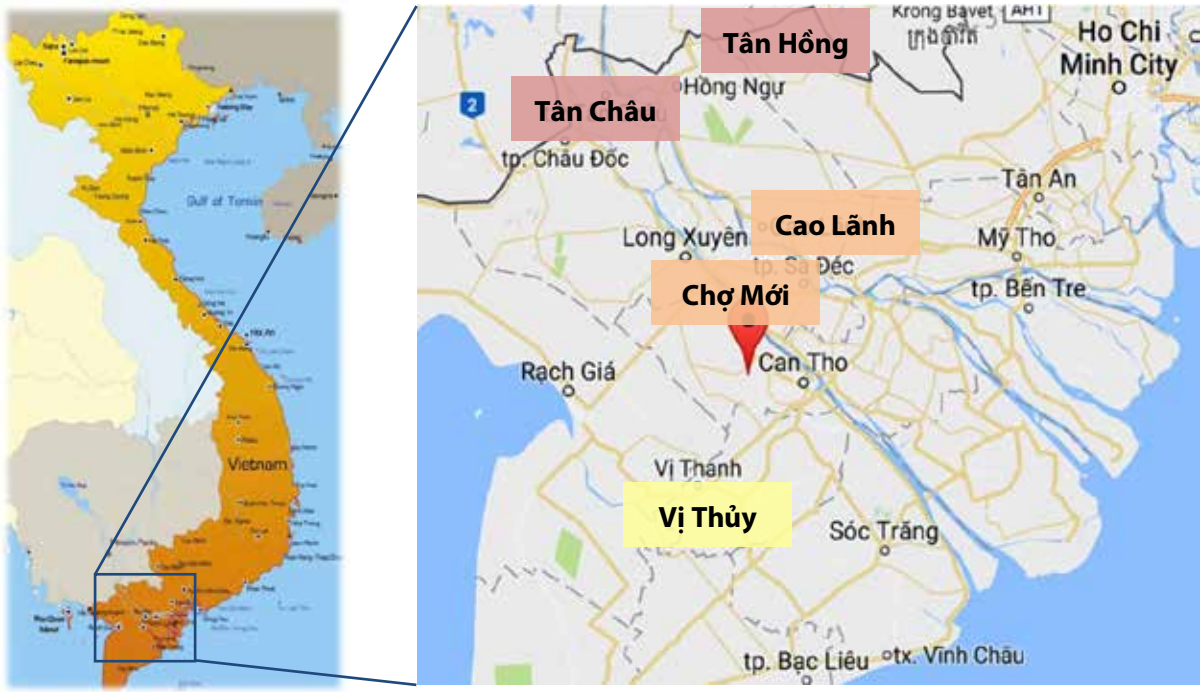


**Figure 1.** Map of the study sites

A list of communes that had both protected and unprotected areas was obtained from the Department of Agriculture and Rural Development. From this list, we randomly selected one representative commune in each study district. In each selected commune, we asked for the map and the proportion of protected and unprotected population then decided the proportion of respondents from each area.

The proportion of people living in protected areas was about 40% in high-risk districts, and about 90% in low-risk districts. Our planned sample size in each district was 100 observations but for various reasons (such as respondents owning no agricultural land, refusing to answer the questionnaire, or answering just a part of the questionnaire) we completed 74.8% of the target.

An hour before approaching the randomly selected households we asked the head of the village to accompany us to each household to make sure that the research team was officially approved to conduct the survey. The village head and other neighbors were not present during the interviews. In Vi Thuy district we mostly travelled by boat because the road infrastructure is poorly developed. The socio-economic characteristics of the sample are summarised in Table 3.

**Table 3.** Summary of socio-economic characteristics (sample mean)

| | Tan Chau | Tan Hong | Cao Lanh | Cho Moi | Vi Thuy | Whole sample |
|---|---|---|---|---|---|---|
| Planned sample size | 100 | 100 | 100 | 100 | 100 | 500 |
| Actual sample size | 81 | 81 | 72 | 71 | 69 | 374 |
| **Risk exposure and flood experience** | | | | | | |
| Percentage of August dike around farm (%) | 37.1 | 42.0 | 88.9 | 93.0 | 85.5 | 67.7 |
| Inundated by a recent flood (%) | 72.8 | 93.8 | 95.8 | 67.6 | 87.0 | 83.4 |
| **Socio-demographic characteristics** | | | | | | |
| Gender of household head (male, %) | 88.9 | 90.1 | 88.9 | 90.1 | 88.4 | 89.3 |
| Age of household head (year) | 50.3 | 50.9 | 52.7 | 55.3 | 51.9 | 52.1 |
| Schooling years of household head (year) | 4.8 | 5.7 | 5.5 | 4.9 | 4.9 | 5.2 |
| Family size (number of people) | 4.1 | 3.9 | 4.2 | 4.3 | 4.8 | 4.0 |
| Agricultural land size (1000m$^2$) | 6.2 | 25.3 | 20.8 | 24.9 | 14.7 | 18.3 |
| Total yearly income (VND mil.) | 76.6 | 150.4 | 154.3 | 283.1 | 113.3 | 153.5 |
| Total income/season/1000 m$^2$ (VND mil.) | 3.1 | 2.4 | 2.9 | 3.7 | 3.1 | 3.1 |
| Yearly cultivation income (VND mil.) | 25.6 | 68.0 | 100.0 | 171.4 | 67.9 | 84.6 |
| Cultivation inc./season/1000 m$^2$ (VND mil.) | 1.31 | 0.90 | 1.65 | 1.49 | 1.57 | 1.39 |
| Share of income from cultivation (%) | 33.0 | 39.1 | 73.1 | 59.3 | 63.4 | 52.6 |
| Share of off-farm income (%) | 41.6 | 17.8 | 15.8 | 22.6 | 17.8 | 23.5 |
| Member of agricultural cooperatives (%) | 11.1 | 18.5 | 38.9 | 4.2 | 27.5 | 19.8 |
| Health insurance purchase (%) | 59.3 | 75.3 | 77.8 | 62.0 | 63.8 | 67.7 |
| **Risk perception characteristics** | | | | | | |
| Flood is a main problem (%) | 50.6 | 42.0 | 25.0 | 18.3 | 21.7 | 32.4 |
| Flood will never happen again (%) | 17.3 | 19.8 | 15.3 | 25.4 | 18.8 | 19.3 |
| **Risk coping characteristics** | | | | | | |
| Number of protection measures in past | 10.0 | 10.7 | 11.0 | 8.7 | 11.3 | 10.3 |
| Number of protection measures at present | 8.1 | 8.2 | 9.9 | 8.0 | 11.5 | 9.1 |
| **Government relief** | | | | | | |
| People require disaster relief from govt. | 86.4 | 86.4 | 76.4 | 88.7 | 82.6 | 84.2 |

Source: Household survey conducted by the authors in January 2015.

## 3.3 Choice Analysis

In this section, we describe the choice decisions of the sample respondents. To determine the relevant observations for further econometric analysis, we considered two things. First, we tested for both the existence of dominant attributes (i.e., the respondent made a choice by looking at only one attribute) and for attribute non-attendance cases (i.e., the respondent ignores one or more attributes). Second, we tested whether respondents make consistent choice decisions.

### 3.3.1 Attribute non-attendance and dominant attributes

Immediately after the choice scenario session, the respondents who always chose 'none of the two' alternatives were asked to explain their reasons for declining flood insurance purchase offers. This follow-up question allowed us to identify 10 respondents as protestors. We then excluded these respondents from further analyses. Accordingly, our sample was reduced to 364 relevant respondents.

For those making relevant choice decisions, we proceeded by asking what attributes they considered when making choices among alternatives. This follow-up question was used to explore the problem of attribute non-attendance. A summary of attribute non-attendance and dominant attributes from the follow-up questions is presented in Tables 4 and 5.

Table 4 shows that about 8.2% (30), 17.3% (63), 32.4% (118), 36.0% (131), and 20.9% (76) of the sample of 364 respondents ignored the attributes of the insurance policies, insurance provider, damage coverage, levels of deductible, and insurance premiums, respectively. It seems that the deductible was the most frequently ignored attribute. The third column of Table 4 confirms that the level of deductible was the least important attribute when respondents made choice decisions. Both insurance policy and insurance provider were highly ranked by the sampled respondents. This indicates that the respondents might be interested in what kind of insurance is offered and who the provider will be.

Table 4 (column four) and Table 5 indicate that about 3.3% of respondents used only one attribute to make choice decisions. In addition, about 2.2% of respondents ignored all five attributes. Thus, 5.5% (= 3.3 + 2.2) of the respondents did not provide information on their willingness to make trade-offs among the attributes of flood insurance products. In the later econometric analyses, this group of respondents (20) were also excluded.

Table 5 also indicates that only 42.9% of respondents considered all five attributes when making their choice decisions. In comparison with previous studies using choice experiments (Nguyen *et al.* 2015), the share of respondents ignoring at least one attribute in our study is relatively high (57.1%). Specifically, 24.7% of respondents ignored one attribute, 14.8% ignored two attributes, 12.1% ignored three attributes, 3.3% ignored four attributes, and 2.2% ignored all five attributes. The ignorance of attribute non-attendance in previous flood insurance studies could thus be questionable in assessing the validity of WTP value measures.

**Table 4.** Attribute non-attendance breakdown

| Attribute | Ignored the attribute | Most important attribute | Dominant attribute |
|---|---|---|---|
| Insurance policy | 8.20% | 50.8% | 1.65% |
| Insurance provider | 17.3% | 30.5% | 1.10% |
| Insurance cover | 32.4% | 6.04% | 0.00% |
| Level of deductible | 36.0% | 2.20% | 0.00% |
| Insurance premium | 20.9% | 7.14% | 0.55% |

**Table 5.** Attribute processing strategy of respondents

| Attribute processing strategy | Number of respondents | Share of respondents |
|---|---|---|
| **Respondents attended all attributes** | **156** | **42.9%** |
| **Respondents ignoring one attribute** | **90** | **24.7%** |
| Policy | 6 | 1.65% |
| Provider | 20 | 5.49% |
| Cover | 20 | 5.49% |
| Deductible | 31 | 8.51% |
| Premium | 13 | 3.57% |
| **Respondents ignoring two attributes** | **54** | **14.8%** |
| Policy and provider | 0 | 0.00% |
| Policy and cover | 4 | 1.10% |
| Policy and deductible | 2 | 0.55% |
| Policy and cost | 0 | 0.00% |
| Provider and cover | 4 | 1.10% |
| Provider and deductible | 7 | 1.92% |
| Provider and premium | 1 | 0.27% |
| Cover and deductible | 24 | 6.59% |
| Cover and premium | 7 | 1.92% |
| Deductible and premium | 5 | 1.37% |
| **Respondents ignoring three attributes** | **44** | **12.1%** |
| Policy, provider, and cover | 0 | 0.00% |
| Policy, provider, and deductible | 0 | 0.00% |
| Policy, provider, and premium | 0 | 0.00% |
| Policy, provider, and deductible | 2 | 0.55% |
| Policy, cover, and deductible | 1 | 0.27% |
| Policy, cover, and premium | 1 | 0.27% |
| Policy, deductible, and premium | 0 | 0.00% |
| Provider, cover, and deductible | 10 | 2.75% |
| Provider, cover, and premium | 1 | 0.27% |
| Provider, deductible, and premium | 4 | 1.10% |
| Cover, deductible, and premium | 25 | 6.87% |
| **Respondents ignoring four attributes** | **12** | **3.3%** |
| Policy, provider, cover, and deductible | 2 | 0.55% |
| Policy, provider, cover, and premium | 0 | 0.00% |
| Policy, provider, deductible, and premium | 0 | 0.00% |
| Policy, cover, deductible, and premium | 4 | 1.10% |
| Provider, cover, deductible, and premium | 6 | 1.65% |
| **Respondents ignored all five attributes** | **8** | **2.2%** |
| **Total** | **364** | **100%** |

### 3.3.2 Choice consistency

Using the Kruskal-Wallis equality-of-populations rank test, we found that there is no statistically significant difference among the eight groups of six choice sets in terms of choice decisions (p-value = 0.9656). This indicates that the random blocking of our experimental design is reliable. In addition, 68.68% of the respondents said that they were aware of the similarity of the repeated set to one of the six choice sets. This awareness rate was higher than the rate estimated by Brouwer *et al.* (2013) (about 38%). This higher rate could be due to the lower number of choice sets per respondent and attributes per choice option in our study, giving a lower fatigue effect (see Carlsson *et al.* 2012). In addition, the attributes of flood return period and probability of fatality in Brouwer *et al.* (2013) could be beyond the cognitive ability of low-educated farmers in developing countries. Of the respondents who were aware of the similarity between the two choice sets, 91.2% made consistent choices. This rate is also higher than the study by Brouwer *et al.* (2013) (about 83%). Therefore, we are confident of stable preferences in the current study.

To explain why respondents made different choice decisions in the last repeated choice set, we regressed the dependent variable (1 = changed choice in the last choice task) on a number of socio-demographic and experimental design characteristics. The regression results are presented in Table 6. We realized that the order of the repeated choice sets does not statistically affect the choice decisions of the respondents. The choice consistency is also not dependent on respondents' judgment about the choice scenarios and the complexity of the choice sets. Those respondents who took more time to complete the choice session, however, were more likely to make inconsistent choices. In addition, higher-educated respondents were more likely to make consistent choices.

**Table 6.** Estimated binary logistic model (1 = changed choice in last choice task)

| Variables | Description | Coefficient |
|---|---|---|
| **Experimental design characteristics** | | |
| Choice set 1 | Last card was the first card, dummy | -0.15834 |
| Choice set 2 | Last card was the first card, dummy | -0.51178 |
| Choice set 3 | Last card was the first card, dummy | 0.48236 |
| Choice set 4 | Last card was the first card, dummy | 0.62357 |
| Choice set 5 | Last card was the first card, dummy | -1.0448 |
| Reliability | Not reliable = 1, very reliable = 5 | 0.33730 |
| Complexibility | Easily = 1, very complex = 5 | 0.25779 |
| Time | Time to complete the choice experiment | 0.08592** |
| **Respondent characteristics** | | |
| Gender | Gender of respondents (1 = male) | 1.37619 |
| Age | Age of respondents | -0.02982 |
| Education | Schooling years of respondents | -0.24918*** |
| Income per capita | Million VND | 0.00056 |
| **Model summary statistics** | | |
| Log likelihood | -62.02 | |
| Pseudo $R^2$ | 0.138 | |
| Number of observations | 248 | |

## 4.0 ECONOMETRIC ANALYSIS

The relevant choices (i.e., 4104 observations) were regressed on the attributes and interactive variables using the random parameter logit model to estimate preference heterogeneity in the population (see Appendix 3 for the model equation). We also estimated conditional logit models, but the results were not as good as their random parameter logit counterparts. According to Hensher *et al.* (2005), a normal distribution produces the statistically best fit for continuous variables, and a uniform distribution is appropriate for dummy variables. The random parameter logit models were estimated using a Halton sequence of 5000 replications in Nlogit 4.0. In addition, we found that a restriction on the variance of qualitative variables (i.e., variance = 0.75*mean) statistically improved the significance of the standard deviation random parameters. We also ran various models with different replications, e.g., 1000, 2000, 3000, 7000, 9000, but the models with a Halton of 5000 replications provided the best statistics. We put various restrictions on variance, e.g., 0.9, 0.8, 0.7, 0.6, but the restriction of 0.75 resulted in the best fit models (i.e., statistically significant standard deviation of random parameters, smallest Akaike information criterion (AIC), and highest Pseudo $R^2$ in each model).

**Table 7.** Coding methods for qualitative variables

| Variables | Levels | Dummy coding | | | | Effects coding | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Code 1 | Code 2 | Code 3 | Code 4 | Code 1 | Code 2 | Code 3 | Code 4 |
| Insurance policy | 1 | 0 | 0 | 0 | | -1 | -1 | -1 | |
| | 2 | 1 | 0 | 0 | | +1 | 0 | 0 | |
| | 3 | 0 | 1 | 0 | | 0 | +1 | 0 | |
| | 4 | 0 | 0 | 1 | | 0 | 0 | +1 | |
| Insurance provider | 1 | 0 | 0 | | | -1 | -1 | | |
| | 2 | 1 | 0 | | | +1 | 0 | | |
| | 3 | 0 | 1 | | | 0 | +1 | | |
| Deductible | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| District | 1 | 1 | 0 | 0 | 0 | -1 | -1 | -1 | -1 |
| | 2 | 0 | 1 | 0 | 0 | 0 | +1 | 0 | 0 |
| | 3 | 0 | 0 | 1 | 0 | 0 | 0 | +1 | 0 |
| | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | +1 |
| | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dike | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Agricultural cooperative | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Inundation status | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Age | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Wishful thinking | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Health insurance | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |
| Risk aversion | 1 | 0 | | | | -1 | | | |
| | 2 | 1 | | | | +1 | | | |

Because attribute non-attendance exists in our current study, we adopted the estimation method previously used by Nguyen *et al.* (2015). In addition, we also investigated whether effects coding results in any differences compared with traditional dummy coding in flood insurance choice experiments. We estimated four models.

- **Model 1** (full attribute attendance, dummy coding): This model assumes that all respondents fully attend to the attributes, and qualitative attributes and qualitative covariates are conventionally coded as dummy variables (see Table 7).

- **Model 2** (full attribute attendance, effects coding): This model assumes that all respondents fully attend to the attributes, and qualitative attributes and qualitative covariates are coded by using the effects coding method (see Table 7).

- **Model 3** (restriction of zero parameter, effects coding): This model assumes that the parameters of any attributes ignored by respondents are simply assigned zero values. Specifically, if respondent *i* ignored attribute *j* in a choice set, the coefficient $\beta_{ij}$ is constrained to zero. The effects coding is applied to qualitative attributes and qualitative covariates.

- **Model 4** (attribute non-attendance interaction, effects coding): This model includes interaction terms between the attributes and their corresponding non-attendance dummy variables. We call these non-attendance dummy variables 'ignored attributes'. If a certain attribute non-attendance influences respondents' choice decision, the coefficient of its corresponding ignored attribute becomes statistically significant. Like Models 2 and 3, the effects coding is applied to qualitative attributes and qualitative covariates.

# 5.0 RESULTS

## 5.1 Random Parameter Logit Models

Table 8 shows that all four models strongly fit the sample data because they have a pseudo-$R^2$ greater than 0.2 (Hoyos 2010). We then select one model that best fits the data by using the Akaike information criterion (AIC), Schwarz's Bayesian criterion (BIC), and the Hannan-Quinn information criterion (HQIC). Table 8 indicates that Model 3 is the best-fit model based on the criteria. We also ran Models 3 and 4 using dummy coding, but this did not improve the models' information criteria. This could suggest that the respondent's marginal utility with respect to the ignored attribute was likely to be zero. Accordingly, ignorance of attribute non-attendance could lead to model misspecifications.

**Table 8.** Model selection criteria (5000 Halton replications)

| Model | Parameters | Log likelihood | AIC | BIC | HQIC | Pseudo $R^2$ |
|---|---|---|---|---|---|---|
| Model 1 | 29 | -929.86 | 1.47177 | 1.58689 | 1.51496 | 0.35043 |
| Model 2 | 29 | -930.11 | 1.47216 | 1.58728 | 1.51535 | 0.35025 |
| Model 3 | 29 | -920.30 | **1.45710** | **1.57222** | **1.50029** | 0.35711 |
| Model 4 | 37 | -916.06 | 1.46287 | 1.60974 | 1.51797 | 0.36007 |

Although effects coding in Model 2 does not statistically improve the model statistics (Table 8), the insignificance at 5% of the ASC and the opposite sign of flood plus whirlwind attribute (Table 9) prove that dummy coding could lead to multicollinearity between dummy variables and the alternative specific constant (Bech and Gyrd-Hansen 2005). Recall that in all models, the ASC takes zero for the alternative describing the status quo (i.e., none of the flood insurance alternatives); the value is one otherwise. By coding this way, the significantly negative signs of the ASC indicate that respondents, on average, favor the status quo to any of the offered insurance alternatives. All effects coding models show that the problem of status quo bias (i.e., respondents disfavor insurance program) exists in the Mekong River Delta, Vietnam. In particular, 'none of the two insurance alternatives' was selected in about 64% of the observed choices.

Almost all of the standard deviations of random parameters presented in the lower part of Table 9 are statistically significant at 5%. The significant coefficients of standard deviation affirm that there exists preference heterogeneity among respondents in the sample and that the random parameter logit models are better fitted than conditional logit models. Looking at the upper part of Table 9, we see that the signs of all attribute coefficients are as expected in the effects coding models (i.e., Models 2–4). Except for 'flood plus whirlwind', main-effect coefficients are statistically significant at 5% in Model 3.

**Table 9.** Estimated flood insurance choice models

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| **Mean fixed parameters** | | | | |
| ASC | -3.86073* | -7.41447*** | -7.65509*** | -7.17840*** |
| Choice attributes | | | | |
| Flood + waterlog | 1.24509*** | 0.18831** | 0.23045** | -0.00811 |
| Flood + whirlwind | 0.89443*** | -0.13601 | -0.10829 | -0.25610 |
| Flood + waterlog + whirlwind | 2.13374*** | 0.99340*** | 1.03421*** | 0.69037** |
| Joint-stock company | 1.14352*** | 0.74452*** | 0.92813*** | 0.45881*** |
| International company | -0.02859 | -0.38906*** | -0.53891*** | -0.20571** |
| Insurance cover | 0.20354** | 0.48734*** | 0.31922** | 0.46362*** |
| High deductible | -0.29742* | -0.26644** | -0.32596** | -0.23078** |
| Insurance premium | -0.01978** | -0.01788*** | -0.01783*** | -0.01398*** |
| Interactions with ASC | | | | |
| ASC x Tan Chau district | -4.41640* | -2.00270*** | -2.35322*** | -1.87765*** |
| ASC x Tan Hong district | -4.85868* | -2.18936*** | -2.48737*** | -2.04225*** |
| ASC x Cao Lanh district | -4.30930* | -2.18936*** | -2.26738*** | -1.8347*** |
| ASC x Cho Moi district | -0.81863 | -0.38122 | -0.46948 | -0.36457 |
| ASC x Unprotected area | 1.17582 | 0.47430* | 0.52054** | 0.41635** |
| ASC x Inundation status | 1.94177 | 0.84838** | 0.86457** | 0.75512** |
| ASC x Flood perception | 0.30087 | 0.26744* | 0.28998* | 0.27673** |
| ASC x Wishful thinking | -1.33796 | -0.63147* | -0.76654** | -0.57854* |
| ASC x Disaster relief | 1.18247 | 1.03221*** | 1.02002** | 0.96722*** |
| ASC x Age of household head | 2.27315 | 0.93611** | 1.01540*** | 0.90145*** |
| ASC x Household size | 0.61132 | 0.56468** | 0.58289*** | 0.53864*** |
| ASC x Income per capita | 0.01491 | 0.01328* | 0.01459** | 0.01311** |
| ASC x Agricultural land size | -0.01347 | -0.01240 | -0.00911 | -0.01232 |
| ASC x Purely agricultural households | -1.60984* | -1.46734** | -1.66774** | -1.40963** |
| ASC x Agricultural cooperative | -1.72469 | -0.83640** | -1.08116*** | -0.74359** |
| ASC x Health insurance | 0.77629 | 0.33582 | 0.42499 | 0.33533 |

*Table 9 continued*

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Interactions with attribute | | | | |
| Insurance cover x Risk averse | 0.59422* | 0.28946** | 0.06472 | 0.25397* |
| Premium x Income per capita | 0.000049 | 0.000046 | 0.00046* | 0.000043* |
| **Ignored attribute** | | | | |
| Flood + waterlog | | | | -0.22160 |
| Flood + whirlwind | | | | -0.13857 |
| Flood + waterlog + whirlwind | | | | -0.23917 |
| Joint-stock company | | | | -0.36203*** |
| International ompany | | | | 0.27183*** |
| Insurance cover | | | | 0.01436 |
| High deductible | | | | 0.73894 |
| Insurance premium | | | | 0.00301 |
| **St. dev. of random parameters** | | | | |
| Flood + waterlog | 0.93382*** | 0.14124** | 0.17284*** | 0.00340 |
| Flood + whirlwind | 0.67083*** | 0.10201* | 0.08122 | 0.19311 |
| Flood + waterlog + whirlwind | 1.60030*** | 0.74505*** | 0.77565*** | 0.51094** |
| Joint-stock company | 0.85764*** | 0.55839*** | 0.69610*** | 0.33819*** |
| International company | 0.02145 | 0.29179*** | 0.40419*** | 0.15125** |
| Insurance cover | 0.39864 | 0.38525 | 0.82920*** | 0.21646 |
| High deductible | 0.22307* | 0.19983** | 0.24447** | 0.17027** |
| Insurance premium | 0.03250 | 0.02748 | 0.02569 | 0.02231 |
| ASC x Unprotected area | 0.88186 | 0.35572* | 0.39041** | 0.31603** |
| ASC x Agricultural cooperative | 1.29352 | 0.62730** | 0.81087*** | 0.53672*** |
| ASC x Inundation status | 1.45633 | 0.63625** | 0.64843** | 0.54656** |
| ASC x Wishful thinking | 1.0035 | 0.47360* | 0.57490** | 0.42686** |
| ASC x Age of household head | 1.70486 | 0.70209** | 0.76155*** | 0.65889*** |

Note: significant levels; *10%, **5%, ***1%.

For those who favor an insurance policy, triple disaster insurance is preferred to the double disaster insurance, and double insurance is preferred to single flood insurance. However, the preference is not always the same among the respondents because the standard deviations of these random parameters are highly significant. Because both the coefficient and standard deviation of 'flood plus whirlwind' parameter are not significant, we could expect that farmers generally are indifferent to the purchase of 'flood plus whirlwind' insurance policy. This could be explained by the fact that farmers can protect themselves by planting trees around farms and houses. In addition, a whirlwind is often accompanied by heavy rain, which results in inundation. For that reason, people tend to favor triple disaster insurance over 'flood plus whirlwind' insurance.

The significant positive coefficient of 'joint-stock company' and the significant negative coefficient of 'international company' imply that farmers prefer joint-stock companies to private companies, and private companies to international companies. A possible explanation is that international insurance companies operate mostly in urban areas. Therefore, rural households are not familiar with their service quality. Preference heterogeneity was also detected for insurance providers in all effects coding models. This indicates that not all farmers favor joint-stock companies and/or disfavor international companies. Therefore, international insurance companies would have an opportunity to offer flood insurance services if the market became available.

The significant positive coefficient for insurance cover means that the higher the cover per 1000 $m^2$, the more likely it is that farmers will potentially buy a flood insurance policy. This also implies that farmers are risk averse. However, the insignificant or less significant coefficients of interactive variables between coverage and risk aversion could indicate that not only risk-averse farmers are looking for higher insurance cover. In the lower part of Table 9, we see that the standard deviation of this random parameter is statistically significant in Model 3.

The significant negative coefficients of 'high deductible' and 'premium' mean that, for those who choose an insurance policy, they are more likely to favor the lower levels of the deductible and cheaper premiums. This indicates that respondents are willing to adopt self-protection measures so that they can pay a lower premium. The positive coefficient of the interactions between premium and income per capita suggests that the richer the household, the more likely it is to be willing to pay more for flood insurance. However, this is only true if we accept a 10% level of significance. The insignificance of the standard deviation of the premium parameter shows that farmers always prefer lower to higher premiums. The standard deviation of the random parameter for the deductible is statistically significant in all models. Depending on the self-protection efforts made by farmers, insurance providers will negotiate a reasonable level of deductible to share the risk of flooding.

## 5.2 Willingness to Pay for Flood Insurance

The willingness to pay (WTP) for each insurance package was calculated from the estimated random parameter logit models presented in Table 10. To estimate the WTP value for each insurance package and its corresponding standard error, we use the Wald command in Nlogit 4.0. The WTP for an insurance package depends on the following factors:

1. **Insurance policy**: flood insurance, flood plus waterlog, flood plus whirlwind, and flood plus waterlog and whirlwind.

2. **Insurance provider**: joint-stock company, international company, and domestic private company.

3. **Insurance coverage**: VND 2 million/1000 $m^2$, VND 3 million/1000 $m^2$, and VND 3 million/1000 $m^2$.

4. **Deductible level**: low deductible (10%), and high deductible (25%).

The formula of WTP calculation is the same as that used in Brouwer and Akter (2010). It is defined as follows:

$$WTP = - \frac{(\widehat{\beta}\,\text{insurance type} + \widehat{\beta}\,\text{provider} + \widehat{\beta}\,\text{cover} * \text{cover} + \widehat{\beta}\,\text{deductible} * \text{deductible})}{\widehat{\beta}\,\text{premium}}$$

For the base case, which is a single flood insurance policy with a high deductible offered by a private company, the estimated WTP depends on how the qualitative attributes are coded. The mean WTPs and their corresponding standard errors are presented in Tables 10, 11 and 12.

**Table 10.** WTP/1000 $m^2$, joint-stock company and high deductible (1000 VND)

| Insurance cover (1000 VND /1000 $m^2$) | | Insurance policy | | | |
|---|---|---|---|---|---|
| | | Flood | Flood plus waterlog | Flood plus whirlwind | Flood plus waterlog, and whirlwind |
| MODEL 1 | 2.000 | 63.36*** (20.73) | 126.31*** (34.00) | 108.58*** (28.98) | 171.24*** (42.05) |
| | 3.000 | 73.65*** (24.94) | 136.60*** (37.87) | 118.87*** (32.82) | 181.53*** (45.66) |
| | 4.000 | 83.94*** (29.36) | 146.89*** (41.96) | 129.16*** (36.91) | 191.82*** (49.49) |
| MODEL 2 | 2.000 | 22.77 (16.84) | 91.81*** (26.25) | 73.66*** (22.50) | 136.85*** (33.73) |
| | 3.000 | 50.04** (24.69) | 119.07*** (34.55) | 100.93*** (30.88) | 164.11*** (41.75) |
| | 4.000 | 77.30** (33.09) | 146.33*** (43.09) | 128.19*** (39.49) | 191.37*** (50.07) |
| MODEL 3 | 2.000 | 4.73 (15.85) | 82.53*** (24.10) | 63.53*** (20.84) | 127.62*** (32.53) |
| | 3.000 | 22.64 (21.23) | 100.44*** (30.13) | 81.44*** (27.05) | 145.53*** (38.10) |
| | 4.000 | 40.55 (27.41) | 118.35*** (36.56) | 99.35*** (33.62) | 163.44*** (44.13) |

**Table 11.** WTP/1000 $m^2$, international company and high deductible (1000 VND)

| Insurance cover (1000 VND/ 1000 $m^2$) | | Insurance policy | | | |
|---|---|---|---|---|---|
| | | Flood | Flood plus waterlog | Flood plus whirlwind | Flood plus waterlog, and whirlwind |
| MODEL 1 | 2.000 | 4.10 (12.47) | 67.05*** (22.05) | 49.32*** (17.87) | 111.98*** (29.48) |
| | 3.000 | 14.39 (16.29) | 77.34*** (26.11) | 59.61*** (21.77) | 122.27*** (33.22) |
| | 4.000 | 24.68 (20.57) | 87.63*** (30.42) | 69.90*** (26.01) | 132.56*** (37.222) |
| MODEL 2 | 2.000 | -40.64** (17.88) | 28.39* (17.07) | 10.25 (15.82) | 73.43*** (22.34) |
| | 3.000 | -13.38 (21.95) | 55.65** (25.13) | 37.51* (23.09) | 100.69*** (30.65) |
| | 4.000 | 13.88 (28.33) | 82.92** (33.63) | 64.77** (31.23) | 127.96*** (39.23) |
| MODEL 3 | 2.000 | -77.58*** (26.10) | 0.23 (15.47) | -18.78 (17.29) | 45.32** (17.96) |
| | 3.000 | -59.67** (27.28) | 18.14 (20.75) | -0.87 (21.44) | 63.23*** (24.09) |
| | 4.000 | -41.76 (30.14) | 36.04 (26.89) | 17.04 (26.87) | 81.14** (30.65) |

**Table 12.** WTP/1000 $m^2$, private company and high deductible (1000 VND)

| Insurance cover (1000 VND/ 1000 $m^2$) | | Insurance policy | | | |
|---|---|---|---|---|---|
| | | Flood | Flood plus waterlog | Flood plus whirlwind | Flood plus waterlog, and whirlwind |
| MODEL 1 | 2.000 | 5.54<br>(10.43) | 68.49***<br>(21.71) | 50.77***<br>(17.11) | 113.42***<br>(29.19) |
| | 3.000 | 15.83<br>(14.77) | 78.78***<br>(22.03) | 61.06***<br>(21.14) | 123.71***<br>(32.95) |
| | 4.000 | 26.13<br>(19.38) | 89.07***<br>(30.17) | 71.35***<br>(25.48) | 134.00***<br>(36.98) |
| MODEL 2 | 2.000 | -38.76**<br>(17.01) | 30.27*<br>(17.80) | 12.13<br>(15.93) | 75.31***<br>(22.98) |
| | 3.000 | -11.50<br>(21.47) | 57.53**<br>(25.82) | 39.39*<br>(23.38) | 102.57***<br>(31.28) |
| | 4.000 | 15.76<br>(28.14) | 84.80**<br>(34.29) | 66.65**<br>(31.59) | 129.84***<br>(39.84) |
| MODEL 3 | 2.000 | -69.18***<br>(23.67) | 8.62<br>(16.16) | -10.38<br>(16.49) | 53.72***<br>(19.73) |
| | 3.000 | -51.27*<br>(25.43) | 26.53<br>(21.81) | 7.53<br>(21.36) | 71.63***<br>(25.90) |
| | 4.000 | -33.36<br>(28.90) | 44.44<br>(28.14) | 25.44<br>(27.24) | 89.54***<br>(32.45) |

From Tables 10, 11 and 12 we have the following remarks:

- First, the dummy coding method overestimates the WTP values, and thus increases the level of significance (i.e., comparing the corresponding insurance packages between Model 1 and Model 2). This implies a potential risk for policy decision making.
- Second, ignorance of attribute non-attendance could also overestimate the WTP of insurance packages because the respondents that ignored a certain attribute could assign a very low value or even zero value for that attribute. This is also a potential risk for policy decision making.
- Third, there is no demand amongst farmers for flood insurance only. There is a potential market for combined insurance policy (i.e., flood with other disasters insurance). Because farmers often face various natural disasters during the rainy season, they have an interest in coping with the most prevalent disasters all at once instead of only one.
- Fourth, the triple-disaster insurance could offer opportunities for all potential providers, not just joint-stock companies. If the break-even profit point is about VND 20,000, both private and international insurance companies could make a profit by providing triple-disaster insurance products. Farmers who are only interested in insuring floods in combination with either waterlog or whirlwind risks can choose the joint-stock companies in the region.
- Fifth, farmers have the ability to pay for flood insurance packages because the WTP accounts for a small percentage of their income from agricultural cultivation (see Table 3). If farmers choose triple-disaster insurance packages, the WTP per 1000 $m^2$ per season is just equivalent to 2.8% (for low cover, from an international company) to 10.6% (for high cover, from a joint-stock company) of agricultural cultivation activities. The percentage becomes even smaller if we compare to total income.

The mean WTP for various flood insurance packages estimated from Model 3 is presented in Figure 2.

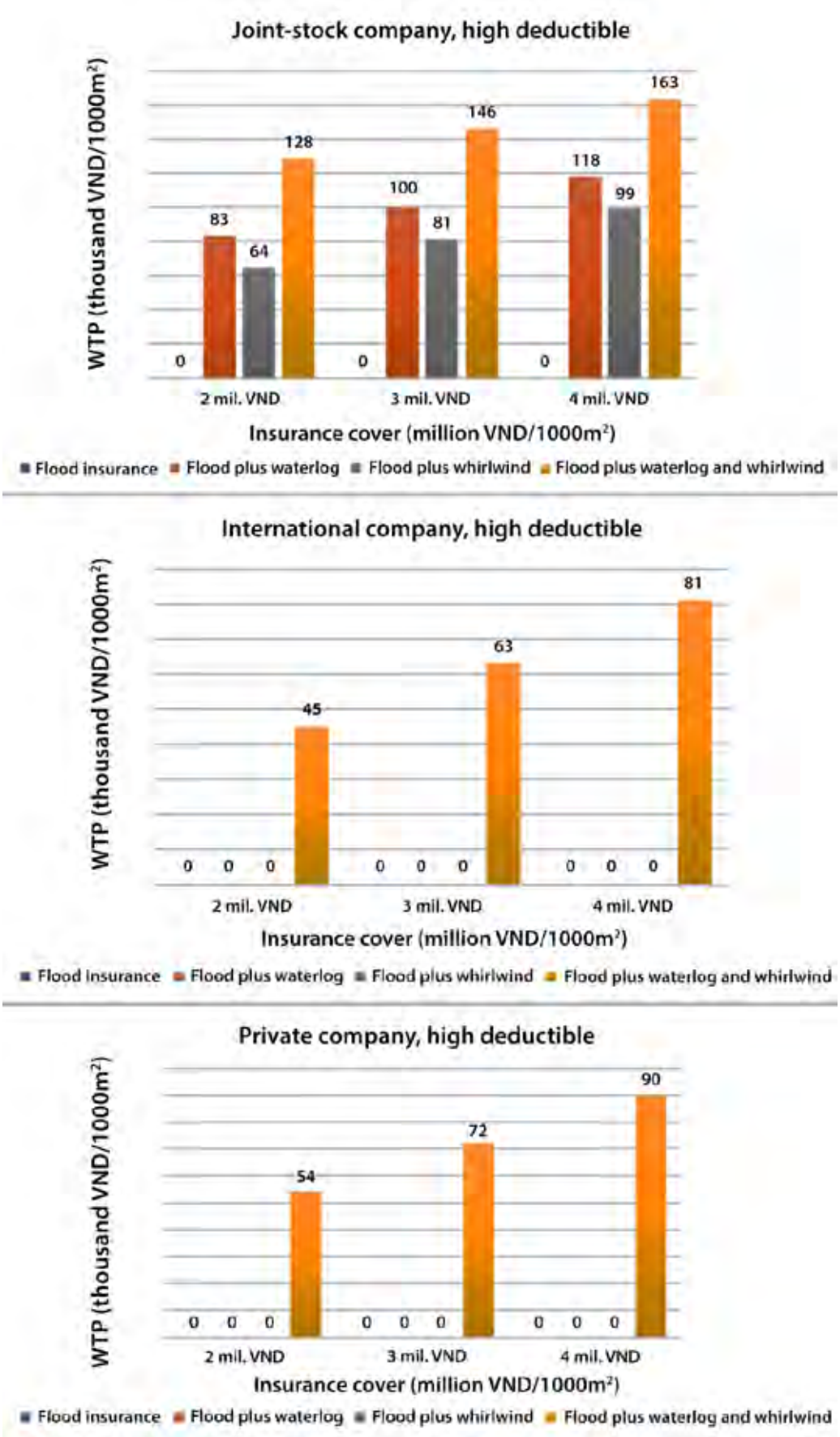


**Figure 2.** Estimated WTP for various flood insurance packages per type of insurance company, for a high deductible

## 5.3 Challenges and Opportunities for Insurance Markets

Our results suggest that a very high proportion of the sample disfavor flood insurance; approximately 64% chose the status quo. This indicates that flood insurance might be beyond the understanding of farmers in a poor country. If this is the case, the government can provide information through various communication programs.

In addition to the relatively high WTP for a flood insurance policy, as discussed in the previous section, the perceptions and attitudes of farmers towards insurance programs could provide a positive signal for developing an insurance market. This section aims to explore the challenges and opportunities of implementing flood insurance in the Mekong River Delta, Vietnam. In doing so, we look at the significant coefficients of interactive variables between the ASC and socio-demographic characteristics in Table 9.

### 5.3.1 Challenges

First, the significant negative coefficients of the interaction of the ASC with Tan Chau, Tan Hong and Cao Lanh indicate that people in higher-risk regions do not favor the insurance plan compared to those who live in low-risk regions (Vi Thuy district). This could be explained by the 'full-dike and cluster' effect. After the catastrophic flood in 2000, the government made huge investments in the construction of large-scale full-dike systems and residential clusters[2]. This could cause residents of this region to blindly trust in the safety of the infrastructure. Households in Cao Lanh district, in addition to the flood regulating function of the surrounding wetland, are relatively far away from the main river and canals, therefore they might feel safe from flooding.

Second, the significant negative coefficients of the interaction of the ASC with 'wishful thinking' indicate that respondents who believe that floods will never happen again in their area are not interested in buying flood insurance. This may reflect the gambler's fallacy, which may "lead some respondents to believe that the odds of another flood occurring in the area in subsequent years have declined after a recent flood" (Atreya *et al.* 2015). In our case, however, not all respondents had the same wishful thinking, because the standard deviations of the random parameters are statistically significant in all models.

Third, the significant negative interaction term of the ASC and 'purely agricultural households' imply that the more a household depends on agricultural activities, the more likely it is that the household head will refuse insurance. This could be a big challenge, because the focus of the insurance program is to help farmers to be less vulnerable to natural disaster risks. However, purely agricultural households may resist the adoption of institutional (insurance) innovations because they "are not risk-averse but rather loss averse" (Hazell and Rahman 2014, p.237).

Fourth, the significant positive interaction term of the ASC and 'age of household head' and its corresponding standard deviation of random parameter mean that people over 40 years old are often interested in a flood insurance program. This can be explained in two ways. Risk aversion rises as age increases, so demand for flood insurance increases with age (Atreya *et al.* 2015). In addition, the older the household head, the more flood disasters they have probably experienced, and this leads to more demand, because flood experience was widely found to have a positive effect on demand for insurance.

[2] The residential clusters provide basic infrastructure such as roads, electricity, water supply, and sewage systems and concrete house foundations. Almost all households who lived on their farms before the year 2000 have been moved to nearby residential clusters.

Finally, the significant negative interaction term of the ASC and 'agricultural cooperative' reveals that members of agricultural cooperatives disfavor an insurance plan. The governments in the Mekong River Delta expect to expand the agricultural cooperative development program to realize economies of scale. Currently, about 20% of households in the study sites have joined agricultural cooperatives, and the number of members will increase in coming years. This phenomenon could be explained by moral hazard. Besides the state-of-the-art production technology, the cooperative implicitly provides common adaptation measures such as pump stations, early weather warning systems, special loan policies for cooperative members, and various agricultural extension services. Therefore, members of cooperatives do not have further incentives to cope with disaster risks themselves via the insurance scheme. In the lower part of Table 9, we see that the statistically significant standard deviations of this random parameter, however, indicate that some cooperative members think differently, and want to participate in a flood insurance scheme.

### 5.3.2 Opportunities

First, the significant positive coefficients of 'unprotected area' mean that households with farms and farming properties not protected by August dikes[3] (i.e., it is risky to produce summer–autumn and autumn–winter crops) are more likely to buy flood insurance. However, the significant standard deviations of its random parameter in the lower part of Table 9 indicate that some of the respondents might dislike flood insurance.

Second, the significant positive coefficients of 'inundation status' and 'flood risk perception' in effects coding models indicate that those who experienced recent flooding favor insurance alternatives. This is consistent with previous studies in both developed and developing countries. The most appropriate explanation for this behavior is the availability heuristic, i.e., a recent flood event is easily brought to mind, which heightens the perceived probability of a future flood and leads to flood insurance purchase (Atreya *et al.* 2015). The standard deviation of 'inundation status' random parameter is statistically significant, which suggests that some respondents with flood experience might not buy flood insurance.

Third, the significant positive coefficients of 'government disaster relief' in all models mean that the charity hazard might not exist in the Mekong River Delta. This could be that the post-flood disaster relief from the government cannot fully compensate for the damage costs. For example, after the catastrophic flood of 2011, local farmers only received a subsidy of about VND 0.5 million per 1000 $m^2$ (Ngoc 2011).

Finally, the significant positive coefficients of 'income per capita' in Models 3 and 4 imply that households with a higher income per capita are more willing to join a flood insurance program. This is quite clear because households with a higher income are better able to pay an insurance premium. In our study site, the WTPs account for approximately 2.8% to 10.6% of agricultural cultivation value per 1000 $m^2$, and approximately 1.3% to 4.8% of total income per 1000 $m^2$.

[3] These are a kind of semi-dikes made of clay and trees, which also serve as irrigation canals that connect to rivers. Farmers and the local government make these dikes together to protect the third crop in August so it is commonly called "August dike" in the Mekong Delta.

# 6.0 CONCLUSION

Insurance has played an important role in adapting to climate risks, particularly in the case of flood hazards. There are an increasing number of studies on the demand for flood insurance in various developed countries. Studies in developing countries, mostly using stated preference methods, have been not only rare, but are often problematic in terms of either experimental designs or estimation techniques. Consequently, mixed results were found even in the same country.

We therefore tried to make novel contributions to the existing literature of the field by changing the experimental design and by applying different coding methods. The purpose of this study was to estimate WTP for flood insurance using a choice experiment with special consideration given to attribute non-attendance and to the effects coding of qualitative variables. We collected a random sample of 374 households from five districts in the Mekong River Delta during the 2015 flood season, used random parameter logit models, and found some interesting results.

First, the effects coding method results in better econometric estimation thanks to solving multicollinearity among the ASC and qualitative attributes. Second, attribute non-attendance has significant effects on model coefficients and WTP values. Third, a large proportion of respondents still favor the status quo because they are influenced by the full-dike and cluster effect, the endowment effect, wishful thinking, and moral hazard. Fourth, the younger generation of household heads is averse to flood insurance schemes. Fifth, there is potential profit for insurers if the market becomes available because the WTPs are much higher than necessary to reach the estimated break-even point. Seventh, a combined insurance policy and joint-stock company is more preferred to a single flood insurance policy and other private companies. Finally, the prospects for a future insurance market are favorable because no evidence of adverse selection and charity hazard was found in this study.

We hope the findings can provide some guidance for policymaking in Vietnam. First, for the successful implementation of a future flood insurance program it is important to enhance the understanding and awareness of purely agricultural communities, especially the younger population, regarding the role and operation mechanism of insurance in reducing damages. Second, communication programs should clearly define the responsibility of each stakeholder in integrated flood management strategies because some households in high-risk areas still blindly trust in the wonder of large-scale dikes and collective adaptation measures. In order to reduce wishful thinking, awareness campaigns should target how climate change affects the strength and frequency of floods, especially in the Greater Mekong sub-region countries. Communication could focus on immediate reminders of exposure to flood risk. Finally, it is recommended that the government should not provide a generous subsidy because the average WTP for risk reduction is relatively high.

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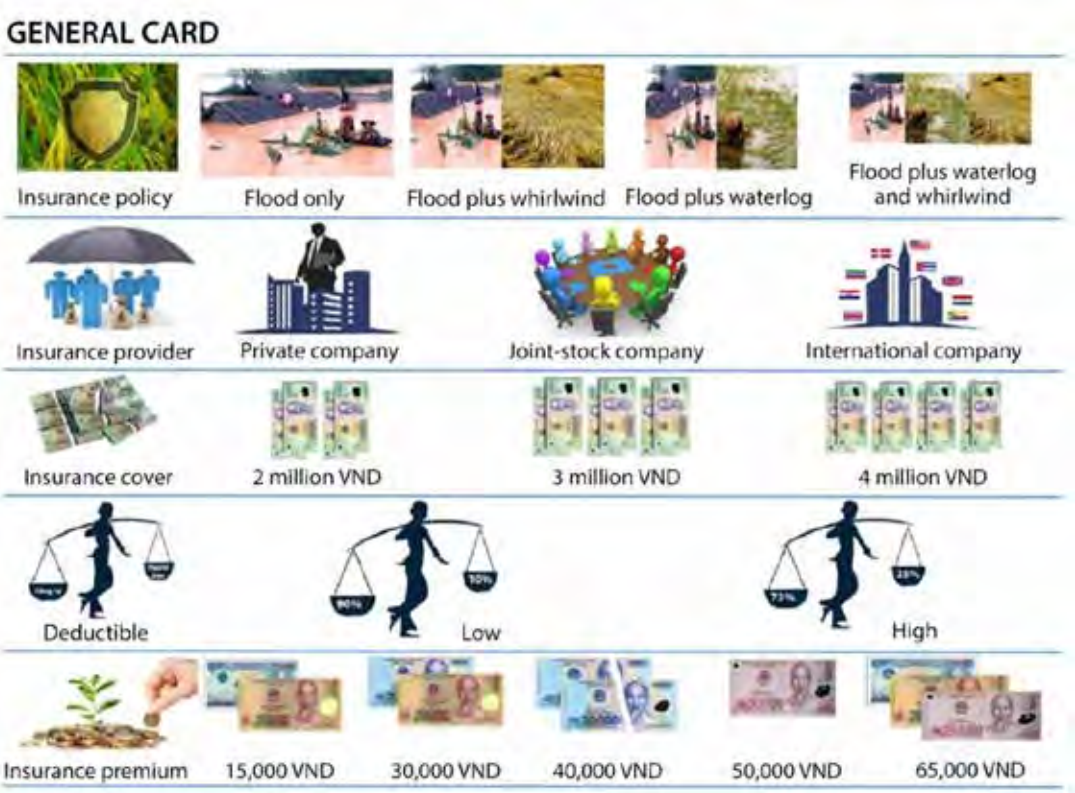
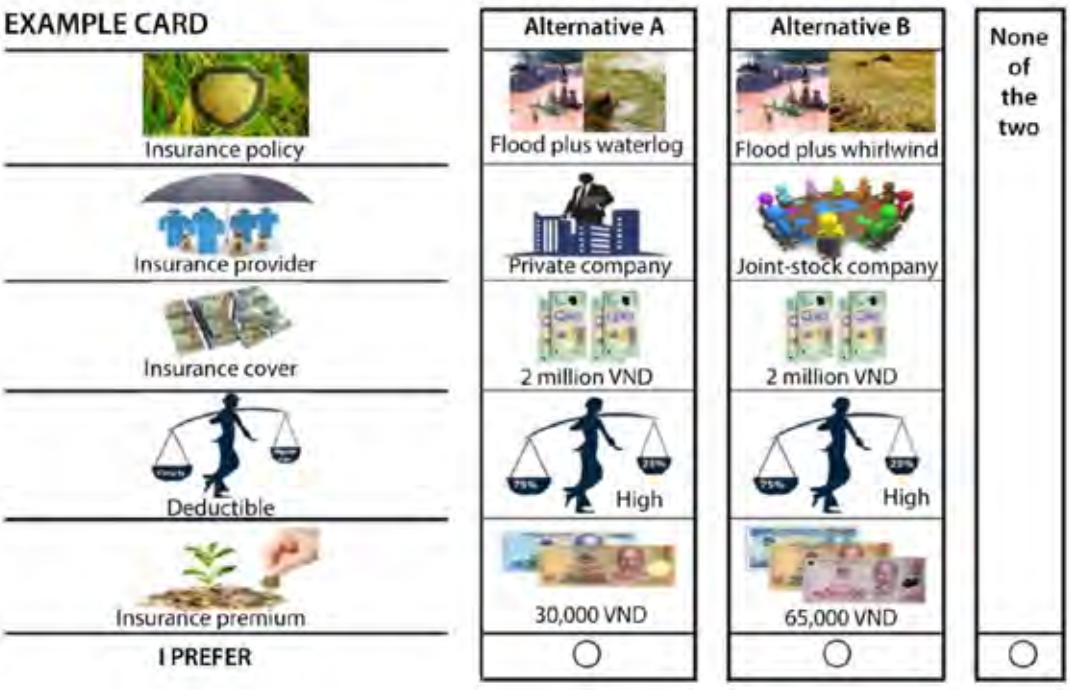
# APPENDICES

**Appendix 1.** General card and example card



**Appendix 2.** Risk attitude game

Now, you have a short break before we ask you other information. During the break, we invite you to play a game with us. This game has five rounds (you have a right to stop the game at any round because the scenarios are independent to each other). Each scenario has two options. Suppose you choose 'option A', you then certainly receive a telephone card that is equivalent to the amount offered; and suppose you choose 'option B', you then have to draw a lottery from a bag with two possibilities: (1) If you draw the YELLOW ball from the bag, then you will win a telephone card that is equivalent to the amount VND; (2) If you draw the WHITE ball, then you get nothing. Note that, before playing the game, our enumerator will ask you to check the balls inside the bag to make sure that the game is fair.

As the game is over, our enumerator will invite you to draw one of the five scenarios to decide which scenario you will really play.

| Scenario | Option A | Option B | Which one you choose, A or B? | For enumerator |
|---|---|---|---|---|
| 1 | VND 25.000 | VND 30.000 if you draw YELLOW ball; VND 0 if you draw WHITE ball. | | If the respondent chose A, enumerator goes to scenario 2. If chose B, enumerator lets the respondent draw the ball, and stop the game. |
| 2 | VND 20.000 | VND 30.000 if you draw YELLOW ball; VND 0 if you draw WHITE ball. | | If the respondent chose A, enumerator goes to scenario 3. If chose B, enumerator lets the respondent draw the ball, and stop the game. |
| 3 | VND 15.000 | VND 30.000 if you draw YELLOW ball; VND 0 if you draw WHITE ball. | | If the respondent chose A, enumerator goes to scenario 4. If chose B, enumerator lets the respondent draw the ball, and stop the game. |
| 4 | VND 10.000 | VND 30.000 if you draw YELLOW ball; VND 0 if you draw WHITE ball. | | If the respondent chose A, enumerator goes to scenario 5. If chose B, enumerator lets the respondent draw the ball, and stop the game. |
| 5 | VND 5.000 | VND 30.000 if you draw YELLOW ball; VND 0 if you draw WHITE ball. | | Enumerator takes note of the final scenario. |

**Appendix 3.** Regression equation

The indirect utility equations (for models 1–3) are specified as follows:

$$U_{insurance} = (B_1+b_1)Policy_1 + (B_2+b_2)Policy_2 + (B_3+b_3)Policy_3 + (B_4+b_4)Joint\text{-}stock + (B_5+b_5)International + (B_6+b_6)Cover + (B_7+b_7)Deductible + (B_8+b_8)Premium + B_9(Cover \times Risk\ averse) + B_{10}(Premium \times Income\ per\ capita) + e_{insurance}$$

$$U_{no\ insurance} = B_{11}ASC + B_{12}ASCxTanChau + B_{13}ASCxTanHong + B_{14}ASCxCaoLanh + B_{15}ASCxChoMoi + (B_{16}+b_{16})ASCxUnprotected\ area + (B_{17}+b_{17})ASCxInundation\ status + B_{18}ASCxRisk\ perception + (B_{19}+b_{19})ASCxWishful\ thinking + B_{20}ASCxDisaster\ reief + (B_{21}+b_{21})ASCxAge + B_{22}ASCxHousehold\ size + B_{23}ASCxIncome\ per\ capita + B_{24}ASCxLand\ size + B_{25}ASCxPurely\ agricultural\ households + (B_{26}+b_{26})ASCxAgricultural\ cooperative + B_{27}ASCxHealth\ insurance + e_{no\ insurance}$$

The first equation for model 4 is specified as follows:

$$U_{insurance} = (B_1+b_1)Policy_1 + (B_2+b_2)Policy_2 + (B_3+b_3)Policy_3 + (B_4+b_4)Joint\text{-}stock + (B_5+b_5)International + (B_6+b_6)Cover + (B_7+b_7)Deductible + (B_8+b_8)Premium + B_9(Cover \times Risk\ averse) + B_{10}(Premium \times Income\ per\ capita) + a_1Policy_1xIgnored\ insurance\ policy + a_2Policy_2xIgnored\ insurance\ policy + a_3Policy_3xIgnored\ insurance\ policy + a_4Joint\text{-}stockxIgnored\ insurance\ provider + a_5InternationalxIgnored\ insurance\ provider + a_6CoverxIgnored\ cover + a_7DeductiblexIgnored\ deductible + a_8PremiumxIgnored\ premium + e_{insurance}$$

where

- $Policy_1$: Flood plus waterlog insurance
- $Policy_2$: Flood plus whirlwind insurance
- $Policy_3$: Flood plus waterlog and whirlwind
- ASC = 1 if the respondent chooses insurance alternative, = 0 if chose no insurance alternative. Therefore, positive $B_{11}$ implies that the respondent favors insurance, and negative B11 implies that the respondent does not favour insurance.
- $B_k$: mean coefficient of the variable k
- $b_k$: standard deviation of random parameter of the variable k

**Appendix 4**. The questionnaire

### Control Section

Questionnaire code: _____ Group _____ Card _____ Date of interview: ___ - ___ - 2015

Full name of enumerator: _____
Full name of data entry person: _____

Location: Latitude N ____° ____' ___._____" Longitude E ____° ____' ___._____"
Degree Minute Second Degree Minute Second
Phone No: _____ Village _____ Commune _____

## SECTION 1: GENERAL INFORMATION

**Question 1**: How many members are there in your family? _____ members.
*Only including those who regularly live here at least six months out of the last twelve months.*

**Question 2**: General information about your family's members.

| Member code | a) Name | b) Relationship with the respondent * | c) Age | d) Gender ** | e) Years of schooling | Occupation *** | |
|---|---|---|---|---|---|---|---|
| | | | | | | f) Main job | g) Secondary job |
| 1 | | Respondent | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |

* 1 = Wife/husband; 2 = Son/daughter; 3 = Grandchild; 4 = Parent; 5 = Brother/sister; 6 = Other.
** 1 = Male; 0 = Female.
*** 1 = Cultivation, 2 = Fish raising; 3 = Fish catching; 4 = Other agricultural jobs; 5 = Nonfarm self-employment; 6 = Wage laborer; 7 = Student; 8 = Unemployment 9 = Housewife; 0 = Out of labor.

**Question 3**: Who is the household head? *Please fill the member code in **Question 2** here* _____.

**Question 4**: How long has your family lived here? _____ years. *Fill 99 if "we have lived here for a long time" and/or "don't know exactly how many years".*

**Question 5**: What are the main agricultural activities that contribute to the main sources of income for your family now and about 10 years ago?
*Note 1 for the most important activity, 2 for the second, the third, …*

| Activity | 1) Now | 2) Before * |
|---|---|---|
| a. ÿ Paddy | | |
| b. ÿ Vegetables | | |
| c. ÿ Fruits | | |
| d. ÿ Husbandry | | |
| e. ÿ Aquaculture | | |

* About the last 10 years.

**Question 6**: [*if there is any change in the importance of these activities in the last five years, as mentioned in the previous question*] Why did the most important activity of your family change? *Chose **all** relevant answers.*

a) ÿ Input price and suppliers
b) ÿ Output price and buyers
c) ÿ Improved dike system
d) ÿ Increased mechanization
e) ÿ Increased natural disasters
f) ÿ Other reasons, in detail _____

**Question 7**: What is the type of your house? *Enumerator observes and takes note.*

(1) ÿ Concrete house
(2) ÿ Concrete house on stilts
(3) ÿ Wooden house
(4) ÿ Wooden house on stilts
(5) ÿ Temporary house

**Question 8**: What is the main source of drinking water during the flooding season? *Only **one** option.*

(1) ÿ Pipeline water (community/government)
(2) ÿ Well water
(3) ÿ River water
(4) ÿ Rain water
(5) ÿ Other, in detail _____

**Question 9**: Where does your family discharge waste? *Choose **all relevant** answers.*

(1) ÿ Public landfill
(2) ÿ Discharge into nearby canal, river
(3) ÿ Self-treatment (such as burning)
(4) ÿ Other, in detail _____

**Question 10**: Has your family joined an agricultural cooperative?

a. ÿ No
b. ÿ Yes

## SECTION 2: FLOOD EXPERIENCE AND PERCEPTIONS

**Question 11**: Did you experience the following flood events? *Select all relevant answers.*

ÿ 1961 ÿ 1966 ÿ 1978 ÿ 1984 ÿ 1991 ÿ 1994
ÿ 1996 ÿ 2000 ÿ 2001 ÿ 2002 ÿ 2011 ÿ Other

Total: _____ *(enumerator takes note number of flood events experienced).*

**Question 12**: Was your farm inundated during the most recent catastrophic flood event? a) ÿ Yes b) ÿ No

**Question 13**: How many days was your farm inundated? _____ days.

**Question 14**: What are difficulties that your family often experiences during the flood season?

| | | |
|---|---|---|
| a) Increased flood adaptation costs | ÿ Yes | ÿ No |
| b) Reduction in jobs of family's members | ÿ Yes | ÿ No |
| c) Damage to crops and/or properties | ÿ Yes | ÿ No |
| d) Increase in diseases (so, increased pesticide costs) | ÿ Yes | ÿ No |
| e) Danger to children and elderly people | ÿ Yes | ÿ No |
| f) Travel becomes more difficult | ÿ Yes | ÿ No |
| g) Feeling of fear | ÿ Yes | ÿ No |

**Question 15**: Did your family adopt the following mitigation measures to cope with flood and other natural disasters?

| Mitigation measures | a) last 10 years | b) Now |
|---|---|---|
| **To protect houses, important house contents** | | |
| 1) Raise floor, reinforce house | ÿ | ÿ |
| 2) Rope and strenthen house | ÿ | ÿ |
| 3) Lift/protect house contents and properties | ÿ | ÿ |
| **Agricultural activities** | | |
| 4) Change cultivation calender | ÿ | ÿ |
| 5) Diversification/crop changes | ÿ | ÿ |
| 6) Prepare private water pumbing machine | ÿ | ÿ |
| **Non-farm activities** | | |
| 7) Handicraft activities | ÿ | ÿ |
| 8) Fishing and/or collecting vegetables | ÿ | ÿ |
| 9) Temporary work elsewhere | ÿ | ÿ |
| **Healthcare** | | |
| 10) Buy health insurance | ÿ | ÿ |
| 11) Prepare medicines chest | ÿ | ÿ |
| 12) Use mosquito net and/or mosquito incense | ÿ | ÿ |
| 13) Prepare food, water, and water treatment chemical | ÿ | ÿ |
| **Other measures** | | |
| 14) Prepare fuels/accumulators | ÿ | ÿ |
| 15) Prepare shelter for livestock | ÿ | ÿ |
| 16) Prepare means of evacuation | ÿ | ÿ |
| 17) Prepare awnings to protect crops/property | ÿ | ÿ |
| 18) Search for weather information | ÿ | ÿ |
| 19) Teach children swimming and basic living skills | ÿ | ÿ |
| 20) Self-insurance measures | ÿ | ÿ |
| **Total** | | |

**Question 16**: Please rank the level of impacts of the following disasters on lives and properties at your place (in the last 10 years). *Note 1 for the most dangerous disaster, 2 for the next, …*

| | Rank |
|---|---|
| a) Storm | |
| b) Flood | |
| c) Waterlog | |
| d) Whirlwind | |
| e) Drought | |

**Question 17**: In your own judgement, what is the "flood return period" of a flood like the one in 2000 in your neighborhood? _____ years/time. *Fill number 99 if the answer is "I think catastrophic flood will never happen here again".*

**Question 18**: What do you think is the likelihood of catastrophic floods in this area?

(1) ÿ High probability, but low consequence
(2) ÿ High probability, and high consequence
(3) ÿ Low probability, and low consequence
(4) ÿ Low probability, but high consequence

**Question 19**: Do you think normal annual flooding is good for local people?

| | | | |
|---|---|---|---|
| a) Source of fish catching for local people | ÿ Yes | ÿ No | ÿ Don't know |
| b) Supply silt and fertilizer for soil | ÿ Yes | ÿ No | ÿ Don't know |
| c) Throw away toxic soil substances | ÿ Yes | ÿ No | ÿ Don't know |
| d) Kill mice and insects that harm crops | ÿ Yes | ÿ No | ÿ Don't know |
| e) Create additional jobs for local people | ÿ Yes | ÿ No | ÿ Don't know |

| | (1) Completely disagree | (2) Disagree | (3) Agree | (4) Completely agree |
|---|---|---|---|---|
| **Question 20**: Do you agree with the following statement: "*The dike system here is too concrete to adopt private adaptation measures*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 21**: Do you agree with the following statement: *"It is hard for catastrophic flooding to happen here, so my family does not need to adopt private adaptation measures*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 22**: Do you agree with the following statement: "*Catastrophic flood is a natural disaster that men cannot cope with*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 23**: Do you agree with the following statement: "*Catastrophic flood happened here a long time ago, so my family does not need to cope with*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 24**: Do you agree with the following statement: "*My family used to adopt private adaptation measures, but flood never happened, so we now do not want to adopt anymore*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 25**: Do you agree with the following statement: "*We realize that the private adaptation measures of my family were not effective, so we do not want to adopt anymore*"? | ÿ | ÿ | ÿ | ÿ |
| **Question 26**: Do you agree with the following statement: "*The government is likely to provide a part of disaster relief for the victims of flood events*"? | ÿ | ÿ | ÿ | ÿ |

## SECTION 3: EVALUATION OF FLOOD CONTROL MANAGEMENT

**Question 27**: Please evaluate the flood hazard in your place (in comparison with the past 10 years) in terms of the following dimensions:

| Item | 1) Reduced/worse off | 2) Stayed the same | 3) Increased/ better off | 99) Don't know/not available |
|---|---|---|---|---|
| 1) Inundation possibility | ÿ | ÿ | ÿ | ÿ |
| 2) Depth and duration of inundation | ÿ | ÿ | ÿ | ÿ |
| 3) Number of irrigation projects | ÿ | ÿ | ÿ | ÿ |
| 4) Water velocity of canal system | ÿ | ÿ | ÿ | ÿ |
| 5) Quality of dike system | ÿ | ÿ | ÿ | ÿ |
| 6) Dike maintenance and upgrading | ÿ | ÿ | ÿ | ÿ |
| 7) Dike breach possibility | ÿ | ÿ | ÿ | ÿ |
| 8) Canal dredging activities | ÿ | ÿ | ÿ | ÿ |
| 9) Drainage culvert system | ÿ | ÿ | ÿ | ÿ |
| 10) Water pumping stations | ÿ | ÿ | ÿ | ÿ |
| 11) Trees along the dike system | ÿ | ÿ | ÿ | ÿ |

**Question 28**: Please evaluate flood exposure in your place (in comparison with the past 10 years) in terms of the following dimensions:

| Item | 1) Reduced/worse off | 2) Stayed the same | 3) Increased/ better off | 99) Don't know/not available |
|---|---|---|---|---|
| 1) Land use density | ÿ | ÿ | ÿ | ÿ |
| 2) Land use regulations | ÿ | ÿ | ÿ | ÿ |
| 3) Asset value of local people | ÿ | ÿ | ÿ | ÿ |
| 4) House building regulations | ÿ | ÿ | ÿ | ÿ |
| 5) Population density | ÿ | ÿ | ÿ | ÿ |
| 6) Flood dependent activities | ÿ | ÿ | ÿ | ÿ |
| 7) Resettlement programs | ÿ | ÿ | ÿ | ÿ |
| 8) Flood map | ÿ | ÿ | ÿ | ÿ |
| 9) Cultivation regulations | ÿ | ÿ | ÿ | ÿ |
| 10) Crop regulations | ÿ | ÿ | ÿ | ÿ |

**Question 29**: Could you please evaluate the vulnerability with flooding of your place (comparison with 10 years ago) in terms of the following items:

| Item | 1) Reduced/ worse off | 2) Stayed the same | 3) Increased/ better off | 99) Don't know/ Not available |
|---|---|---|---|---|
| 1) Properties are prone to damages | ÿ | ÿ | ÿ | ÿ |
| 2) Risk perceptions of people | ÿ | ÿ | ÿ | ÿ |
| 3) Risk awareness campaigns | ÿ | ÿ | ÿ | ÿ |
| 4) Private mitigation measures | ÿ | ÿ | ÿ | ÿ |
| 5) Community-based mitigation efforts | ÿ | ÿ | ÿ | ÿ |
| 6) Community flood management plans | ÿ | ÿ | ÿ | ÿ |
| 7) Flood risk communication systems | ÿ | ÿ | ÿ | ÿ |
| 8) Health care activities in flooding season | ÿ | ÿ | ÿ | ÿ |
| 9) Post-flood recovery preparation | ÿ | ÿ | ÿ | ÿ |
| 10) Preparing shelters for local people | ÿ | ÿ | ÿ | ÿ |
| 11) Health risk warning activities | ÿ | ÿ | ÿ | ÿ |
| 12) Mosquito and insect repellents | ÿ | ÿ | ÿ | ÿ |
| 13) Provision of water purification chemicals | ÿ | ÿ | ÿ | ÿ |

**Question 30**: Do you often _____ to know information about the weather such as heavy rain, storm, or water level?

| | (1) Never | (2) Rare | (3) Sometime | (4) Often | (5) Very much |
|---|---|---|---|---|---|
| a) ÿ Watch television | | | | | |
| b) ÿ Listen radio | | | | | |
| c) ÿ Follow local weather announcement | | | | | |
| d) ÿ Attend group discussion/meeting | | | | | |
| e) ÿ Meet local officers | | | | | |
| f) ÿ Attend flood risk training | | | | | |

**Question 31**: Please rank the usefulness and evaluate the current conditions of the following communication channels in your place:

| | 1) Rank the usefulness (*) | 2) Evaluate current condition (**) |
|---|---|---|
| a) ÿ Television | | |
| b) ÿ Radio | | |
| c) ÿ Local weather announcement | | |
| d) ÿ Group discussion/meeting | | |
| e) ÿ Local officers | | |
| f) ÿ Training | | |

(*) Only rank those channels that you have known. Note 1 for the most effective channel, 2 for the second, 3 for the third, … (and you can rank them equally).

(**) Only evaluate the channels that you have known. Note 1 for very bad, 2 for bad, 3 for normal, 4 for good, and 5 for very good. If the channel is not available, please note 1.

## SECTION 4: RISK ATTITUDE

***Enumerator describe the risk attitude game and its rules.***

**Question 32**: What is the most preferred scenario? _____ (noted by enumerator). *Amount of money paid*: _____ VND.

## SECTION 5: FLOOD INSURANCE EXPERIMENTS

### Introduction

In future, according to flood management experts, the frequency of extreme flood events like the one in the year 2000 is expected to increase due to the impact of climate change. Also, the damage associated with flood events is likely to be more serious under the increased pressures of population growth and economic development. In order to find appropriate mitigation measures and risk transfer tools, economists and policymakers propose a flood insurance program.

It is suggested that insurance against natural risks has recently been proposed as a means for adaptation to climate change in various countries. Flood insurance is likely to provide incentives for reducing risks and adapting to climate change because insurance policy can be designed to reward private self-protection behavior. This means that under the insurance arrangements, your family will commit to have certain precautionary measures, and this results in reducing the probability of financial losses. In the context of flood disaster, this policy is considered to be a complementary adaptation mechanism because structural flood protection measures by the government are likely to be insufficient to reduce risks under climate change.

Research results from other countries indicate that purchasing flood insurance can benefit your family if a worse year of extreme flooding occurs. Unfortunately, markets for such insurance are not readily available in Vietnam and your family is basically dependent on ad hoc compensation by the government for potential damages. Such ad hoc compensation can simply provide your family with either basic needs or a small amount of money, and you are always put in a passive situation.

### The flood insurance program

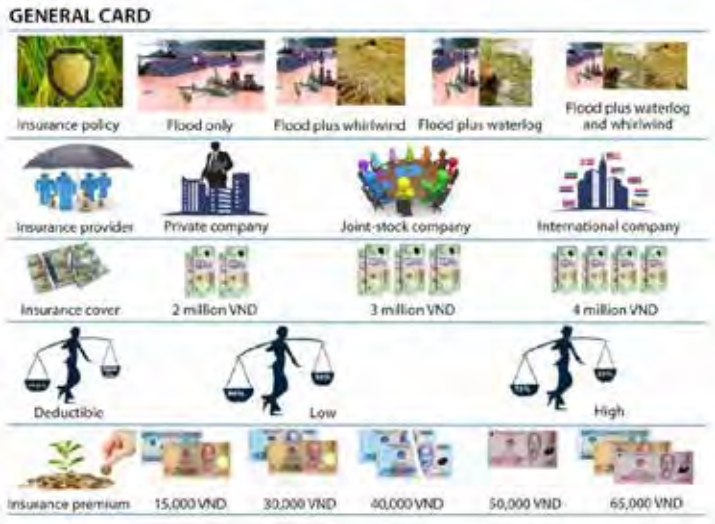
We would now like to ask you a number of questions related to the possible introduction of flood insurance in Vietnam. Such insurance would help your family to cover any future financial risks as a result of extreme flood events like the one in year 2000. The objective of the flood insurance program is to compensate your family for any possible future losses due to floods and other natural disasters such as waterlogging and whirlwinds. You can choose to insure yourself for damages your family may suffer during a disaster given the expected future situation.

The principle is as follows: your family will pay a fixed amount of money per *cong* (i.e. 1000 $m^2$) per crop season – called an insurance premium – given the expected insurance alternative. It is noted that you are free to buy flood insurance for any season that you are most interested in. With this insurance premium you are paid off any financial damage (regarding the actual damage and bound in the insurance cover agreed under the insurance contract) that your family suffers if it is struck by either a flood, a waterlog, or a whirlwind. It is worth noting that you will be compensated for loss you suffer only in the event of an officially acknowledged disaster.

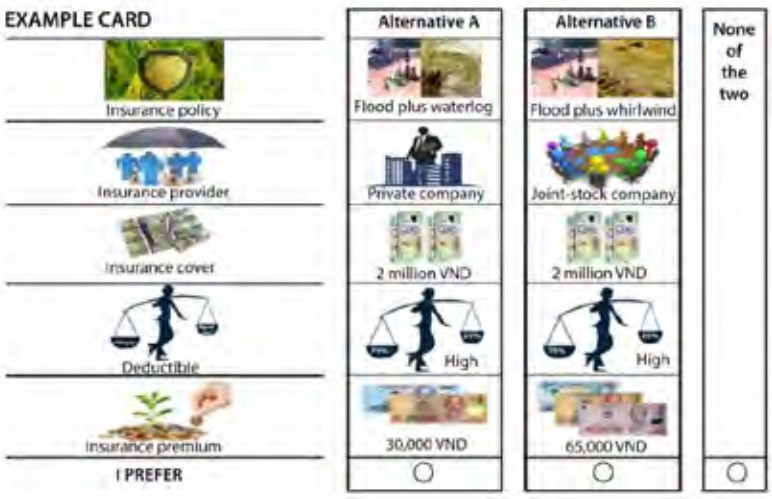
It is important to point out, again, that you will be compensated for loss you suffer only in the event of an officially acknowledged disaster. The maximum amount of compensation depends upon your chosen insurance option. If there is a disaster, e.g. a flood, a waterlog, or a whirlwind, and you claim compensation, an independent surveyor will visit you and assess the extent of damage your family suffered. Based on the surveyor's independent assessment your family will be compensated under the terms in the insurance contract with an insurance company. The terms and conditions of your insurance policy are protected by law.

Before going further, we want to emphasize that this insurance program is implemented in accordance with the market and your family will, of course, not receive any subsidy for paying the insurance premium. As the insurance program is implemented, you will mainly work with the insurance provider under a business contract, and the government just assures a fair policy from the insurance by laws. In addition, it is also noted that you are required to buy insurance for the whole agricultural land that you currently own.

Suppose that we have an insurance program at the Mekong River Delta, and your family is a potential client. We will now present you with an overview card to explain to you what the situations represent. Following the example cards, we will show you seven other cards and for each of these cards, you will be asked to indicate which situation you prefer most.




In each choice card, there are two proposed insurance alternatives, and please let us know your most preferred alternative. If you do not prefer any alternative, you can choose "none of the two alternatives". Here is an example card:




**Question 33**: Please consider the following choice sets, one after another, and let us know which alternative you most prefer in each choice set. (Enumerator offers each choice set from 1 to 7 after the first two example choice sets.)

| | Alternative A | Alternative B | None of the two |
|---|---|---|---|
| Example choice set 1 | • | • | • |
| Example choice set 2 | • | • | • |
| (1) Choice set 1 | • | • | • |
| (2) Choice set 2 | • | • | • |
| (3) Choice set 3 | • | • | • |
| (4) Choice set 4 | • | • | • |
| (5) Choice set 5 | • | • | • |
| (6) Choice set 6 | • | • | • |
| (7) Choice set 7 | • | • | • |

If the respondent continuously chose "none of the two" move to **Question 37**.

**Question 34**: Did you realize that the final choice set is similar to the choice set _____? (***Note:*** Enumerator check and notes the repeated choice set).

(1) □ Yes (0) □ No (Move to **Question 35**.)

**Question 35**: If "Yes" in Question 34, did the respondent make the same choice as the pervious choice set? (***Note:*** enumerator takes note of this.)

(1) □ Yes (0) □ No

**Question 36**: What attributes did you pay attention to when making your choice among the alternatives in each choice set?

| Attribute | 1) Yes/No | 2) Most important attribute | 3) Least important attribute |
|---|---|---|---|
| a) Insurance policy | □ | □ | □ |
| b) Insurance provider | □ | □ | □ |
| c) Insurance cover | □ | □ | □ |
| d) Deductible | □ | □ | □ |
| e) Insurance premium | □ | □ | □ |

**Question 37**: Please let us know why you always chose "none of the two"? *Choose **all** the relevant answers.*

a) □ I am not interested in buying flood insurance.
b) □ I do not trust insurance companies.
c) □ My family's conditions at present are good enough.
d) □ My family is not able pay for the insurance premium.
e) □ Flood insurance is the responsibility of the government, not of my family.
f) □ I have a belief that the government and other organizations will compensate the victims if a catastrophic flood happens.

**Question 38**: In your opinion, are the offered insurance choice sets credible? *Only **one** answer.*

(1) □ Completely uncredible
(2) □ Not credible
(3) □ Credible
(4) □ Completely credible

**Question 39**: Please evaluate the level of difficulty of the choice sets that you have to consider when making decisions.

(1) □ Very difficult to understand
(2) □ Difficult to understand
(3) □ Normal
(4) □ Easy to understand
(5) □ Very easy to understand

**Question 40**: Time to complete the description of choice experiment scenario and insurance choice sets? _____ minutes. *Starting time*_____ *and ending time* _____. (***Note:*** enumerator takes notes.)

## SECTION 6: FAMILY BUSINESS ACTIVITIES (during the last 12 months)

### A. CULTIVATION ACTIVITIES

**Question 41**: Is your agricultural cultivation area protected by August dike? (1) □ Yes (0) □ No

**Question 42**: How does the August dike affect your agricultural cultivation activities?

| | | |
|---|---|---|
| (1) □ Bad | (2) □ No effect | (3) □ Good |

**Question 43**: What are the difficulties of your agricultural cultivation activities?

| | | |
|---|---|---|
| a) Lack of land | □ Yes | □ No |
| b) lack of capital | □ Yes | □ No |
| c) Lack of labor | □ Yes | □ No |
| d) Input prices and suppliers | □ Yes | □ No |
| e) Output prices and buyers | □ Yes | □ No |
| f) Flood, waterlog, and whirlwind | □ Yes | □ No |
| g) Disease | □ Yes | □ No |

**Question 44**: How many lots of land did you cultivate in 2015? _____ lots.

| **Question 45:** PLOT 1 | Season 1 (Winter – Spring) | Season 2 (Summer – Autumn) | Season 3 (Autumn – Winter) |
|---|---|---|---|
| (01) Crop/fruit | | | |
| (02) Actual area | $m^2$ | $m^2$ | $m^2$ |
| **COSTS** | | | |
| **1. Soil preparation** | | | |
| (11) Plough | VND | VND | VND |
| (12) Family labor | _____ days | _____ days | _____ days |
| (13) Hired labor | VND | VND | VND |
| (14) Initial fertilizers | VND | VND | VND |
| (15) Other materials | VND | VND | VND |
| **2. Seeding/breeding** | | | |
| (21) Cost of seeding/breeding | VND | VND | VND |
| (22) Family labor | _____ days | _____ days | _____ days |
| (23) Hired labor | VND | VND | VND |
| **3. Irrigation (including pumping water out if farm was inundated)** | | | |
| (31) Family labor | _____ days | _____ days | _____ days |
| (32) Hired labor | VND | VND | VND |
| (33) Cost of irrigation | VND | VND | VND |
| (34) Depreciation of irr. system | VND | VND | VND |
| (35) Cost of maintenance | VND | VND | VND |
| **4. Fertilizers (excluding initial fertilizer)** | | | |
| (41) Cost of fertilizers | VND | VND | VND |
| (42) Family labor | _____ days | _____ days | _____ days |
| (43) Hired labor | VND | VND | VND |
| **5. Pesticides** | | | |
| (51) Cost of insecticide/herbicide | VND | VND | VND |
| (52) Family labor | _____ days | _____ days | _____ days |
| (53) Hired labor | VND | VND | VND |
| **6. Other labor costs** | | | |
| (61) Family labor | _____ days | _____ days | _____ days |
| (62) Hired labor | VND | VND | VND |
| **7. Other farm equipments/costs** | | | |
| (71) Depreciation | VND | VND | VND |
| (72) Maintenance/repair | VND | VND | VND |
| (73) Other costs (rent) | VND | VND | VND |
| **HARVEST** | | | |
| (81) Total harvest (kg) | | | |
| (82) Sold quantity (kg) | | | |
| (83) Price (VND/kg) | VND | VND | VND |
| (84) Transport cost | VND | VND | VND |
| (85) Harvest cost | VND | VND | VND |

| **Question 46:** PLOT 2 | Season 1 (Winter – Spring) | Season 2 (Summer – Autumn) | Season 3 (Autumn – Winter) |
|---|---|---|---|
| (01) Crop/fruit | | | |
| (02) Actual area | $m^2$ | $m^2$ | $m^2$ |
| **COSTS** | | | |
| **1. Soil preparation** | | | |
| (11) Plough | VND | VND | VND |
| (12) Family labor | _____ days | _____ days | _____ days |
| (13) Hired labor | VND | VND | VND |
| (14) Initial fertilizers | VND | VND | VND |
| (15) Other materials | VND | VND | VND |
| **2. Seeding/breeding** | | | |
| (21) Cost of seeding/breeding | VND | VND | VND |
| (22) Family labor | _____ days | _____ days | _____ days |
| (23) Hired labor | VND | VND | VND |
| **3. Irrigation (including pumping water out if farm was inundated)** | | | |
| (31) Family labor | _____ days | _____ days | _____ days |
| (32) Hired labor | VND | VND | VND |
| (33) Cost of irrigation | VND | VND | VND |
| (34) Depreciation of irr. system | VND | VND | VND |
| (35) Cost of maintenance | VND | VND | VND |
| **4. Fertilizers (excluding initial fertilizer)** | | | |
| (41) Cost of fertilizers | VND | VND | VND |
| (42) Family labor | _____ days | _____ days | _____ days |
| (43) Hired labor | VND | VND | VND |
| **5. Pesticides** | | | |
| (51) Cost of insecticide/herbicide | VND | VND | VND |
| (52) Family labor | _____ days | _____ days | _____ days |
| (53) Hired labor | VND | VND | VND |
| **6. Other labor costs** | | | |
| (61) Family labor | _____ days | _____ days | _____ days |
| (62) Hired labor | VND | VND | VND |
| **7. Other farm equipments/costs** | | | |
| (71) Depreciation | VND | VND | VND |
| (72) Maintenance/repair | VND | VND | VND |
| (73) Other costs (rent) | VND | VND | VND |
| **HARVEST** | | | |
| (81) Total harvest (kg) | | | |
| (82) Sold quantity (kg) | | | |
| (83) Price (VND/kg) | VND | VND | VND |
| (84) Transport cost | VND | VND | VND |
| (85) Harvest cost | VND | VND | VND |

**B. AQUACULTURE ACTIVITIES**

**Question 47**: Is your aquaculture area protected by August dike? (1) □ Yes (0) □ No

**Question 48**: How does the August dike affect your aquaculture activities?

| | | |
|---|---|---|
| (1) □ Bad | (2) □ No effect | (3) □ Good |

**Question 49**: What are the difficulties of your aquaculture activities?

| | | |
|---|---|---|
| a) Lack of land | □ Yes | □ No |
| b) lack of capital | □ Yes | □ No |
| c) Lack of labor | □ Yes | □ No |
| d) Input prices and suppliers | □ Yes | □ No |
| e) Output prices and buyers | □ Yes | □ No |
| f) Flood, waterlog, and whirlwind | □ Yes | □ No |
| g) Disease | □ Yes | □ No |

| **Question 50:** POND 1 | Season 1 | Season 2 |
|---|---|---|
| (01) Kind of fish | | |
| (02) Actual area | $m^2$ | $m^2$ |
| **COSTS** | | |
| **1. Pond preparation (excluding costs of digging pond)** | | |
| (11) Clean pond (pump mud out) | VND | VND |
| (12) Fish medicine | VND | VND |
| (13) Lime | VND | VND |
| (14) Other chemical costs | VND | VND |
| (15) Family labor | ____ days | ____ days |
| (16) Hired labor | VND | VND |
| **2. Juvenile fish** | | |
| (21) Cost of buying juvenile fish | VND | VND |
| **3. Chemicals** | | |
| (31) Cost of chemicals | VND | VND |
| (32) Family labor | ____ days | ____ days |
| (33) Hired labor | VND | VND |
| **4. Feed** | | |
| (41) Cost of feed | VND | VND |
| (42) Family labor | ____ days | ____ days |
| (43) Hired labor | VND | VND |
| **5. Water treatment** | | |
| (51) Cost (excluding labor) | VND | VND |
| (52) Family labor | ____ days | ____ days |
| (53) Hired labor | VND | VND |
| **6. Other costs** | | |
| (61) Agricultural engineer | VND | VND |
| (62) Electricity/fuels | VND | VND |
| (63) Other costs (rent, …) | VND | VND |
| **HARVEST** | | |
| (71) Times of harvesting | times | times |
| (72) Average cost per time | VND | VND |
| (73) Family labor | ____ days | ____ days |
| (74) Hired labor | VND | VND |

| **Question 51:** POND 2 | Season 1 | Season 2 |
|---|---|---|
| (01) Kind of fish | | |
| (02) Actual area | $m^2$ | $m^2$ |
| **COSTS** | | |
| **1. Pond preparation (excluding costs of digging pond)** | | |
| (11) Clean pond (pump mud out) | VND | VND |
| (12) Fish medicine | VND | VND |
| (13) Lime | VND | VND |
| (14) Other chemical costs | VND | VND |
| (15) Family labor | ____ days | ____ days |
| (16) Hired labor | VND | VND |
| **2. Juvenile fish** | | |
| (21) Cost of buying juvenile fish | VND | VND |
| **3. Chemicals** | | |
| (31) Cost of chemicals | VND | VND |
| (32) Family labor | ____ days | ____ days |
| **3. Chemicals** | | |
| (33) Hired labor | VND | VND |
| **4. Feed** | | |
| (41) Cost of feed | VND | VND |
| (42) Family labor | ____ days | ____ days |
| (43) Hired labor | VND | VND |
| **5. Water treatment** | | |
| (51) Cost (excluding labor) | VND | VND |
| (52) Family labor | ____ days | ____ days |
| (53) Hired labor | VND | VND |
| **6. Other costs** | | |
| (61) Agricultural engineer | VND | VND |
| (62) Electricity/fuels | VND | VND |
| (63) Other costs (rent, …) | VND | VND |
| **HARVEST** | | |
| (71) Times of harvesting | times | times |
| (72) Average cost per time | VND | VND |
| (73) Family labor | ____ days | ____ days |
| (74) Hired labor | VND | VND |

**C. LIVESTOCK BREADING**

**Question 52**: Is your livestock breading protected by the August dike? (1) □ Yes (0) □ No

**Question 53**: How does the August dike affect your livestock breading activities?

| | | |
|---|---|---|
| (1) □ Bad | (2) □ No effect | (3) □ Good |

**Question 54**: What are the difficulties of your family livestock?

| | | |
|---|---|---|
| a) Lack of land | □ Yes | □ No |
| b) lack of capital | □ Yes | □ No |
| c) Lack of labor | □ Yes | □ No |
| d) Input prices and suppliers | □ Yes | □ No |
| e) Output prices and buyers | □ Yes | □ No |
| f) Waste treatment | □ Yes | □ No |
| g) Disease | □ Yes | □ No |

**Question 55**: How many kinds of livestock do you breed? _____ kind.

| Question 56: | Kind 1 | Kind 2 |
|---|---|---|
| (01) Quantity of year 2015 | animals | animals |
| (02) Current value of the livestock | VND | VND |
| (03) Value of the livestock in last 12 months | VND | VND |
| **COSTS** | | |
| **1. Cage (excluding costs of building cage)** | | |
| (11) Repairing cage | VND | VND |
| (12) How often do you repair it? | _____ year | _____ year |
| **1. Cage (excluding costs of building cage)** | | |
| (13) Family labor | ___days | ___days |
| (14) Hired labor | VND | VND |
| **2. Breeding** | | |
| (21) Cost of breading in year 2015 | VND | VND |
| **3. Veterinary** | | |
| (31) Cost of veterinary medicine | VND | VND |
| **4. Feeding** | | |
| (41) Cost of feeding | VND | VND |
| (42) Family labor | ___days | ___days |
| (43) Hired labor | VND | VND |
| **5. Water and water treatment** | | |
| (51) Cost (excluding labor) | VND | VND |
| (52) Family labor | ___days | ___days |
| (53) Hired labor | VND | VND |
| **6. Other costs** | | |
| (61) Veterinary surgeon | VND | VND |
| (62) Other costs | VND | VND |
| **HARVEST** | | |
| (71) Times of harvesting | time | time |
| (72) Average value per time | VND/time | VND/time |
| (73) Other revenue | VND | VND |

**D. OTHER INCOME**

**Question 57**: Did your family grow any other trees/crops for sales this year? (1) □ Yes (0) □ No (Move to **#59**.)

**Question 58**: How much does your family have from selling these fruits/crops? _____ VND.

**Question 59**: Did your family raise any other fish for sales this year? (1) □ Yes (0) □ No (Move to **#61**.)

**Question 60**: How much did your family have from selling the fish? _____ VND.

**Question 61**: Did your family breed poultry for sale this year? (1) □ Yes (0) □ No (move to **#63**)

**Question 62**: How much did your family have from selling the poultry?_____ VND.

**Question 63**: Agricultural services that your family earned income from this year.

| | Amount (VND) | | Amount (VND) |
|---|---|---|---|
| 1. ÿ Lease land | | 4. ÿ Sell breed | |
| 2. ÿ Lease machines | | 5. ÿ Consultancy | |
| 3. ÿ Sell seeding | | 6. ÿ Others, specify _____ | |

**Question 64**: Non-farm income that your family earned this year.

| | Amount (VND) | | Amount (VND) |
|---|---|---|---|
| 1. ÿ Salary | | 4. ÿ Remittance | |
| 2. ÿ Self-employed | | 5. ÿ Interest | |
| 3. ÿ Handicrafts | | 6. ÿ Others, _____ | |

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