Area yield crop insurance in Vietnam An Analysis from the Demand Side

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Abstract

This study is the attempt to analyze the demand of rice farmers for the area yield crop insurance, which is designed and piloted in the period of 2011 - 2013 in Vietnam according to Decision No. 315/QD-TTg of the Prime Minister. Using the contingent valuation method and experimental method, we estimate the willingness to pay of farmers in Binh Thuan province for area yield crop insurance and the factors influence the demand of farmers. We find that although farmers in Binh Thuan province are highly averse to basis risk, when farmers receive enough information about the insurance, the demand should be higher than current take up rate. However, the marketing channel of the insurance program is inefficient in providing information and building the mutual understanding between farmers and insurance company. Moreover, the demand for area yield crop insurance can also increase if the insurance company takes the advantages of the multi-regional setting of the program. In this case, insurance company should pay more attention to the relative level of basis risk and the correlation of losses across regions when setting the prices for each province instead of only focusing on the general level of risk exposure of each region.

1 Introduction

Agriculture is an important sector in Vietnam's economy, providing livelihoods for about 70% of the population and contributing more than 20% of GDP of the nation (Dao Trong Tu and Nguyen Van Viet, 2011). However, agricultural production is also exposed to a variety of risks, including adverse weather events, pests and diseases. Every year, the total agricultural production losses in Vietnam due to natural perils are nearly 5% of GDP (Menzinger, 2011). As Vietnam is one of the countries affected seriously by climate change, these risks are increasing day by day (Dasgupta et al., 2007).

On 01 March, 2011, the Prime Minister approved Decision No. 315/QD-TTg about the implementation of pilot program on agricultural insurance in the period of 2011-2013. There are 3 different agricultural insurance products, in which crop insurance for rice production is an area-yield based insurance. Under an area yield crop insurance contract, indemnities are based on the value of an average yield of an area instead of the value of individual yield. In the piloting period, there are 7 provinces participating in the program of the rice crop insurance with different crop premium. The government will subsidize up to 100% of insurance premium.

Index insurance in general or area yield crop insurance in particular is a newly developed alternative to overcome the problems of traditional agricultural insurance. Before the introduction of the such new product, many developing countries (for example, Brazil, Costa Rica, Mexico, India and the Philippines) have implemented agricultural insurance programs in which traditional agricultural insurance based on individual yield have been provided. However, most of these programs failed in fulfilling their objectives (Mahul and J. Stutley, 2010). There are two main problems leading to the failure of this type of agri-

cultural insurance. First, because farmers have more information about their own actual yields and thus can calculate their actuarial fairness more exactly than insurance companies, adverse selection will arise (Miranda, 1991). Second, difficulty in loss adjustment and record keeping, especially in the situation of developing countries, will lead to the problem of high administrative and monitoring cost and uncontrolled moral hazard. As a result, traditional agricultural insurance programs are often not sustainable and cost-effective (Mahul and J. Stutley, 2010).

Under index insurance, indemnities are triggered by pre-specified value of an index, not by individual yields. Theoretically, index insurance helps to reduce the problem of adverse selection because information about the distribution of the index is more reliable and available than information regarding the distribution of individual yield. Moral hazard problem can also be eliminated as the index cannot be affected by farmers or any 3rd party. Moreover, because indemnity payout is not based on individual yield and the index value is observable, loss assessment at individual level is not needed and the administrative and monitoring costs are reduced (Miranda, 1991; Skees et al., 1997; Iturrioz, 2009).

However, the existing evidence from other countries show that the take-up rate of index insurance is low even when the premium rate is actuarially fair and the product is subsidized (Boucher and Mullaly, 2010). Many studies have examined the demand for such products and suggested that low demand is caused by lack of trust, financial illiteracy, credit constraints and most importantly, basis risk (Gin et al., 2008; Gin and Yang, 2009; Carter, 2009; Cole et al., 2009; Boucher and Mullaly, 2010). Basis risk refers "the potential mismatch between contract payouts and the actual loss experienced by individual farmers" (UN, 2007, p.6). When participating in the index insurance, a farmer may suffer a yield loss but doesn't receive an indemnity if the index value is not lower than

the critical threshold. Basis risk may decrease the effectiveness of this type of insurance in risk reducing and therefore decrease the demand of farmers. Moreover, in the situation of developing countries where farmers are not familiar with modern financial products, it's very hard to explain the index insurance to farmers and make them accept the possibility of suffering a loss but not receiving the indemnity. Carter (2009) proposed that a careful analysis from demand-side to choose acceptable index signal, to identify trust-inducing indemnity structures and to design effective training for farmers is needed for establishing sustainable and efficient index insurance program.

Vietnamese rice crop insurance program has been implemented since September 2011 but after 10 months of piloting, this program is facing the same problem of low demand as other developing countries' index insurance program. Only two provinces (Nghe An and Dong Thap) now have households purchasing rice crop insurance while in other provinces, farmers are not interested in this insurance product. As the area yield crop insurance product is being revised to be scheduled for large-scale sale in the whole country after the pilot program, it is needed to understand why the demand is low and how to establish an effective and sustainable demand for this area yield crop insurance program.

The purpose of this study is to investigate the effectiveness of the area yield crop insurance program in risk management and the effective demand of rice farmers in Vietnam. We first carry out a contingent valuation (CV) survey to examine the demand of farmers for this area yield crop insurance program in Binh Thuan province of Vietnam. CV method is used in several studies of index insurance in developing countries (Ramasubramanian, 2012; Seth, Ansari and Datta, 2012; Chantarat, Mude and Barrett, 2009) but for Vietnam, to our best knowledge, there are only two studies using this method to estimate the demand for area yield crop insurance (Vandeveer, 2001; Nguyen, 2013) in which

only one study by Nguyen (2013) tried to determine the willingness to pay of rice farmers in Dong Thap province for this insurance product. Our study follows the design of these studies in examining the willingness to pay for this insurance of farmers under current design and determining factors influencing the demand of farmers.

We then focus on the impact of basis risk on the demand for the area yield crop insurance. Due to the lack of historical data, we cannot measure the true basis risk for each farmer and incorporate this value into the CV study. We therefore use the framed eld experiment in Binh Thuan province to examine whether farmers are not willing to join in the area yield crop insurance due to the basis risk.

Finally, we adopt an expected-value-variance approach by Ducan and Myers (2000) and Shen and Odening (2012) to simulate the equilibrium prices and the participant ratios of area yield crop insurance in a multi-region setting. Theoretically, insurance company can overcome the problem of basis risk by regional diversification. If losses among regions are negatively correlated, enlarging the trading area of the insurance can help insurance company to reduce the premium rate and therefore attract more customers (Shen and Odening, 2012). Premium rates in this case not only depend on the general level of risk exposure of each region but the relative basis risk level across regions. Results from the simulation will shed some light on pricing the insurance under multi-region setting.

The rest of this paper is organized as follows. Section 2 describes the background context of agricultural production, agricultural insurance and area yield crop insurance program in Vietnam and Binh Thuan province where we conduct our study. Section 3 presents our CV study in Section 4 with a review of

relevant literature on the demand for index-based insurance and the results from our survey. We then move to our experiment and the result in Section 4. In section 5, we presents the equilibrium framework for both single region and multi-region settings and the results of the simulation from this framework for the area yield insurance for rice producers in Binh Thuan and An Giang provinces. Section 6 is the discussion and conclusion.

2 An Overview about Area Yield Crop Insurance in Viet-nam

2.1 Area Yield Crop Insurance for Rice Producers in Vietnam

Although the Decision No.315/QD-TTG about the implementation of pilot program on agricultural insurance was approved on 01 March 2011, it was not until the Winter-Spring crop 2012 that the insurance marketing program was launched. Main features of the area yield crop insurance at the beginning of 3-year pilot program are summarized as follows:

1. Provinces and Areas covered: there are 7 provinces joining in this pilot program for rice crop insurance including Nam Dinh, Thai Binh, Nghe An, Ha Tinh, Binh Thuan, Dong Thap and An Giang. In the Winter - Spring crop 2012 and the Summer - Autumn crop 2012, only 3 communes of 3 districts of each province were chosen to introduce this insurance. Since the Autumn - Winter 2012, the market has been expanded to most of the communes of 3 districts of each province.
2. Farmers covered: All farmers are covered
3. Risks covered: this insurance covers all yield losses due to common natural calamities and epidemic - insect risk.
4. Coverage and threshold yield: the scope of area in this insurance is the commune level. If the actual average yield per hectare of the rice crop for

the commune in the insured season is lower than the Threshold yield, all insured farmers in this area will receive an indemnity. In the first design of this insurance, the threshold yield was defined as 75% of the three-year moving average of seasonal area yields. After the revision of this program in late 2012, this threshold yield changed to 90% of the three-year moving average of seasonal area yield.

5. Premium rate: Different provinces have different premium rates, which are summarized in Table 1. These premium rates are based on the risk exposure level of the province.

6. Premium subsidy: The subsidy rate for poor farmers is 100% of the premium, for nearly-poor farmers is 80%, for normal farmers is 60% of the premium rate.

Table 1: Premium rates of different province

No.	Province	Premium rate in the first design	Premium rate after the revision
1	Nam Dinh	5.23	4.97
2	Thai Binh	5.23	4.97
3	Binh Thuan	5.38	4.53
4	Nghe An	4.77	4.53
5	Ha Tinh	5.08	4.53
6	An Giang	2.31	2.19
7	Dong Thap	2.77	2.19

After one year of piloting, the total insured area is 36,997 ha, with 160,787 households participating in this insurance, of which about 85% are poor households. This result is very low compared with the total piloted. It raises question about the feasibility of this program as well as the reasons why farmers are not interested in area yield crop insurance.

2.2 Area Yield Crop Insurance for Rice Producers in Binh Thuan Province

Binh Thuan province is one of the provinces implementing the pilot program of

area yield crop insurance in Vietnam. There are 3 districts of Binh Thuan participating in this pilot program, including Bac Binh, Ham Thuan Bac and Tanh Linh. After one year, the total number of households buying area yield crop insurance is 3,502 households, 100% of which are poor households. There was no payment during the first year of the pilot program. According to the preliminary report provided by the People's Committee of Binh Thuan province, there are two main reasons for the low demand of area yield crop insurance, that are: (1.) the high premium rate and (2.) the unreasonable payout policy of this insurance due to the basis risk.

3 Willingness to pay for the area yield crop insurance of rice production farmers in Binh Thuan province - A contingent valuation survey

3.1 Research methodologies and survey design

3.1.1 Contingent valuation method

To explore the factors influencing the demand of farmers for index insurance, we use the contingent valuation method (CVM). CVM is widely used in empirical literature on agricultural insurance demand where the agricultural market has not been developed or underdeveloped (Kouame and Komenan, 2012).

Willingness to pay for index insurance can be expressed as follows:

$$WTP = \phi(q^1, q^0, y, X, \pi, \varepsilon)$$

where q^1 and q^0 are the levels of utility associated with and without insurance, y is wealth, X represents a vector of socio economic characteristics, π is probability of facing the risk, and ε is other unobserved factors. Φ(.) is the maximum value individuals are willing to pay to reduce their level of risk.

Farmers will buy the insurance when:

$$V(q^1, y - WTP, X, \pi, \varepsilon^1) \geq V(q^0, y, X, \pi, \varepsilon^0)$$

where V(.) are indirect utility function for an individual and ε^1 and ε^0 are assumed to be independent and identically distributed with zero mean.

Due to the fact that surveyed farmers are mainly not familiar with the index insurance, we thus use the close-ended question in our case. We conducted the double-bounded dichotomous choice procedure because this approach has more significant statistical efficiency gains than other methods (Hanemann, 1991).

3.1.2 Determinants of demand for index insurance

In recent years, there is a growing number of empirical studies trying to identify factors that influence demand for index insurance and analyze how to make this product more attractive for farmers, many of which employed experimental method. These factors are:

1. Economic aspects of the product: the role of basis risk, premium and the payout frequency.

   Basis risk is the most important feature of index insurance, making this product different from the traditional agricultural insurance. Therefore, many studies tried to examine the role of basis risk in demand for index insurance. However, due to the lack of historical data in developing countries, till now, there is no study that can measure basis risk at individual levels and correlate real basis risk on the demand of farmers. Researchers instead use many different ways to deal with this problem, including measuring the basis risk through introspection (directly ask farmers about the correlation between their own yield and the average yield) or setting the objective basis risk through framed field experiment (Clarke, 2011; Norton et al., 2012, Cole et al., 2008, Hill et al, 2011). They all found that basis risk significantly reduced the demand for index insurance, especially at high price.

2. Risk aversion and time preference.

   Risk preference can be seen as one of the main determinants of demand for index insurance and was included in all studies about index insurance. However, the impact of this factor on the demand of index insurance is not clear. While some studies found that high risk-averse farmers will have high demand for insurance (Kouame and Komenan, 2012; Chantarat, Mude and Barrett, 2009), other studies found the oppoisite direction (Gine, Townsend and Vickery, 2008) or no effects (Clarke et al., 2012).

   Because in many index insurance products, farmers have to pay the premium at the beginning of the crop season and only receive the possible payment at a particular time after the end of the crop season, one should expected farmers with high discount rates tend to not join the insurance. However, most of the

studies cannot find the effect of time preference on the demand for index insurance (Chantarat et al., 2009).

3. The crowding out effect of current risk management strategies.

   As one of the risk management strategies, the demand for index insurance is influenced by the availability and effectiveness of other strategies such as diversification, access to saving and borrowings, or risk poolings through social networks. Binswagner-Mkhize (2012) argued that analysis of the demand for index insurance without taking into account the interaction between formal insurance and other risk strategies can lead to overestimating the demand.

4. Non-economic factors: trust and financial literacy.

   While the key elements of the design of index insurance (basis risk, premium and payout frequency) are crucial for attracting farmers, empirical evidence suggested that non-economic factors such as trust, financial literacy and social networks are also very important (Gin et al., 2008, Gin et al., 2009, Gin et al., 2012, McPeak et al., 2010)

In our contingent valuation study, we include all of these factors, except the basis risk, in our question and will examine the impact of these factors on the demand for the index insurance.

3.1.3 The survey

- The study area:

  This study was conducted in 5 communes (Lac Tanh, Huy Khiem, Bac Ruong, Nghi Duc, Duc Binh) of Tanh Linh district, Binh Thuan province. We chose these communes because according to the group discussion with agricultural experts of the district government, these communes can capture all variations in the natural condition of Tanh Linh. We adopted a multi-stage sampling

strategy and 276 farmers in 5 communes were randomly interviewed in August 2013. All of them are rice production farmers.

- Focus-group discussion:

6 focus-group discussion was conducted with insurance company (Bao Minh), local authority of Tanh Linh district and farmers in Tanh Linh district in January, March and July, 2013 to identify the starting price for the WTP question as well as explore the risk management strategies currently used here.

- The questionnaire:

The final questionnaire includes 5 sections. Section 1 comprises questions about the social and economic characteristics of the respondents. Section 2 comprises questions about risk experience, risk perception, social capital, time preference as well as risk management strategies of farmers. Questions about farmers' information and purchase decisions towards the current pilot insurance program are asked in Section 3 and Section 4 is the CV question about the willingness to pay.

Section 5 is the Binswanger experiment to measure risk attitude of farmers (Binswanger, 1980, 1981). In this experiment, farmers have to choose among 6 different lotteries (Table 2), corresponding to different levels of risk attitude (different constant relative risk aversion - CRRA). In the total sample, 83 participants were randomly chosen to play the Binswanger experiment for real payment while the others would play the hypothetical Binswanger experiment and 60 other participants in Lac Tanh commune were invited to join a framed field experiment later. Each farmer participating in the survey would receive a gift of 50.000 VND at the end of the survey.

Table 2: Binswanger Experiment

Lottery	High payoff (50%)	Low payoff (50%)	Risk attitude	CRRA
1	50	50	Extreme	$+\infty - 7.5$
2	95	45	Serve	$7.5 - 1.74$
3	120	40	Intermediate	$1.74 - 0.812$
4	150	30	Moderate	$0.812 - 0.31$
5	190	10	Slight Averse to Neutral	$0.31 - 0$
6	200	0	Neutral to Risk Seeking	$0 - -\infty$

The valuation section (Section 3) comprises an explanation about the area yield crop insurance, a test of the understanding of farmers about this insurance and a double-bounded choice. Under this method, each respondent is asked if she/he is willing to pay the first bid. If she/he choose "yes", a second higher bid will be given. If she or he choose "no", a second lower bid will be given. Respondent continues to make decision on whether she/he is willing to pay the second bid. Five different first bids were randomly used in the survey to avoid the starting bias (Table 3). These amounts are based on the average of current premium rate at Tanh Linh district (about 408,830 VND/ha).

3.2 Results

3.2.1 Household characteristics

The age of farmers participating in the survey ranges from 23 to 83 while the number of years they have been involved in rice production is from 3 to 69. Most of respondents are male. 30% of them belong to ethnic minority group.

Table 3: Design of the valuation question

Questionnaire code	Lower bid (10000 VND/ha)	Starting bis (10000 VND/ha)	Higher bid (10000 VND/ha)	% of total sample
1	10	20	30	21
2	20	30	40	20
3	30	40	50	20
4	40	50	60	21
5	50	60	70	18

All farmers in Tanh Linh district grow rice in 3 crop seasons. On average, monthly income of a household is per capita of farmers is 4,460,000 VND/month. Farmers derive income from rice production as well as other crops such as pepper and cashew. They also keep livestock or have off-farm activities. While the percentage of farmers who save money for future risk is low (0.40%), the percentage of income derived from other activities and the percentage of farmers who have borrowed in the last 5 years are high (30% and 78% respectively). This was consistent with the findings of group discussion, in which farmers suggested that the main risk management strategies are diversification and risk pooling through social network.

3.2.2 Risk aversion and time preference of farmers

Table 4 shows the results from Binswanger experiment for both real and hypothetical questions. There is no significant difference between the risk aversion proportion of the real and the hypothetical group (Wilcoxon test: p = 0.174).

Table 4: Risk attitude of farmers

	Real	Hypothetical
Risk aversion (choose Lottery 1 - 4)	0.78	0.80
Risk neutrality to Risk-seeking (choose Lottery 5, 6)	0.22	0.20

To measure time preference, we use two hypothetical questions about the amount farmers are willing to accept now to give up the payment of 800,000 VND after 6 months and the amount they are willing to accept 6 months from now to give up the payment of 800,000 VND after one year. The first question is used to calculate the discount rate of farmers while the second question is used to examine whether farmers are present-biased or future-biased. Table 5 presents the results from these two questions. We do not find the evidence for future-biased but 44% of farmers have a tendency of present bias.

Table 5: Time preferences of farmers

	Mean	Std.
Discount rate (%/year)	7.80%	8.3%
Present biased (=1 if farmer is present-biased)	0.44	

3.2.3 Farmers' under studying and opinions about the current pilot insurance program

Although Tanh Linh is one of the pilot districts for the area yield crop insurance program, after 3 years of implementation, only 37% of farmers in our survey stated that they have heard about this insurance. Table 6 presents the information channel from which farmers heard about area yield crop insurance.

Table 6: Information channel of insurance

Channel	Local authority	Insurance agents	Neighbor/Friends/ Relatives	Media (Tivi/Radio/Etc.)	Others
Percentage (%)	23.76	6.9	7.9	61.39	0

Farmers received information about the area yield crop insurance mainly from the media and local authority. Only few farmers were approached by the insurance company and the proportion of farmers received information from

their social networks is also very low. There may be a number of explanations for this: farmers did not find this product attractive so that they did not introduce or talk with the others in their network about it or may be because the information was not provided to the key people in the village/commune.

We also asked farmers who stated that they have heard about the area yield crop insurance to describe the insurance for us. Only 1 farmer could describe exactly this insurance while the others do not know the fee and do not understand the payment conditions. “Do not understand the product” is also the main reason for farmers to not buy the insurance (44%). The marketing strategy for the area yield crop is obviously ineffective.

3.2.4 WTP and factors influencing the demand of farmers for area yield crop insurance

We run the maximum likelihood model for the WTP. The average WTP of the farmers calculated from the estimation is approximately 398,530 VND per hectare, which is very close to the premium in case of 60% subsidy. This result suggests that when farmers receive sufficient information about the insurance, the demand should be higher than current take up rate and the main problem of the current pilot program is the marketing channel.

Table 7 presents the marginal effects of all factors on the WTP. Among 3 risk management strategies we examine here, only diversification had significant effect on the WTP. Diversification had a negative impact on the WTP: farmers who have higher proportion of income derived from rice production (lower level of diversification) will have higher WTP. We found no significant effect of risk attitude on the WTP of farmers. This result may be explained through the suggestions of Elabed and Carter (2013) and Bryan (2010): not risk attitude but ambiguity attitude influences the demand of farmers for area yield crop

insurance. For time preference, while the discount rate of farmers did not have any significant effect on WTP, we found an interesting result about the effect of time inconsistency, that is farmer who are present biased will have lower WTP. Among 4 socio-economic variables, only education has effect on the WTP of farmers. Trust and financial literacy have significant impact on the WTP of farmers, which is in line with the results in literature.

Table 7: Regression results for the WTP

Group of Factors	Variable	Description	Marginal effects on WTP (Std in parenthese) (***:p¡0.01,**:p¡0.05,*:p¡0.1)
Risk management strategy	Diversification	% of income from rice production	109.867** (51.34)
	Saving	1=save for future risks (0 = otherwise)	1108.38 (2614.47)
	Borrow	1=easy to borrow money (0 = otherwise)	3094 (3223.996)
Risk experience	Risk experience	1=no significant experience in last 5 years, 0 = otherwise	-193.81 (585.64)
Risk preference	Risk aversion	1 = risk aversion 0 = otherwise	1943.378 (3208.068)
Time preference	Discount rate		-9601.225 (14807.18)
	Present-biased	1 = present biased 0 = otherwise	-6630.612***
Trust	Insu-trust	1 = trust in insurance company 0 = otherwise	778.157* (427.701)
Financial literacy	Score	1 = answer correctly more than 5 questions in the test 0 = otherwise	11498.92*** (3967.628)
Socio-economic characteristics	Age		55.75 (183.939)
	Education		3842.8*** (1080.108)
	Income per capita		-1.754 (2.026)
	production experience		-8.364 (159.42)

a

b

4 Basis risk and area yield crop insurance: Evidence from a framed field experiment

Basis risk is one of the most important problems of the index insurance. Basis risk causes two effects on the demand of farmers: (1) through the imperfect correlation between farmers' loss and payoff; (2) through the level of ambiguity of this product, which may reduce the demand if farmers are ambiguity averse (Elabed and Carter, 2013). Due to the lack of historical data, in the contingent valuation study, we do not have any variable capturing the basis risk. Instead, we examine the effects of basis risk on the demand of farmers for area yield crop insurance through a framed field experiment, by which we can control the basis risk. This experiment is designed in the same way as the experiment of Elabed and Carter (2013) in Mali with some modifications. In this experiment, farmers face with a hypothetical situation in which they invest in crop production and have to decide between three different options to manage their production risk: (1) doing nothing; (2) buying an area yield crop insurance; (3.) buying a(n) (traditional) indemnity crop insurance.

4.1 Experimental Design

4.1.1 The production game

The production game includes several rounds, in which each round represents one crop season. At the beginning of each round, each farmer is assigned to a group representing the area. During each round, farmers may gain different amount of points, depending on their individual yield which is determined by the combination of two shocks: the systematic shock and the idiosyncratic shock. The systematic shock will affect the endowment of every farmers in the group while the idiosyncratic shock only affect the endowment of individual farmer.

These two shocks are described to farmers by two gambles. The systematic

shock is described as "Area Condition" and this shock is drawn from a bag containing 10 chips (1 black, 2 red, 4 white, 2 blue and 1 green). At the end of each round, one farmer from each group will draw a chip from this bag to determine the "Area Condition". If she/he draw the black chip, it means that the "area condition" is very bad; if she/he draw the red chips, it means that the "area condition" is bad, etc. The idiosyncratic risk is described as "Individual Luck" and this shock is drawn by each farmer from a bag containing 4 balls (1 red, 2 white, 1 yellow). If she/he draw the red ball, it means that the "individual luck" is low; if she/he draw the white ball, it means that the "individual luck" is normal, etc. The individual yield of each farmer will be calculated based on the area condition and the individual luck (Table 8). For example, if one farmer in one round draw the white ball for the individual luck (Normal) and his/her group draw the red ball for the area condition (Bad), he/she will have the yield of 350 for this round.

Table 8 also presents the probability distributions of the systematic risk and the idiosyncratic risk. We derive these two probability distributions from group discussions with farmers and local authority of Lac Tanh commune, Tanh Linh district, Binh Thuan province to make sure that these probability distributions can represent the subjective probability of farmer towards systematic risk and individual risk in real life.

Table 8: Payoffs of farmers in the production game

Individual yield		Area condition (Systematic Risk)				
		Very bad (Black chip - 10%)	Bad (Red chips - 20%)	Normal (White chips - 40%)	Good (Blue chips - 20%	Very good (Green chip - 10%)
Individual Luck (Idiosyncratic Risk)	Low (Red ball - 25%)	80	250	350	450	580
	Normal (White ball - 50%)	200	350	450	550	700
	High (Yellow ball - 25%	320	450	550	650	820
Average yield of area (use to calculate in the insurance)		200	350	450	550	700

4.1.2 The insurance treatment

In the insurance treatment of the production game, farmers have a chance to buy insurance to protect their income against production loss. We design two different insurance products, including the area yield crop insurance and the traditional indemnity insurance.

The area yield crop insurance offered in this experiment is designed with the following parameters:

- The threshold level: In this experiment, we chose the coverage level of 90% and the expected area yield crop is the yield of the whole area in a normal condition (i.e. long-term average area yield - 450 qt per hectare). This area yield crop is calculated based on 10-year yield data of Winter Spring crop in Lac Tanh commune, Tanh Linh district, Binh Thuan province.
- The premium: We calculate the actuarially fair price based on the probabilities and outcomes of two events: very bad area condition and bad area condition. *The actuarially fair price of area yield crop insurance = price*

of one unit of rice x *(10%* x *(90%* x *450 - 200) + 20%* x *(90%* x *450 - 350))*. We assume that the price of one unit of rice is constant and equal to one unit, then the actuarially fair price of area yield crop insurance is 31.5. We add the loading factor of 20% to this price and come up with the price of 37.8 for area yield crop insurance over one hectare of land. This loading factor is based on the review of World Bank of agricultural insurance (Mahul, O. and Stutley, C., 2010) as well as the mid-term reports of pilot provinces in Vietnam about area yield crop insurance. Elabed and Carter (2013) also used the loading factor of 20% in their experiment in Mali.

The traditional indemnity insurance offered in this experiment is designed with the following parameters:

- The threshold level: we still keep the same threshold level (405 pt per hectare) as in the area yield crop insurance to make them comparable.
- The premium: We calculate the actuarially fair price based on the probabilities and outcomes of the combined events between systematic risk and idiosyncratic risk which yield lower than the threshold. *The actuarially fair price in this case = 10%* x *(25%* x *(405 - 80) + 50%* x *(405 - 200) + 25%* x *(405 - 320)) + 20%* x *(25%* x *(405 - 250) + 50%* x *(405 - 350)) + 40%* x *25%* x *(405 - 350) = 39.* We add the loading factor of 80% to this price and come up with the price of 71. The loading factor for indemnity insurance is considerably higher than for area yield crop insurance because in the case of indemnity insurance, the insurance company has to spend more money on investigating the loss.

4.1.3 Experimental procedure and data

The participants are 59 farmers from Lac Tanh commune, Tanh Linh district, Binh Thuan province (at the beginning of the experiment we had 60 participants but during the session, one participant had to leave due to an emergency so that we only had 59 participants with full attendance). We chose participants randomly based on the household list given by local authority. After selecting participants, we did the WTP survey first to gather detailed information on socio-economic characteristics of participating farmers to make sure that our sample captures the diversity in socio-characteristics of farmers as well as to collect data on the WTP of farmers. Each participant then received an invitation letter to join in our experiment conducted in August 2013. At the end of the session, participants received their game winnings in cash, in addition to a show up fee of 30.000 VND.

The experimental procedures can be summarized as follows. After the introduction of the experiment session, we described the production game to farmers and they played 2 trial rounds to understand the payoff mechanism. The sequence of events in each round is:

- One player drew a chip from the "Area Condition" bag to determine the systematic shock.
- Each player drew a ball from the "Individual Luck" bag to determine the idiosyncratic shock.
- Based on the payoff table, farmers calculated their yield and wrote it down on the record sheet. Our assistants helped farmers to identify their profits.

After 2 trial round, farmers played 5 rounds of the first insurance treatment in which only area yield crop insurance was offered. The sequence of events in

each round now was:

- Our assistants explained the area yield crop insurance
- Farmers chose among 2 different options: doing nothing or buying the AYC insurance
- One player drew a chip from the "Area Condition" bag to determine the systematic shock.
- Each player drew a ball from the "Individual Luck" bag to determine the idiosyncratic shock.
- Our assistants announced the indemnity of each insurance contract of this season.
- Based on the payoff table, the premium level and the indemnity, farmers calculated their yield and wrote it down on the record sheet.

Finally, farmers played 5 rounds of the second insurance treatment in which both area yield crop insurance and traditional insurance were offered. The sequence of events is exactly the same with 5 previous rounds except that now farmers have 3 options: doing nothing or buying the AYC insurance or buying the traditional insurance.

At the end of the experiment, one of 12 rounds was chosen randomly to make the payment with an exchange rate (1 point = 150 VND) and farmers were paid this amount together with the attendance fee.

4.2 Results

Table 9 show the number of participants buying AYI in each round from round 3 to round 5. In these rounds, participants are only allowed to choose between buying an AYI or not. The number of participants buying AYI was stable over 5 rounds, suggesting that farmers were consistent in their decisions.

With the basis risk in our experiment (10%), under the assumption of maximizing the expected utility function, participants with CRRA lower than 0.4675 will not buy the insurance and participants with CRRA higher than 0.4675 will buy the area yield insurance. Based on the results from the Binswanger experiment, we can predict the percentage of participants who will buy the AYI in each round is from 68% to 83.25% (the percentage of participants who choose Lottery 1, 2 and part of participants choosing Lottery 3).

Table 9: Number of participants buying AYI in each round of treatment 1

	Round 1	Round 2	Round 3	Round 4	Round 5
Number of buying	34	37	37	36	35
Percentage (%)	57.6	62.7	63.7	61.0	59.3
Prediction from EUT (%)	68 - 83.25				

Comparing between the CRRA in the Binswanger and the percentage of participants buying AYI in each round, we found that the percentages of participants buying AYI in all 5 rounds are lower than the prediction by expected utility theory. However, we also found that the more risk averse one participant is, the higher number of rounds in which he/she bought the AYI (Kruskal-Wallis test: $p = 0.04$).

We are interested in the change in farmers' behaviors when there is a change in the basis risk. In our experiment, the change in the basis risk is represented by the introduction of the indemnity insurance since round 8. Table 10 shows the decisions of farmers from round 8 to round 12, when the indemnity insurance with the basis risk = 0 and higher price was introduced.

Table 10: The number of participants buying AYI in treatment 2 (round 8 – 12)

	Round 1	Round 2	Round 3	Round 4	Round 5
Number of buying AYI	11	5	5	3	0
Number of buying traditional insurance	27 (45.75%)	30 (50.84%)	30 (50.84%)	33 (55.93%)	36 (61.01%)
Prediction of buying traditional insurance from EUT (%)	33.8% - 47.4%				

When an individual yield insurance contract was introduced, we found a high proportion of participants switching from an AYI contract to an IYI contract or from not buying any insurance to an IYI contract. There was no new participants buying the AYI contract after the IYI contract was introduced. Under the assumption of expected utility theory, farmers only choose this IYI contract if their CRRA is higher than 4.53. However, based on the results of the Binswanger experiment, only 34% of participants choosing Lottery 1, which means they have CRRA higher than 7.5 and 13.6% participants choosing Lottery 2, which means their CRRA is from 1.74 to 7.51. Comparing between the CRRA distribution from the Binswanger and the distribution from the insurance choices from round 8 to round 12, we found that the percentage of choosing IYI is higher than the prediction.

These above results suggest that the higher risk aversion, the higher demand of participants for the area yield crop insurance. However, risk aversion is not sufficient to explain the demand for area yield crop insurance. When participants only chose between AYI and no insurance, the demand for AYI is lower than prediction under expected utility theory. When the IYI was

introduced, participants tended to favor the insurance without basis risk even though they had to pay more than expected gains for this insurance. The percentage of participants switching from AYI to IYI is higher than prediction under expected utility theory, suggesting that participants are averse towards the basis-risk.

The number of participants buying the IYI contract was not stable but increasing over the last 5 rounds. This result may come from the learning process or herding behavior of participants through communication during the experiment. However, with our data from this experiment, we cannot detect these effects, and thus we do not have a reasonable explanation for this increasing tendency.

We now examine the impact of experiencing the basis risk on the decision of switching at round 8. We only examine the switching behavior at round 8 to avoid the effect of communication and herding. Farmers' basis risk experience is measured through a dummy variable which equals to 1 if in the last 5 rounds (round 3 - 7) farmers bought the AYI contract but did not receive the payment when suffering a loss and equals to 0 otherwise. Result from a chi-square test suggested that there is a significant relationship between experiencing the basis risk and switching behaviors ($p = 0.027$).

5 Price and demand for area yield crop insurance in a multi-regional setting

Results from the framed field experiment suggest that due to ambiguity aversion, farmers will be less interested in area yield crop insurance. This problem can be partly solved through regional diversification. By enlarging the trading area of the insurance, if losses among regions are negatively correlated, insurance company can set the premium rate lower than in the case of single-region (lower than the total of loading factor and fair rate) (Shen and Odening,

2012) and thus attract more customers. It's the advantage of the multi-regional setting when the insurance company can set different premium rates for different regions.

Till now, we only examine the demand of farmers in Binh Thuan province with pre-determined price. In this section, we will analyze both demand and supply side of the insurance at the same time to see whether the current pricing policy of area yield crop insurance program in Vietnam takes the advantages of the multi-region setting and whether the multi-region setting can help to increase the demand of farmers.

To answer this questions, we use the theoretical model developed by Shen and Odening (2012) to simulate the equilibrium prices and the participation ratios of area yield crop insurance for Binh Thuan province under two different scenarios: single-region setting and multi-region setting. Because we do not have a long time series on agricultural yield at farm level and at community level, we consider a whole region as a representative farm (all farmers in one region are assumed to have the same yield distribution) and area yields are represented by the provincial yields. Although there is drawback in using aggregate yield data, in this study we only use results derived from this model to compare between the single regional setting and the multi regional setting, not to give direct evaluation about the demand of insurance.

5.1 Theoretical Model

5.1.1 A Single Region Equilibrium Pricing

Using the mean-variance framework, Shen and Odening (2012) developed a model comprises a single region with N farmers on the demand side and one insurance company on the supply side. They assumed that all agents are risk-averse and their preferences take the exponential utility forms. At t = 0, farmers

and insurance company make decisions about buying or selling some amount of area yield crop insurance to maximize their expected utility. At t = 1, farmers and insurance company received information about the crop yields and the average yield of the whole area and the company payout the indemnity if the average yield is lower than the threshold. There is no secondary market for selling or buying insurance between two periods.

By maximizing the expected utility of farmer, we have the optimal demand of farmer i for area yield crop insurance is:

$$a_i = max\left[0, \frac{E\Big(\theta(I)\Big) - \pi(1+r) - \lambda_f cov\Big(L_i Y_I, \theta(I)\Big)}{\lambda_f \sigma^2_{\theta(I)}}\right]$$

in which $E(\theta(I))$ is expecting indemnity, $\pi(1 + r)$ is the insurance premium, λ_f is the risk preference of farmer, $\sigma^2_{\theta(I)}$ is the volatility of the insurance payoff and $cov(L_i Y_i; \theta(I))$ is the covariance term between the production revenues and the indemnity payoffs (basis risk).

The supply function of insurance company derived from the maximizing problem is:

$$\beta = \frac{\pi(1+r) - E\Big(\theta(I)\Big)}{\lambda_s \sigma^2_{\theta(I)}}$$

in which β is the number of insurance contracts the insurance company is willing to sell and λ_S is the risk preference of insurance company.

Market is at equilibrium if:

$$\sum_{i=1}^{N} a_i = \beta \ (1)$$

5.1.2 A Multi-Region Equilibrium Pricing

Under the multi-regional setting, there is only one insurance company facing M heterogeneous region and insurance company can set different prices for different regions. We define π_1; π_2; …; π_M as equilibrium prices of region 1, 2, ... M and β_1; β_2; …; β_M as corresponding equilibrium quantities.

The optimal demand of farmer i in region m is the same with the optimal demand of farmer in the single regional setting but the supply function of insurance company at region m now also depend on the covariance of payoffs between region m and other regions:

$$\beta_m = \frac{\pi_m(1+r) - E\Big(\theta(I_m)\Big) - \lambda_S \sum_{k \neq m}^{M} \beta_k cov\Big(\theta(I_m), \theta(I_k)\Big)}{\lambda_s \sigma^2_{\theta(I)}}$$

Market is at equilibrium if:

$$\sum_{i=1}^{N_m} a_{i,m} = \beta_m \ (2)$$

We use equations (1) and (2) to run the simulation of price and demand for Binh Thuan province under the case of single region setting and under the case of multi-region setting (when the insurance is also traded in An Giang Province).

5.2 Results

5.2.1 Specification of the parameters for analysis

The area yield crop insurance is represented by the following payoff function:

$$\theta(I) = Tmax(K - I, 0)$$

in which I is the actual area yield per hectare, T is the tick value (the price used to calculate the indemnity) and K is the threshold level. In our simulation, the tick value is assumed to be constant and equal to the average minimum purchase price policy for rice (type I and type II) in 2011 which is 500 thousand VND/quintal. Following the design of the pilot program, the threshold value K equals to 90% of the 3-year moving average of area yield of the same crop season.

To run the equilibrium models we also need the parameters of risk aversion and risk-free interest rate. Result from the Binswanger experiment suggested that farmers in Binh Thuan are risk-averse with the median CRRA lies between 1.74-0.81. Referring to some studies measuring the risk attitudes of Vietnamese farmers (Tanaka et al., 2010; Gloede, 2011; Nielsen et al., 2012) and some studies measuring this parameter of other developing countries (Gong et al., 2010; Liebenehmand et al., 2011), we assume that the relative risk aversion parameter of farmers in are 0.8. The absolute risk aversion is then computed by by dividing the relative risk aversion parameter by the initial wealth of farmers. We assume that the initial wealth of farmers is equal to the annual cash income per household (50,332,800 VND), calculated by multiplying monthly average

income per capita (1,070,000 VND) by 12 and then household size (3.92) in rural areas (data based on the VHLSS 2010). The absolute risk aversion parameter of farmer therefore is assumed to equal $1.56x10^{-8}$. The absolute risk aversion of insurance company is assumed to be less than the risk aversion of farmers. The risk-free interest rate is 10% per annum, based on the average interest rate of the Government bond in the period of 2008 – 2011 (maturity of 5 years). Table 11 summarizes all of the parameters used in the simulation.

Table 11: Specification of Parameters for Simulation

	Binh Thuan	An Giang
Tick-size (1000 VND)	500/index point	
Strike-level (dt/ha)	= 90 % of the 3-year moving average of the area yield of each province for each crop season	
Expected payoff (1000 VND/ha)		
- WS season	12.22	114.148
- SA season	112.49	169.898
- AW season	2.5	120.000
Standard deviation of payoff (1000 VND/ha)		
- WS season	50	360.993
- SA season	453	444.731
- AW season	10	494.775
Risk free interest rate	10 %	
Average sown area per farm L (ha)		
- WS season	0.51	1.64
- SA season	0.57	1.61
- WA season	0.63	1.03
Absolute risk aversion for all farmers	$1.56x10^{-8}$	
Absolute risk aversion for insurance	$1.56x10^{-9}$	
Correlation of insurance payoff		
	Binh Thuan	An Giang
Binh Thuan	1	-0.08 (WS crop) -0.09 (SA crop) -0.06 (AW crop)
An Giang	-0.08 (WS crop) -0.09 (SA crop) -0.06 (AW crop)	1

5.2.2 Results of the simulation

Table 12 presents the equilibirum prices and quantities for area yield insurnace in Binh Thuan province and An Giang province under two different settings: single-regional setting and multi-regional setting with two different scenarios of subsidy: no subsidy and subsidy of 60% of the premium.

The results show that the insurance premia for Binh Thuan provinces do not change much when the insurer also provides insurance in An Giang province because the low correlations of area yield between An Giang and Binh Thuan. We only found a significant decrease in insurance premium (and thus a significant increase in the demand) for AW crop season. It is reasonable because AW crop season is the most risky crop season for An Giang province due to the flood while the yield risk for this season in Binh Thuan is moderate. Enlarging the trading area of the insurance in this case helps diversify the systemic yield risk due to the negative correlation between area yields among these two provinces and therefore helps increase the participation ratio.

One interesting result from our simulation under multi-region setting is that the insurance premium for An Giang province is higher than for Binh Thuan province in all cases, which differs from the current design of the pilot program. Intuitively, rice production is Binh Thuan province is considered to be exposed to higher risk than in An Giang province and therefore the insurance premium for Binh Thuan must be higher than the premium for An Giang. However, while the correlation between regional yields and the payoff of area yield insurance in Binh Thuan varies between 0.23 and -0.6, implying the higher basis risk; this parameter for An Giang is only from 0.12 to -0.89, implying the lower basis risk. In other words, rice production risk in Binh Thuan is highly idiosyncratic while the risk in An Giang is systematic and may cause effects on large scale. As a

result, although Binh Thuan is a high risk zone, the expected payoff from area yield crop insurance for Binh Thuan is lower than for An Giang and the premium is also lower. These results suggest that the premium for each province should not be only based on the general level of risk exposure of this region but the relative level of basis risk and the correlation between the losses across regions should also be taken into account.

Table 12: Simulation Results

	Single regional setting		Multi-regional setting			
	Binh Thuan		Binh Thuan		An Giang	
	Price (1000VND/ha)	Quantity (ha)	Price (1000VND/ha)	Quantity (ha)	Price (1000VND/ha)	Quantity (ha)
WS crop						
Without subsidy	13.8	719	13.706	760.30	116.242	75.45
Subsidy 60%	29.7	5139	29.668	5727	290.606	1069
SA crop						
Without subsidy	125.26	78	125.252	79.81	155.404	11.09
Subsidy 60%	313.140	722.5	313.132	807	388.510	910
AW crop						
Without subsidy	2.544	1800	2.514	2323	197.883	257.95
Subsidy 60%	5.838	23600	5.761	26313	494.708	1140

6 Discussion and Conclusion

In this paper we examine the demand and the factors that influence the demand of farmers for the area yield crop insurance program, using a contingent valuation survey and a framed field experiment. We find that information and trust are the two main factors influencing the demand of farmers for this insurance product. When farmers receive sufficient information about the insurance, the average WTP of farmers is very close to the premium in case of 60% subsidy, suggesting that the demand for area yield crop insurance in Binh Thuan province should be higher than the current take up rate. Our results also confirm the important role of basis risk in determining the demand for area yield crop insurance. Farmers are highly averse to basis risk, especially when they already experienced the basis risk in the past. They are willing to switch to

individual yield insurance with higher premium when both types of insurance are offered to avoid the basis risk.

The problem of basis risk can be partly solve through the multi-regional setting of the area yield crop insurance program. Results from our equilibrium pricing model suggest that if losses among regions are negatively correlated, regional diversification allows insurance company to reduce the premium rate. To take this advantage of the multi-regional setting, the premium for each province should not only based on the general level of risk exposure of this region but the relative level of basis risk and the correlation of losses across regions.

The results of our study has some implications for policy-makers. First, in the pilot program the premium for An Giang province is lower than Binh Thuan province, which is reasonable if we only consider the general level of risk exposure of these regions. However, because the level of basis risk of Binh Thuan is higher than An Giang, when we analyze the equilibrium under multi-region setting, the premium for An Giang province should be higher than for Binh Thuan province. In other words, if we take into account the relative level of basis risk and the correlation between losses across regions, the relative premium will be different from the one calculated from the risk exposure level only. Insurance company should pay attention to this point when they assign the premium for each province.

One should notice that one of the main assumption of our equilibrium model is that the market consists of one seller and many buyers. In other words, our model is only used to analyze the seller-buyer relationship under monopoly, which allows the insurance company to employ the price discrimination strategy. However, if we relax the assumption of monopoly, all results may change and

profits of insurance companies should be equal to zero. Since the agricultural insurance market in Vietnam is completely monopolistic, this model is the most suitable one to analyze market equilibrium and provides useful advice.

Secondly, according to our survey, the main marketing channel for the pilot program is media (tivi or radio). However, information through media can only help farmers to be aware of the availability of the insurance, not to understand fully the insurance, especially when this insurance is a new, innovative financial product. Moreover, providing farmers information through media cannot help to build the mutual understanding and trust between insurance company and farmers. While trust, knowledge about the insurance and sophisticated thinking are the main factors influencing the willingness to pay of farmers for area yield crop insurane, insurance company should invest in other marketing channels to explain the insurance to farmers better and to build trust.

Finally, farmers in Binh Thuan province of Vietnam express that they are highly averse towards the basis risk. They are willing to pay more to avoid the basis risk, even when the expected gain is lower than the cost. This result suggests that the attractiveness of the area yield crop insurance in particular and the index insurance in general may be overstated due to the ignorance of farmers' aversion against basis risk and there is still a possibility for the feasibility of other types of crop insurance. Insurance company should consider again the advantages of index insurance over traditional crop insurance and may have more feasible studies to compare these two insurance types.

Due to the limit of time, budget and knowledge, there are many shortcomings of this study. The lack of historical data, the inaccurate measurement of some variables and the simple experiment design are three main weaknesses. These weaknesses together with the findings of this study

imply some suggestions for further research.

In this study, due to the lack of historical data at individual and commune level, we only use the aggregate yield data. Therefore, we can only examine the general tendency and only give policy recommendations based on this instead of the detailed recommendations about the equilibrium price and quantity. Further research can combine between the yield data and the geographic data to increase the effectiveness of the equlibirum analysis and have better understanding about the level of basis risk.

In our CV survey, we do not capture the subjective probability of the basis risk of farmers and only use risk experience as a measure of basis risk. In the literature, there are some ways to elicit the subjective probability of people such as the proper scoring rule (Brier, 1950; Good, 1952) or the bisection method (Abdellaoui et al., 2011). Further research may focus on farmers' subjective probability of the basis risk, factors that influence this probability and the way this subjective probability influences the demand for area yield crop insurance.

Moreoever, the results from our CV survey suggest that building trust and providing information are very important to increase the demand of farmers. When the traditional marketing channels (tivi or radio) seem not to be effective, more complicated marketing channels such as workshop may be very costly. Further research may examine which information channel is the most efficient one to introduce the insurance to farmers and how insurance company can build trust through such channel.

In our framed field experiment, we can only show that people are averse to basis risk. However, the underlying mechanism for this aversion attitude is not clear. Elabed and Carter (2013) suggested that people are averse to basis risk and thus have lower demand for the area yield crop insurance than prediction

by the expected utility theory due to the fact that basis risk makes the area yield crop insurance become a compound lotter. This argument follows the argument of Halevy (2007) in which attitudes towards compound objective lotteries and attitudes toward ambiguity are tightly associated. However, farmers' aversion towards basis risk can also be explained by other phenomina such as perceived control (Bracha and Weber, 2012) or framing effects. Further research may design the experiment to test which mechanism is the main reason for the aversion to basis risk and how we can reduce this aversion through product design and framing.

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Appendix 1. ABBREVIATIONS

AW season : Autumn Winter season

AYI : Annually Yield Insurance

CRRA : Constant relative risk aversion

CV : Contingent Valuation

CVM : Contingent Valuation Method

GDP : Gross Domestic Product

IYI : Individual Yield Insurance

SA season : Summer Autumn season

VHLSS : Vietnam Household Living Standard Survey

WS season : Winter Spring season

WTP : Willing To Pay

Appendix 2. The CV questionnaire

Date:_____ **ID:** _____

Interviewer: _____

Name of household head:_____

QUESTIONNAIRE

Interviewer Information:

Are there people at home?	Yes _____	Proceed with the survey
1st Visit	No _____	
Are there people at home?	Yes _____	Proceed with the survey
2nd Visit	No _____	

Good morning (afternoon, night). My name is_____ I am conducting a survey regarding agricultural risk and we are interested in know your opinion about this topic. We would like to interview the person in the household who makes decision related to farming activities. This survey is totally confidential. Is it you? Or Could I talk to him/her?

Yes _____ Thank you very much.

No _____ Reason:

[01] _____ Is not at home*

[02]_____ Cannot answer in this moment*

[03] _____Do not want to respond

[04]_____ Other _____

* Can I come back in other day/moment for apply it?

Yes _____ Day: _____ Time _____

No _____ Finish the survey

If respondent does not show up in the second visit, the household is classified as non-respondent. Enumerator picks a neighbor as a replacement.

Section 1: Background information

1. Year of birth:……..
2. Marital status: 1 = Single; 2 = Married; 3 = Divorced; 4 = Widow

1 What class of school did you complete or what degrees have you received? 1 = no school; 2 = Elementary school; 3 = Middle School; 4 = High School; 5 = Vocational School; 6 = College/University; 7 = Post graduate

4. Gender: 1 = Male; 0 = Female

1 What is your religion? = Ancestor Worship; 2 = Buddhist; 3 = Catholic; 4 = Protestant; 5 = No Religion; 6 = Others

6. What is your race? 1 = Kinh; 0 = Others
7. Area you member of Communist party? 1 = yes; 0 = no
8. Number of household members: …….
9. Number of years that you involve in rice production: ……
10. How much is your family average monthly income?

Income source	**Amounts (Local currency)**
Salary	
Farming (cultivating, gardening)	
Animal husbandry (cow, aquaculture)	
Fishing	
Rentedlabor	
Leased land	
Remittance	
Other_____	

Note: (98) no response (99) don't know/not sure

11. How large proportion of income comes from rice production? ____%
12. How much is your family's monthly expenditure?

Source	Amount (Local currency)
Food	
Education	
Health	
Electricity and domestic water	
Small shopping	
Social events (for example wedding or funeral)	
Telephone	
Other _____	
Total	

13. The house in which you live in: 1 = Owned by you; 2 = Owned by your parents/in-laws; 3 = Owned by others; 4 = Rented
14. How much do you think you would have to pay to buy a house similar to yours?
15. How many ha of land does your household own? …….ha
16. Agricultural activities

Year/Crop	16.1.Land owned (ha)	16.2.Land lend (ha)	16.3.Land rent (ha)	16.4. Land used for rice production (%)	16.5. Yield
2012 WS					
2012 SA					
2012 AW					

17. Do you have a fish farm? 1 =yes 0 = no

    If a pond - please indicate size:_____(m2)

    If a cage in river - please indicate size:_____ (m2)

18. Do you own any livestock? If yes, please indicate quantity for each type: pigs:_____

water buffalo:_____

cattle:_____

chicken:_____

other:_____

Section 2. Risk management strategies – Social capital – Time preferences

19. In general, in the last 10 years, have you experienced disadvantage natural conditions (weather and epidemic – insect risk) that significantly affect on your rice production?

Not at all										Most of the time
0	1	2	3	4	5	6	7	8	9	10
O	O	O	O	O	O	O	O	O	O	0

20. Does your household save to cater for emergency in future? 1 = yes; 0 = no
21. If yes, how much is your household's total saving now? _____
22. How easy would it be to borrow 10000000 VND? *(Enumerator: read responses)*

1 = Very easy

2 = Somewhat easy

3 = Somewhat difficult

4 = Very difficult

5 = Impossible

6 = Don’t know/not sure

23. If you want to borrow 10000000 VND and cannot borrow it from a family member, where would you want to go to borrow it?

    1 = Neighbor/Friend

    2 = ROSCA

    3 = Official State-run Bank

    4 = Market money lender

    5 = Pawn shop (the place to take the motorbike or TV to get the money)

    6 = Other (please specify) _____

    7 = Don’t know/not sure

24. What adaptation practices have your household made to cope with long term shifts in flooding during the last 5 years?

Adaptation practices	24.1 Done the practices (1=yes, 0=no)	24.2 When have you done this practice (year) and what did you do
1. Changed crop variety		
2. Built a water harvesting system		
3. Built higher dykes		
4. Bought insurance		
5. Irrigated more		
6. Changed from crop to livestock		

7. Migrated to another area		
8. Found off-farm jobs		
9. Leased your land		

25. Please indicate below how much you trust several institutions, with zero indicating that you do not trust them at all, and 10 indicating that you fully trust them:

25.1. The local authorities:

Do not trust at all									Fully trust	
0	1	2	3	4	5	6	7	8	9	10
O	O	O	O	O	O	O	O	O	O	O

25.2. Banks and micro-insurance:

Do not trust at all									Fully trust	
0	1	2	3	4	5	6	7	8	9	10
O	O	O	O	O	O	O	O	O	O	O

25.3.Insurance company:

Do not trust at all									Fully trust	
0	1	2	3	4	5	6	7	8	9	10
O	O	O	O	O	O	O	O	O	O	O

25.4.My neighbors:

Do not trust at all									Fully trust	
0	1	2	3	4	5	6	7	8	9	10
O	O	O	O	O	O	O	O	O	O	O

26. Imagine when you harvest, a middleman approaches and offers a term of payment that you agree on. You could obtain either a delayed payment six months from now, or a different smaller amount immediately. There is no risk involved—both amounts will be paid out for sure. Please indicate below instead of receiving a delayed payment of 800000 VND six months from now, which is the smallest amount that you would need to be paid right now. I would need to be given _____Dong right now to give up the payment of 800000 VND six months from now.
27. Imagine when you harvest, a middleman approaches and offers a term of payment that you agree on. You could obtain either a delayed payment one year from now, or a different smaller amount six months from now. There is no

risk involved—both amounts will be paid out for sure. Please indicate below instead of receiving a delayed payment of 800000 VND one year from now, which is the smallest delayed payment that you would need to be paid six months from now. I would need to be given _____Dong 6 months from now to give up the payment of 800000 VND one year from now.

Section 3. Pilot Insurance Program

28. Do you know or have you heard of any agricultural insurance that you could purchase to protect your rice production against risks associated with disadvantage natural conditions? Please specify below:
    1 = I have been approached by someone outside your family
    2 = I have heard about the possibility, but have never been approached personally 3 = I have never heard about such insurance
29. [Enumerator: ask this question if answer to question above =1] Where did you hear from? 1 = village leader/ local authority; 2 = insurance agent; 3= friend/neighbor/relatives; 4 = media (tivi/radio); 5 = others
30. If you have heard about such insurance or have been approached, please answer the following:

30.1. I am insured: 1= yes 0= no

30.2. Please provide details about the insurance you are insured or you decided not to be insured:
    The premium: …… $ per hectare (in local currency) The coverage (please describe……. Payment condition (please describe): …….

31. If you don't know the premium, how much do you expect for the premium_____
32. If you have heard about it but are not insured, please indicate the most important reasons for this below:

1 = the insurance was too expensive

2 = I did not have the money at the time/ insufficient funds

3 = who knows if they are really going to pay in case of damage

4 = the administrative procedures are too complicated

5 = I have neighbors/friends/family helping me out, so I do not need insurance

6 = the insurance offered me was too complicated, I did not understand it

7 = I felt I did not have enough information about the insurance

8 = the government would help in case of disaster, so no need for insurance

9 = I have not thought about it

10 = I have not had time to think about it

11= Do not need insurance for other reasons:_____

Section 4. WTP question

Now we want to ask you more about the area yield crop insurance for rice production. This rice insurance product is provided by Bao Minh company, a state-owned insurance company. This product is designed to protect farmers against the loss due to natural calamity or epidemic diseases.

The design of this area yield crop insurance is as follows:

- This insurance is sold at the beginning of each crop season. If you buy this product, you may receive an indemnity when there is a loss in rice production caused by the following risk:
    - o Natural calamity: storm, flood, drought, damaging cold, frost, tsunami, saltwater intrusion, typhoon, whirlwind. Natural calamity must be announced by the appropriate authorities.
    - o Epidemic diseases: rice grassy stunt virus, rice ragged stunt virus, pyricularia oryzae carava, oryzae dowson, brown planthopper, stermborer. Epidemic diseases must be announced by the appropriate authorities.
- The condition for indemnity payment is based on the average yield of the whole

commune, not based on individual yield. Details of the payment condition are as follows:

- At the end of the crop season, if the average yield per hectare of your commune is lower than a pre-defined threshold and if you already bought the area yield crop insurance for your rice field at the beginning of the crop season, you will receive an indemnity payment, regardless of your real individual yield. This means that besides the case that you will receive an indemnity when your individual yield is low (you suffer a loss), there is another case in which you will not receive an indemnity although you suffer a loss, that is when your individual yield is low but the average yield of your commune is higher than the threshold. There is also a case that although your individual yield is high but the average yield of your commune is lower than the threshold, you still receive an indemnity payment.
- The indemnity payment is calculated by the following formula:

Indemnity payment = (average yield of your commune – threshold) x price x the area of your rice field

- The average yield of your commune is the yield announced by the statistics branch at your commune at the end of the crop season.
- The price is announced by the People's Committee of your province at the beginning of the crop season. This price is used to calculate the premium of the insurance as well as the possible indemnity.
- The threshold is the yield defined at the beginning of the crop season and it is written in the insurance contract. This pre-defined threshold is equal to 90% of the moving average of the past 3 years' area yield of the corresponding growing seasons of your communes. These yields are from the statistics office's annual year book.

To buy this insurance, at the beginning of each crop season, you have to sign the contract with the insurance company and pay the premium.

The following table summarizes all characteristics of the area yield crop insurance for rice production:

SUMMARY OF THE AREA YIELD CROP INSURANCE FOR RICE PRODUCTION

The contract is signed and the premium is paid at the beginning of the crop season. You have to buy the insurance for all of your rice field (100% coverage).

The threshold: 90% of the moving average of the past 3 years' area yield of the corresponding growing seasons.

Indemnity Payment Condition:

If you buy the area yield crop insurance for rice production and if the average yield of the commune is lower than the threshold, you will received the indemnity payment at the end of the crop season.

If you buy the area yield crop insurance for rice production and if the average yield of the commune is higher than the threshold, you will not receive the indemnity payment at the end of the crop season.

The indemnity = (the threshold – the average yield of the commune) x Price x Area of rice field

The indemnity payment is based only on the average yield of your commune, not based on your individual yield. You may receive the indemnity when you suffer a loss or not and you may not receive the indemnity when you suffer a loss.

Before we continue, please answer all of the questions in the "Comprehensive Test". These questions are used to make sure that you fully understand the area yield crop insurance. We will explain all of these questions again after you finish answering these questions.

Comprehensive Test

1. Will you receive the indemnity if your individual yield is lower than the

threshold? 1. Yes; 2. No; 3. Not Sure

2. Is there any possibility that you receive the indemnity if you don't suffer a loss? 1. Yes; 2. No
3. Is there any possibility that you don't received the indemnity if you suffer a loss? 1. Yes; 2. No
4. If your individual yield is 500 kg/cong; the average yield of your commune is 600, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No; If yes, the indemnity is……..
5. If your individual yield is 700 kg/cong; the average yield of your commune is 600, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No; If yes, the indemnity is……..
6. If your individual yield is 300 kg/cong; the average yield of your commune is 600, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No
7. If your individual yield is 700 kg/cong; the average yield of your commune is 400, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No; If yes, the indemnity is……..
8. If your individual yield is 300 kg/cong; the average yield of your commune is 400, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No; If yes, the indemnity is……..
9. If your individual yield is 500 kg/cong; the average yield of your commune is 560, the threshold is 560 kg/cong, the price is 6000 VND/kg, will you receive an indemnity? 1. Yes; 2. No; If yes, the indemnity is……..
10. If the probability of the event that your average yield is lower than the threshold is 10%; the probability of the event that your individual yield is lower than the threshold is 5%; what is the probability of the event that you may receive the indemnity payment? ……..

We now want to ask you about the premium that you are willing to pay to buy this area yield insurance for your rice field for one crop season in 2014. Assume that the threshold used in this contract is 560 kg/cong (56 Q/ha) (=90% of the moving average of the area yield of 3 years 2013, 2012, 2011) and the price is 6000 VND/kg. At the end of the crop season, if the average yield of your commune is lower than 560 kg/cong and if you buy the insurance, you will receive an indemnity based on the threshold (560 kg/cong); the average yield of your commune of this crop season and the price (6000 VND/kg). These are some examples:

Your individual yield (kg/cong) (determined at the end of the season)	Average yield of your commune (kg/công) (determined at the end of the season)	Indemnity	Differences between the average yield and the threshold (560 kg/cong)	Indemnity (VND/cong)
300/500/600/700	600	No	-	-
300/500/600/700	560	No	-	-
300/500/600/700	500	Yes	560 – 500 = 60	60x6.000=360.000
300/500/600/700	460	Yes	560 – 460 = 100	100x6.000=600.000
300/500/600/700	200	Yes	560 – 200 = 360	360x6.000=2.160.000

33. If the premium is B1 for each insured cong, are you willing to pay for insurance?

1 = Yes (go to question 34)

0 = No (go to question 35)

34. If the premium is Bh for each insured cong, are you willing to pay for insurance?

1 = Yes 0 = No

35. If the premium is Bl for each insured cong, are you willing to pay for insurance?

1 = Yes 0 = No

Questionnaire code	Bl (VND/cong)	B1 (VND/cong)	Bh (VND/cong)
1	10000	20000	30000
2	20000	30000	40000
3	30000	40000	50000
4	40000	50000	60000
5	50000	60000	70000

Section 5. Binswanger experiment (hypothetical question)

Now image that you have a chance to participate in a game. In this game, you can make a bet on coin flip. First, you can choose the side of the coin (head or tail) that you want to bet on. Then you will toss the air to determine whether you win or not. For example, if you choose to bet on the head and the face-up side after the toss is the head, you will win the game but if you choose to bet on the head and the face-up side after the toss is the tail, you will lose. If you win, you will receive an amount A and if you lose, you will receive an amount B.

36. These are 6 coin flipping games with different outcomes for winning/losing. If you can choose to participate in one of these 6 games, which one will you choose to play?

Lottery	Amount A (winning)	Amount B (losing)
1	50	50
2	95	45
3	120	40
4	150	30
5	190	10
6	200	0

Appendix 3. The Insurance Game - Instruction

Thank you for coming! You've earned 30.000 VND for joining this experiment, and the instructions explain how you make decisions to earn more money. So please read these instructions carefully! There is no talking at any time during this experiment. If you have a question, please raise your hand, and an experimenter will assist you.

The experiment is divided into two different stages. There will be 2 rounds in the first stage. The second stage will consist of 10 rounds. In all, the experiment will have 12 rounds. You will be randomly assigned to a group with 9 other participants. **The composition of each group will NOT change during the entire experiment. All players in one group belong to one area.**

Each round represents a crop season, in which you will invest all land in rice production. Each of you will have a hectare of land for rice production in each round and you will receive the yield based on the general condition of the whole area and your individual luck. The points you receive in each round is equal to the yield you get and all the points you get from 12 rounds of the second stage will be exchanged to money and pay to you at the end of the game. The yield may be high (means you have a good crop) or low (means you have a poor crop), depending on how the general condition and your individual luck are. More details about this will be given later.

At the end of the first stage (2 rounds), everyone in the group will have an opportunity to buy insurance to protect you from the loss in the second stage (10 rounds). You can choose among 3 different insurance contracts or choose not to do anything. One of the 10 rounds will be randomly chosen at the end of the experiment and the points you earn from this round will be exchanged to money through an exchange rate and this amount will be paid to you inaddition of the show up fee (30000 VND). The exchange rate is 1 point = 150 VND**.**

Part 1. The crop season (2 trial rounds)

Calculating your own yield

Each round in this game represents a crop season in which you will invest your resource in rice production. Each of you will have one hectare of land for growing rice. **Your individual yield depends on the natural condition, which influence the yield of the whole area and your own individual luck**. Because the natural condition is the same for all farmers in your area, all players in your group will suffer from the same "Area condition", which is divided into 5 conditions: "Very bad", "Bad", "Normal", "Good", "Very good" and has corresponding area yield for. However, your individual yield is not only influenced by the "area condition" but also by your own individual luck. In one crop season (one round in this game) when the "area condition" is "very bad", if your individual luck is good, your yield may be higher than the average yield of the whole area and thus, not too low while if the "area condition" is "very good" but your individual luck is bad, your own yield may be lower than the average yield of the whole area and thus, not too high.

The "Payoff Table" you have on the desk will show you how to determine your own yield (quintal/ha) based on the "area condition" and your "individual luck". The third row shows the average yield of the whole area in each "area condition" while the values in the next 3 rows show your individual yield depending on the combination between area condition and individual luck. For example, if the area condition of this crop season (this round) is very bad, and your individual luck is normal, your individual yield of this crop season is 30 QQ and the average area yield is also 30 QQ. If the area condition of this crop season (this round) is very high but your individual luck is low, your individual yield is 50 QQ while the average area yield is 60 QQ.

Yield (Quintal)	Area condition				
	1. Very bad	2. Bad	3. Normal	4. High	5. Very high

		200	350	450	550	700
Individual Luck	1. Low	80	250	350	450	580
	2. Normal	200	350	450	550	700
	3. High	320	450	550	650	820

Determining the area condition and the individual luck

To determine the area condition, at the end of each round, one player from your group will draw a chip from the white bag. This bag contains 10 chips, including 1 black, 2 red, 4 white, 2 blue and 1 green chips. The black chip represents the "Very bad" condition, the red chip represents the "Bad" condition, the while chip represents the "Normal" condition, the blue chip represents the "Good" condition and the green chip represents the "Very good" condition. We will write down the condition as well as the average area yield of each crop season on the board in sequence so that all of you can see the results.

Then, each player will draw a ball from the yellow bag to determine your own individual luck. This bag contains 4 balls, including 1 red, 2 white and 1 yellow balls. The red ball represents the "Low" luck, the white ball represents the "Normal" luck, and the yellow ball represents the "High" luck. **Please write down the "area condition", your own "individual luck", calculate your own yield based on the "area condition" and your "individual luck" and write down the result on the "RESULT SHEET".**

In the 5 trial rounds of the first stage, you will not make any decision. Your yield will be determined by the results of these two drawings. After all of you calculate your

individual yields of the crop season, our enumerator will check all of the results and will explain again the rules if there is some wrong.

Do you have any questions?

Comprehensive Test

Before we start the first 2 trial rounds, please answer all of the questions in the "Comprehensive Test Sheet". If you find any difficulty in answering these questions, please raise your hand and we will come and help you.

Comprehensive Test

1. If the area condition is "Normal" and your individual luck is "Normal", your yield of this crop season is …….
2. If the area condition is "Good" and your individual luck is "Low", your yield of this crop season is …….
3. If the area condition is "Very Bad" and your individual luck is "High", your yield of this crop season is …….
4. How many out of 10 rounds do you think will have a "Good" area condition? In other words, the probability that your team can draw a "Good" area condition at one round is …….
5. How many out of 10 rounds do you think will have a "Normal" area condition? In other words, the probability that your team can draw a "Good" area condition at one round is…….
6. How many out of 10 rounds do you think you will have a "High" individual luck? In other words, the probability that you can draw a "High" area condition at one round is …….
7. How many out of 10 rounds do you think you will have a "Normal area condition" and a "Normal" individual luck? In other words, the probability that you can draw both a "Normal" area condition and a "Normal" individual luck at one round is ……

(Start the 2 trial rounds)

Part 2. The crop season with area yield crop insurance (5 rounds)

Since this round, you have a chance to buy an insurance to protect your crop season.

You can choose between 2 options described as follows:

1. **Option 1: Buy an area yield crop insurance with the coverage level of 90%.**

This area yield crop insurance contract has the following features:

- Premium: 37.8 Q/ha. Because each of you only own 1 hectare of land, if you decide to buy this insurance, you have to pay 37.8 points from your total winning points of this crop season.
- Payment conditions: The indemnity of this insurance is paid based on the average yield of the whole area. **If the average area yield of one crop season is lower than a threshold level and if you buy this insurance in this crop season, you will be paid an amount equal to the difference between the threshold level and the area yield, regardless of your individual level**. It means that apart from the case that you receive the payment when your individual yield is low, there is a case in which your individual yield is low but the average area yield is higher than the threshold level so that you don't receive any payment and there is also a case in which your individual yield is high but the average area yield is lower than the threshold level so that you receive the payment. **We want to remind you that the average area yield in one crop season (one round) is determined by the "area condition" and showed in the third row of the "PAYOFF TABLE" while your individual yield is determined by the combination of the "area condition"and "individual luck".**
- The threshold level of the area yield insurance in this game is 90% of the area yield in a normal year: 450 x 90% = 405 Q.
- All features of this insurance as well as the calculation of the final yield is described by the "AREA YIELD CROP INSURANCE TABLE"

AREA YIELD CROP INSURANCE TABLE

- **Premium: 37.8**
- **Threshold level:** 90% of average area yield in a normal area condition = 90% x 450 = **405**
- **Payment mechanism and final individual yield:**
  - **If you decide to buy this insurance and the average yield of the whole area in this crop season is lower than 405, you will receive the payment and your final individual yield is:**

    Final individual yield = Individual yield – 37.8 + (405 – Average yield of the whole area)
  - **If you decide to buy this insurance and the average yield of the whole area in this crop season is equal to or higher than 405, you will not receive the payment and your final individual yield is:**

    Final individual yield = Individual yield – 37.8

- Do you have any question?
- If you don't have any question, please answer these following examples.

	Example 1	Example 2	Example 3	Example 4
Area condition	Bad	Bad	Normal	High
Individual luck	Normal	High	Low	Normal
Average yield of the whole are				
Individual yield				

You receive payment or not				
Insurance payment				
Final individual yield				

2. Option 2: Do not buy any insurance

In this option, you don't buy any insurance and your individual yield is calculated as in the first 3 trial rounds.

Do you have any question?

How to make decision in these rounds

In each round of this stage, you will have time to consider 3 options and make decisions. Your decisions are separate among rounds, which mean that your decision in one round do not affect your decision in the next round. After you make decision, please stick on the option you want to choose on the "DECISION SHEET" and submit it to us. Please also write down on the "RESULT SHEET" the option you want to choose.

After all of you submit your decisions, we will invite one member of your group to draw one chip from the white bag to determine the "area condition" and each of you will then draw a ball from the yellow bag to determine your "Individual Luck". **Please write down the "area condition", your own "individual luck", calculate your own yield based on the "area condition" and your "individual luck", calculate the indemnity of the insurance if you buy one and then calculate your final yields. Please write down all the results on the "RESULT SHEET".**

Do you have any question?

Part 2 (cont). The crop season with area yield crop insurance and indemnity insurance (5 rounds)

Since this round, besides the two options, you can choose another option, that is buying

an individual indemnity insurance. It means that now you can choose among 3 options to manage your risk. Let us explain the indemnity insurance as following:

Option 3: Buy an individual indemnity insurance

This individual indemnity insurance contract has the following features:

- Premium: 71 Q/ha. Because each of you only own 1 hectare of land, if you decide to buy this insurance, you have to pay 71 points from your total winning points of this crop season.
- Payment conditions: The indemnity of this insurance is paid based on **your individual yield**. **If your individual yield is lower than a threshold level and if you buy this insurance in this crop season, you will be paid an amount equal to the difference between the threshold level and your individual yield**.
- The threshold level of this individual indemnity insurance is 90% of the area yield in a normal year: 450 x 90% = 405 Q.
- All features of this insurance as well as the calculation of the final yield is described by the "INDIVIDUAL INDEMNITY INSURANCE"

INDIVIDUAL INDEMNITY INSURANCE TABLE

- **Premium: 71**
- **Threshold level:** 90% of average area yield in a normal area condition = 90% x 450 = **405**
- **Payment mechanism and final individual yield:**
  - **If you decide to buy this insurance and your individual yield in this crop season is lower than 405, you will receive the payment and your final individual yield is:**

    Final individual yield = Individual yield – 71 + (405 – Individual yield)

    = 405 – 71
  - **If you decide to buy this insurance and your individual yield in this crop season is higher than or equal to 405, you will not receive the payment**

and your final individual yield is:

Final individual yield = Individual yield – 71

- Do you have any question?
- If you don't have any question, please answer these following examples.

	Example 1	Example 2	Example 3	Example 4
Area condition	Bad	Bad	Normal	High
Individual luck	Normal	High	Low	Normal
Average yield of the whole are				
Individual yield				
You receive payment or not				
Insurance payment				
Final individual yield				

How to make decision in these rounds

In each round of this stage, you will have time to consider 3 options and make decisions. Your decisions are separate among rounds, which mean that your decision in one round do not affect your decision in the next round. After you make decision, please stick on the option you want to choose on the "DECISION SHEET" and submit it to us. Please also write down on the "RESULT SHEET" the option you want to choose.

After all of you submit your decisions, we will invite one member of your group to draw

one chip from the white bag to determine the “area condition” and each of you will then draw a ball from the yellow bag to determine your “Individual Luck”. **Please write down the “**area **condition”, your own “individual luck”, calculate your own yield based on the “area condition” and your “individual luck”, calculate the indemnity of the insurance if you buy one and then calculate your final yields. Please write down all the results on the “RESULT SHEET”.**

Do you have any question?