Agricultural Production Cost Insurance in West Java, Indonesia:

A Case of Garut District

by

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DISSERTATION

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List of Acronyms

ACSI	= American Customer Satisfaction Index
ADB	= Asian Development Bank
ADS	= Accident and Dismemberment Security
AIC	= Agricultural Insurance Company
AP3	= Agriculture Producer Protection Plan
BIG	= *Badan Informasi Geospatial*
BMKG	= *Badan Meteorologi Klimatologi and Geofisika*
BNPB	= *Badan National Penanggulangan Bencana*
CBS	= Central Bureau of Statistics
CCE	= Crop Cutting Experiment
CCIS	= Comprehensive Crop Insurance Scheme
CDB	= Coconut Development Board of India
CEI	= Composite Entropy Index
CSR	= Corporate Social Responsibility
CVM	= Contingent Valuation Method
ENSO	= El Nino Southern Oscillation
FAO	= Food and Agriculture Organization
FIIS	= Farm Income Insurance Scheme
FPB	= Farm Plan and Budget
GFDRR	= Global Facility for Disaster Reduction and Recovery
GIC	= General Insurance Corporation of India
HVCC	= High-Value Commercial Crops
ICAR	= Indian Council of Agricultural Research
JICA	= Japan International Cooperation Agency
KMO	= Kaiser-Meyer-Olkin of sampling adequacy
LARRDIS	= Parliament Library and Reference, Research, Documentation, and Information Service

LRP2	= Loan Repayment Protection Plan
MNAIS	= Modified National Agricultural Insurance Scheme
MoA	= Ministry of Agriculture of the Republic of Indonesia
MoAI	= Ministry of Agriculture of the Republic of India
MPCI	= Multi-Perils Crop Insurance
NAIS	= National Agricultural Insurance Scheme
NCAA	= Non-Crop Agricultural Asset
PCIC	= Philippine Crop Insurance Corporation
PCIS	= Pilot Crop Insurance Scheme
PLMSC	= Philippines Livestock Management Service Corporation
POLS	= Probit Adopted Ordinary Least Square
ROSCA	= Rotating Savings and Credit Associations
Rp	= Rupiah (Indonesian Currency)
RSBSA	= Registry System for Basic Sectors in Agriculture
SLCCI	= State Level Coordination Committee on Crop Insurance
UNDP	= United Nations Development Program
WBCIS	= Weather Based Crop Insurance Scheme
WII	= Weather Index Insurance
WTP	= Willingness to Pay
ZTNBM	= Zero Truncated Negative Binomial Model
ZTPRM	= Zero Truncated Poisson Regression Model

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CHAPTER 1. INTRODUCTION

1.1 Background of Study

1.1.1 General Context

Farming has particular features compared to other activities because it has high risks. Farming is highly influenced by natural conditions such as weather, biological processes, and pests and diseases. These factors cannot be easily controlled. The source of risks in farming is not only related to natural conditions but also to other sources such as markets, institutions, and government policy (Hardaker et al., 2015; Harwood et al., 1999). Since early agricultural development, people have tried to develop a farming system that can give better control over production. Thus, the risks can be minimized, and agricultural production can be conducted sustainably to fulfill human needs (Motes, 2010; Ruthenberg, 1971). However, despite many efforts undertaken by farmers to reduce risks, risks remain one of the unavoidable characteristics of farming.

Risks in farming are aggravated by the existence of climate change. It has influenced environmental factors such as soil, water, and weather. Changes in these factors lead to a reduction in production (Rounsevell et al., 1999). Hijioka et al. (2014) report that climate change impacts vary among regions. One of the most vulnerable areas is the tropical Asian region, particularly Southeast Asia.[1] The region is highly susceptible to climate change due to its geographical, social, and economic characteristics. It has a tropical climate, and most of the population is located in coastline areas. Moreover, its economic growth depends on natural

[1] Hijioka et al. (2014) report that in the Southeast Asian region, there has been an increase in temperature since 1960 at the rate of 0.14^0c to 0.20^0c. At the same time, extreme events have frequently been reported, such as rising numbers of hot days and warm nights. The region has experienced an increasing sea level (1-3 mm per year) and a decreasing trend in rainfall during the past several decades.

resources (particularly forests), and agriculture remains an essential sector (ADB, 2009).[2]

The existence of climate change will have negative impacts on smallholder farmers with low adaptive capacity (Hazell, 1992; Verchot et al., 2007). Due to climate-related hazards (such as floods, droughts, hurricanes, and fires) that cause production loss, smallholder farmers might have unstable income. This condition generates welfare problems in rural areas. For smallholder farmers, production loss can be easily transformed into disrupting food security and malnutrition (hidden hunger). This condition magnifies pre-existing vulnerabilities, which leads to poorer health and reduces intellectual and physical capabilities (Bloem et al., 2010; Hazell, 1992). In the worst case, farmers might lose their most precious assets, for example, selling farmland due to the obligation of paying loans to moneylenders or selling livestock to fulfill their daily needs (Helgeson et al., 2013; Sarap, 1995). As a result, it takes a long time for them to recover from shocks. This is exacerbated by the fact that farmers are mostly risk-averse, which makes them reluctant to adopt risk coping strategies with uncertain results. Although they decide to adopt risk coping strategies, they will select the strategies that have low cost, but their overall return might decrease (Morduch, 1995).

The decrease in agricultural production due to climate-related hazards influences not only farm households but also non-farm households (spillover effects). It will reduce employment opportunities for landless households and make them poorer (de Janvry & Sodoulet, 2009). The income of traders of agricultural products might also be influenced due to the decrease in the supply of the products. As a result, the rural economy might be influenced because the reduction in rural households' income leads to a reduction in aggregate demand for goods and services in rural areas (Hazell, 1992).

According to Smit & Skinner (2002), there are various strategies to cope with risks in farming

[2] According to ADB (2009), around 80 percent of the Southeast Asian population is living on the coast (within 100 km). The agriculture sector contributed to around 11 percent of gross domestic product (GDP) in 2006 and provided about 43.3 percent of employment in the same year.

that are implemented by various stakeholders at different scales. They can be grouped into four types: production practices (farming practices), financial management, technological developments, and government programs and agricultural insurance. The first two are conducted by producers (farm-level decision-making), while the other two are conducted by agribusinesses and by public agencies at a wide-scale (macro wide). Modification of farming practices could include crop and livestock diversification, planting crops in a different location, and changing the production intensity. Financial management (non-farm strategies) could consist of saving, income diversification, and agricultural insurance purchase. Innovations in resource management and new crop varieties that are tolerant to moisture, temperature, and other climatic conditions are examples of technological developments. Government programs and agricultural insurance include providing government programs to increase farm-level risk coping strategies and establishing agricultural insurance.

The first farmers' efforts to reduce the adverse impacts of risks are to modify production practices (on-farm strategies) followed by financial management (Corbett, 1988; Zimmerman & Carter, 2003). Some studies find that the traditional risk coping strategies (modifying farming practices, financial management) are not sufficient to protect income from risks, particularly if farmers experience covariate risks (systemic risks) that occur in a large area (Bradshaw et al., 2004; Mahul & Stutley, 2010; Skees et al., 1999). To some degree, the income shortfall can be compensated by public relief and private borrowing. However, public relief is not sustainable to minimize the adverse impacts of risks since it is implemented in the short term when disasters occur. Most farmers do not have access to formal financial institutions, and they often borrow small amounts from informal lenders with excessive interest rates. Therefore, farmers cannot depend on private borrowing to solve the income shortfall (Duong & Izumida, 2002; Saqib et al., 2018). This condition reduces farmers' adaptive capacity in the future and leads to farmers becoming more vulnerable (Cohen & Sebstad, 2005; Montgomery, 1996).

Because most of the smallholder farmers are risk-averse, have low capacity to adopt risk

coping strategies, and have limited credit access to formal financial institutions, the government (public) intervention to increase smallholder farmers' resilience to risks in farming is needed. Agricultural insurance is one of the risk coping strategies provided by the public. It might deliver benefits to reduce the adverse impacts of risks on smallholder farmers' prosperity. First, agricultural insurance can prevent farmers from using long run irreversible resources (for example, selling production and consumption assets and defaulting on loans) that make them more vulnerable to future shocks. Second, agricultural insurance has the potential to increase smallholder farmers' resilience by providing payout during bad years to help farmers to survive and protect their assets (Greatrex et al., 2015). Falco et al. (2014) find that agricultural insurance can decrease the variability of incomes from farming (smoothing income in a bad year). Third, agricultural insurance might reduce high government expenditure allocated for disaster relief after the shocks take place (Burke et al., 2010).

According to Mahul & Stutley (2010), agricultural insurance is commonly used by governments to minimize the impacts of risks in farming. Currently, around 104 countries are implementing various types of agricultural insurance. To increase the penetration of the insurance, the governments allocate a subsidy for the insurance premium. Almost one-third of countries provide a premium subsidy. However, the subsidy is not always a prerequisite for a high agricultural insurance uptake (Bielza et al., 2007; Mahul & Stutley, 2010). A high level of agricultural insurance penetration can also be found in countries that do not allocate a premium subsidy. In general, the penetration rates of agricultural insurance in developed countries are higher than those in developing countries (Mahul & Stutley, 2010). Research on agricultural insurance participation, especially in developing countries, becomes essential to increase the effectiveness of the insurance as well as its sustainability to enhance smallholder farmers' resilience to risks.

1.1.2 The Indonesian Context

As a country, Indonesia has been vulnerable to climate change. Some studies report that

there is an increase in the variability of temperature and rainfall in all Indonesian regions (Aldrian & Djamil, 2006; Boer et al., 2009; Boer et al., 2007).[3] According to Boer & Suharnoto (2014), climate change in Indonesia is associated with the occurrence of El-Nino Southern Oscillation (ENSO). ENSO causes changes in the dry season and the wet season. During the warm period of ENSO (El-Nino), there is a significant increase in the dry season length that causes the delay of the wet season (Supari et al., 2018). As a result, the planted farmlands decrease.[4] The farmers compensate for the delay in the onset of the wet season by growing more crops during the dry season. This condition leads to an increase in production failure (Boer & Suharnoto, 2014). The Asian Development Bank (ADB) (2015) predicts that agricultural production in Indonesia will reduce by 9-25 percent in the future due to climate change.

Besides the shift of the growing season, there is an increase in natural hazards, particularly floods and droughts. Recent data from the National Disaster Management Authority (BNPB) (2017) show that the number of floods and droughts doubled in 2015 compared to that in 2005. A flood or drought causes the loss of soil fertility. As a result, the productivity of farmland will be reduced. Another threat is the growing incident of pests and diseases. The Ministry of Agriculture (MoA) (2017a) reports that there is an increase in the number of attacks of pests and diseases during the period 2014-2016, particularly stem borers.[5]

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[3] Aldrian & Djamil (2006) find that there is an increase in the number of extreme dry months in Brantas' catchment areas in Java Island. For example, during the period 1992-2002, the average number of the extreme dry months increased by four months in the coastal areas and by two months in the mountainous areas. Boer et al. (2007) report that there was a decrease in water level in eight essential dams in Java Island in the period 1994-2006, due to the decline of rainfall. The reservoirs are essential for irrigating farmlands and generating electricity on the island.

[4] According to Naylor et al. (2007), a one month delay of the growing season in the wet season will reduce the January-April rice production by 11.0 percent in East Java and Bali Island, and by 6.5 percent in West Java and Central Java.

[5] The Ministry of Agriculture of the Republic of Indonesia (MoA) (2017a) reports that during the period 2014-2016, the attacks of stem borers in rice cultivation increased by 21.5 percent.

The increase in risks due to natural hazards has caused a reduction in farmers' income from farming. As a result, farmers have to choose other activities that are more attractive to fulfill their daily needs and have lower uncertainties. The Central Bureau of Statistics (CBS) (2013b) reveals that the number of farmers had decreased significantly by around 16.32 percent during the period 2003-2013. Moreover, as the attractiveness of agriculture decreased, many farmlands were converted to other economic uses. According to CBS (2013b), the area of farmland owned by smallholder farmers reduced from 19.02 million ha to around 14.23 million ha (33.7 percent) in 2003-2013.

Government intervention to reduce risks in farming is needed to maintain the contribution of the agriculture sector to the national economy. Agriculture remains an essential sector in Indonesia. This sector contributes to around 13.36 percent of GDP and provides jobs for about 31.7 million people (34 percent) (CBS, 2017a). Moreover, the agriculture sector is also essential in achieving national food security (Bappenas, 2015). Since the economic crisis in 1998, the government has had difficulties in achieving food sufficiency. The government has a target to achieve food sufficiency, particularly rice in 2019. This target is stated in the Middle Term National Development Planning of 2015-2019.

The Indonesian government has implemented agriculture insurance for smallholder farmers for rice since 2015. This policy is the implementation of the Law No.19/2013 concerning the protection and farmer empowerment. Among various types of agricultural insurance, the government selected agricultural production cost insurance known as *Asuransi Usahatani Padi* (AUTP). In this type of insurance, the value of indemnity is equal to the value of the production cost of rice (MoA, 2017b). The objective of agricultural insurance in Indonesia is to keep the insured farmers to continue farming by providing the cost of production through insurance if there are disasters, and the damage reaches the guaranteed yield. The government has a target to cover 1 million ha of rice fields every year by the insurance from the total area of 14 million ha of rice field managed by smallholder farmers. In 2017, the agricultural production cost insurance

was already implemented in 27 provinces. The government subsidizes the premium of the insurance at 80 percent (MoA, 2017b). The proportion of subsidy is one of the highest agricultural insurance subsidies compared to other countries.

1.2 Problem Statements

Even though the premium of insurance is highly subsidized, the number of farmers who participates in the insurance remains low. According to Asuransi Jasa Indonesia (Jasindo) (2017), the farmlands that were covered by the insurance was around 233,397 ha in 2016. This number is about 23.3 percent of the target area (1 mil/ha/season). The farmers' low participation is an indicator that the current implementation of agricultural production cost insurance is not yet effective.

There are various reasons why the participation rate of agricultural production cost insurance in Indonesia is low. First, agricultural production cost insurance is poorly designed (government policy failure). Second, farmers' characteristics influence the decision to participate in the insurance. Third, the insurance price is not affordable by farmers, making them reluctant to pay for the insurance. Fourth, farmers are not satisfied with the current insurance implementation. Therefore, farmers who have already purchased might decide not to use the insurance after experiencing the insurance. As a result, the sustainability of the insurance implementation is negatively affected.

Failure in designing the scheme and institutional arrangements will inadvertently lead to the failure of the agricultural production cost insurance implementation. The scheme is an essential factor in encouraging farmers to take insurance as one of the risk coping strategies. The scheme determines what benefits and costs of taking insurance. According to Smith & Baquet (1996) and Just et al. (1999), failure in determining the insurance scheme (such as premium, coverage, and guaranteed yield) leads to a market failure, especially adverse selection. Moreover, institutional arrangements are an important factor that determines the effectiveness of the agricultural production cost insurance implemented by the government and other stakeholders.

Personal characteristics of farmers can trigger low participation in the insurance. These include farmers' motivation for farming, risk behavior, and risk perception. The decision to take a certain risk management practice might contribute to farmers' motivation for farming (Binswanger & Rosenzweig, 2007; Gasson, 1973; Hansson et al., 2013; Northcote & Alonso, 2011). Moreover, farmers might have different perceptions about the outcomes and risks that occur when they select a certain type of innovation (Tucker et al., 2010). Another aspect that can be influential in selecting risk management is farmers' risk behavior. Some studies find that risk behavior influences farmers' decisions on the adoption of innovations (Feder, 1980; Kabede & Bogale, 1992; Moscardi & de Janvry, 1977). Therefore, farmers' motivation for farming, risk behavior, and risk perception might determine farmers' decision to adopt agricultural production cost insurance as one of the risk management practices.

Other personal characteristics that might influence the decision to participate in the agricultural production cost insurance are socio-economic, physiological, location, and farming characteristics. Moreover, existing risk coping strategies adopted by farmers might influence the rate of their participation in the insurance. Farmers with better risk coping strategies (ex-ante risk coping) might be more likely to purchase the insurance because they have more capacity to purchase the insurance (shown by higher risk coping strategies adopted) and they might think that purchasing the insurance will improve their capacity to overcome the adverse impacts of risks. On the other hand, farmers who do not have ex-ante risk coping strategies, due to their capacity, might be unlikely to adopt the insurance as a risk coping strategy.

There is a possibility that farmers' low participation in the agricultural production cost insurance is because the premium of the insurance is hardly affordable by the farmers. Currently, the premium of the agricultural production cost insurance is directly determined by the government (the producer value). When the premium (after deducting the government subsidy) is higher than the willingness to pay (WTP) of farmers (consumer value), the participation rate might be lower. When the premium can be set at the level of farmers' WTP, the premium is more

affordable by farmers, and it might improve farmers' participation in the insurance (Barnett & Mahul, 2007; Goodwin, 2001).

Farmers who have already purchased agricultural production cost insurance might either join or disjoin the insurance in the next cropping. The decision will depend on whether they were satisfied or unsatisfied with the insurance results. Satisfaction with insurance is one of the indicators of the sustainability of the insurance program. Farmers who are satisfied with the insurance (value, services, and outcomes) will be very likely to purchase insurance in the next cropping. On the contrary, farmers who are not satisfied with the insurance might be unlikely to purchase insurance in the next cropping.

As a new policy implemented by the Indonesian government, currently, there are no studies that attempt to analyze whether the design of agricultural production cost insurance including its scheme and institutional arrangements has already been well formulated. There are also no studies concerning smallholder farmers' WTP for agricultural production cost insurance in Indonesia. Risk coping strategies adopted by farmers before the insurance is introduced to the farmers have not yet been investigated. An investigation of risk coping strategies adopted by farmers before the government introduces the agricultural production cost insurance to farmers is essential to identify whether the insurance can be adopted by farmers as one of the risk management practices. In addition, farmers' satisfaction with the insurance is important to be identified. Customer satisfaction is considered a major indicator in the evaluation of goods and services. Thus, by investigating farmers' satisfaction, the government and the insurance provider can enhance the quality of the insurance (goods and services).

1.3 Objectives of the Study

There are five objectives of the study as follows:

(1) To review the current scheme and institutional arrangements of agricultural production cost insurance in Indonesia and its differences from other agricultural insurance schemes implemented in other countries. The review will provide policy recommendations to enhance

the scheme and institutional arrangements of the insurance by identifying its strengths and weaknesses.

(2) To investigate the influence of farmers' motivation for farming, risk behavior, and risk perception on a risk coping strategy adopted by farmers. Cropping pattern diversification will be used as an approach to examining the influence of these factors (motivation for farming, risk behavior, and risk perception) and their association. The analysis will provide a recommendation concerning what type of farmers (based on their motivation for farming, risk behavior, and risk perception) should be the target of the agricultural insurance program.

(3) To identify farmers' risk coping strategies and their determinants. The analysis will provide information concerning risk coping strategies adopted by farmers and factors which determine the decision to adopt a certain type of risk coping strategy, both ex-ante and ex-post strategies. It is predicted that the current risk coping strategies adopted by farmers will influence farmers' participation in agricultural production cost insurance.

(4) To estimate farmers' WTP for agricultural production cost insurance. The analysis will provide information about the mean value of farmers' WTP that reflects the consumer value of the insurance. This information is essential to determine an appropriate premium level for smallholder farmers. Moreover, the analysis will provide a recommendation to increase farmers' affordability to purchase the insurance.

(5) To investigate farmers' satisfaction with the agricultural production cost insurance and its determinants. The study is essential to identify the aspect (value, services, and outcomes) of the insurance that farmers deem satisfy/dissatisfy. The information can be used to improve the quality of the insurance regarding value, services, and outcomes.

1.4 Significance of the Study

As a whole, the study will contribute to the improvement of the insurance implementation in Indonesia. The specific contributions of the study are as follows:

(1) Improving the agricultural production cost insurance scheme (premium, coverage, guaranteed yield) and institutional arrangements by investigating the strengths and weaknesses of the current scheme and its institutional arrangements.

(2) Improving the understanding of the influence of farmers' motivation for farming, risk behavior, and risk perception on risk management. These factors might also affect the decision of farmers to participate in agricultural production cost insurance.

(3) Improving the understanding of risk coping strategies conducted by smallholder farmers and its determinants before agricultural production cost insurance introduced.

(4) Farmers' WTP for agricultural insurance will improve insurance pricing.

(5) Investigating farmers' satisfaction with the insurance and its determinants will enhance the understanding of the quality of the agricultural production cost insurance and how to improve its value, services, and outcomes.

1.5 Organization of the Dissertation

Along with the Introduction Chapter, the dissertation is organized into nine chapters. Chapter 2 presents an overview of current studies concerning risk coping strategies adopted by farmers. Empirical studies regarding determinants of risk coping strategies adopted by farmers, farmers' willingness to pay, and farmers' satisfaction with the insurance are reviewed to identify the relevant variables for the analysis of these topics.

Chapter 3 provides details of the methodology used in the study. It presents the details of the framework, estimation techniques, survey area, and questionnaires to collect data. Chapter 4 explores the implementation of agricultural production cost insurance in Indonesia regarding the scheme and institutional arrangements. This chapter provides an analysis of the strengths and weaknesses of the agricultural production cost insurance in Indonesia, mainly on its scheme and institutional arrangements.

Chapter 5 identifies farmers' motivation for farming, risk behavior, and risk perception in risk management by cropping pattern diversification. The result of the analyses will provide

information about whether there is an association among farmers' motivation for farming, risk behavior, and risk perception in determining a risk coping strategy adopted by farmers.

In Chapter 6, risk coping strategies adopted by farmers, both ex-ante and ex-post coping strategies, will be investigated, and determinants of farmers' decision on risk coping strategies will be identified. Moreover, farmers' behavior on risk coping strategies will be also analyzed. Chapter 7 identifies farmers' willingness to pay for agricultural production cost insurance. The analysis is essential to formulate the policy to increase farmers' affordability for the insurance.

Chapter 8 analyzes farmers' satisfaction with agricultural production cost insurance including its value, services, and outcomes. It will help to determine whether the insurance implementation can be sustainable. Chapter 9 presents the conclusions and policy recommendations.

CHAPTER 2. LITERATURE REVIEW

2.1 Risk and Uncertainty in Agriculture

There are several definitions of risk and uncertainty. Risk is defined as imperfect knowledge, in which its probabilities of outcomes can be identified. Uncertainty occurs when probabilities cannot be identified (Knight, 1921). Adams (1995) defines risk as the multiplication between the magnitudes of a future adverse shock with its probability. Meanwhile, Hardaker et al. (2015) define risk as an uncertain consequence and uncertainty as imperfect knowledge. According to Moschini & Hennessy (1999), the distinction of risk and uncertainty is virtually meaningless because there is a widespread acceptance that probabilities are rarely known, and it is a subjective belief. Therefore, the notions of risk and uncertainty are interchangeable.

Agriculture is a financially risky business. Agriculture involves managing crops and animals that are often conducted in an open area. Therefore, in almost every cropping season, farmers face risks and uncertainties. Hardaker et al. (2015) argue that the existence of risk is not important if the loss value is small or if the probability of the loss is assessed to be low. However, risk should be taken into account if there is a huge difference between good and bad consequences.

There are various risks in agriculture. The first is commonly called production risk. In agriculture, the result of a bundle of inputs allocated for production cannot be known with certainty in both the amount of product and its quality. This uncertainty takes place because factors of production such as soil quality, water availability, and weather (temperature, rainfall) are uncontrollable and unpredicted (Di Falco et al., 2006; Hardaker et al., 2015; Loomis et al., 1971). Crops and livestock are also influenced by pests and diseases. Biological processes that underlie crop production are also important rules. The longer time needed to produce crops, the more risks faced in crop production are (Moschini & Hennessy, 1999).

The second risk is the price risk. Farmers seldom know the price of crops at the time of

deciding how much and what products should be produced and how many inputs should be allocated. The decision has to be made by farmers far in advance because they need time to produce crops or animals which depend on their biological process (Hardaker et al., 2015; Moschini & Hennessy, 1999). The price of crops may change from when it was predicted at the beginning of the time when the crops were planted. This price change is mainly influenced by demand fluctuation (Moschini & Hennessy, 1999). The production risk mentioned above is also a significant contribution to the price risk because the price volatility is determined by not only demand but also the supply of the product.

The third is the institutional risk. The risk has resulted from the change in government regulations and policies. One of the characteristics of agriculture in many countries is strong government intervention. When the government changes the policies and regulations such as import policy, more taxes, use of pesticides, restriction in conservation practices, and high standard of products, this might cause adverse impacts on farming income (Goetz & Zilberman, 2007; Hardaker et al., 2015; Moschini & Hennessy, 1999). In many cases, the impacts of changes in policies and regulations are manifested on unanticipated changes in the prices of inputs or outputs and production constraints (Harwood et al., 1999).

The fourth is the human or personal risk. Farmers themselves who manage farmland may be a source of risks. Major life crises such as death and permanent injury may threaten the sustainability of crop production (Harwood et al., 1999). Prolonged illness will substantially increase costs because more labors have to be allocated for farming. Otherwise, it will significantly reduce production. Carelessness by workers in farmland, such as handling production or machinery, will contribute to the significant losses that reduce the profit (Hardaker et al., 2015).

The fifth is the financial risk. The risk has resulted from the method used by farmers in financing farming operations. If the operation use borrowed capital, farmers should allocate a proportion of output to repay creditors. If they fail to do so, they will face difficulties in

sustaining farming operations (Harwood et al., 1999). Other financial risks include a change in the interest rate on borrowed capital, unpredicted inflation that can have negative impacts on both borrowers and lenders, and lack of loan availability when it is required (Hardaker et al., 2015).

2.2 Risk Management

The risks in agriculture can range from independent (for example, death, illness, and injury) to highly correlated ones (for example, market price, pests and diseases, floods, and droughts). Managing risks in agriculture is challenging as the majority of risks occurred are highly correlated, and they affect whole communities. Farmers are not only agricultural stakeholders affected by the correlated risks. The risks may also influence the government because they have a responsibility to conduct humanitarian relief and other necessary actions such as rebuilding damaged infrastructure. Other agricultural stakeholders that are affected by the risks are agribusiness companies and agricultural industries that process agricultural products and transport them to the market. Consumers who buy agricultural products in the market will also suffer from the risks as the availability of agricultural products in the market is reduced.

Table 2.1 Potential risk management

Actor	Severity of Risk			
	Non-specific	Low	Moderate	High (Catastrophic)
Households/ community	▪ Water resource management ▪ Farmers' self-help group	▪ Crop diversification ▪ Planting in a different plot ▪ Saving in livestock ▪ Food buffer stock ▪ Informal saving in assets (money, gold)	▪ Income diversification ▪ Risk pooling (peers, family members) ▪ Borrowing to formal and informal sources	▪ Reduce consumption ▪ Reduce expenditure ▪ Sale of production assets ▪ Sale of consumption assets ▪ Migration ▪ Default on loans ▪ Take out children from school
Market	▪ New technology ▪ Improved seed	▪ Formal saving	▪ Formal lending ▪ Risk-sharing (input suppliers, wholesalers)	▪ Insurance
Government	▪ Building infrastructure (irrigation) ▪ Extension ▪ Provide weather data system ▪ Agricultural research		▪ State-sponsored lending	▪ Disasters relief ▪ State-sponsored insurance

Source: World Bank (2011).

As it is presented in Table 2.1, there are three approaches to risk management in agriculture that can be implemented by households, government, and the market (private businesses): mitigation, transfers, and coping. Mitigation is to lessen the negative impacts of related disasters and hazards. Transfer is to transfer the adverse impacts of particular risks on financial consequences to other parties. The most commonly known risk transfer is agricultural insurance. Coping is to improve resilience to manage events by preparing some risk coping strategies before and after the occurrence of hazards (World Bank, 2011).

2.3 Farmers' Risk Coping Strategies

Many definitions of coping strategies have been introduced. For instance, the coping strategy has been defined as the ability of individuals to respond to hazard occurrences and protect themselves from hazard's potential impacts within existing structural constraints (Eriksen et al., 2005; Kelly & Adger, 2000). Yohe & Tol (2002) define coping strategies as a range of actions that are available to respond to the risk perception of climate change in a certain policy context. For this study, the coping strategy is defined as an adaptation to and anticipation of expected future risks and as an immediate response to minimize the impacts of shocks (Berman et al., 2012).

Most farmers are risk-averse. They will try to avoid risks to reduce the negative impacts of the risks on their wealth by adopting specific strategies (Dercon, 1996; Harwood et al., 1999; Morduch, 1995). Farmers select risk coping strategies that are more appropriate for their situation. Each farmer has a different situation, and it determines their preferences and decision making (Harwood et al., 1999). In general, risk coping strategies can be grouped into two: ex-ante and ex-post coping strategies. The ability to adopt ex-ante and ex-post coping strategies is influenced by adaptive capacity. Adaptive capacity is defined as the ability of individuals to prepare in advance for stresses and adapt to and adjust the effect of the stresses (Berman et al., 2012; Engle, 2017).

2.3.1 Ex-Ante Coping Strategies

Ex-ante coping strategies are called protective responses (Grothmann & Reusswig, 2006). They are implemented before disasters occur and have an objective to smooth income flow to the household. Ex-ante coping strategies can be grouped into two: on-farm and off-farm strategies. On-farm strategies include choosing a plant that is more resistant to pests and diseases, water excess, and water scarcity. Other on-farm strategies are planting crops in several plots and diversification of cropping pattern. Off-farm strategies consist of diversifying incomes, rotating savings and credit association (ROSCA), and saving some incomes or agricultural products to be used in the future (Cooper et al., 2008; Hardaker et al., 2015; Morduch, 1995).

Diversification of cropping pattern is one of the strategies adopted by farmers (Mandal & Bezbaruah, 2013). Cropping pattern is defined as the arrangement of crops, both a spatial and temporal, to be raised in a plot of management (Gomez & Gomez, 1983; Harwood, 1973). The decision made by a farmer on cropping pattern reflects the farmer's action in minimizing the negative impacts of risk. According to Alderman & Paxson (1992), the cropping pattern selected by farmers is influenced by three factors: farmers' risk preference, the cost to implement the cropping pattern, and farmers' ability to cope with the risks by other available coping strategies. The idea behind the diversification of cropping pattern is to reduce the variability of net return by selecting crops planted that have a low correlation of the net return among the crops. However, the main objective is not only to minimize the variability, but also to find the risk-efficient combinations of crops planted. Therefore, the change in cropping pattern will be not necessary to avoid risks in farming, but farmers will try to find the best combination of activities and risks faced that maximize the outcomes (Hardaker et al., 2015). When farmers change the cropping pattern, they change the combination of crops planted. If the proportion of high-value crops increases, it is likely to increase the total return.

Planting crops in different plots is one of the strategies to reduce risks. The strategy is commonly used by farmers to reduce the variability of return from farming. Di Falco et al. (2006)

shows that planting crops in different plots significantly contribute to farmers' incomes. This occurs because planting in different plots can minimize production failure. When there is a failure in one plot, this can be compensated by the production in other plots. The plots are sometimes separated by long distances. Therefore, each plot might have different quality of soils and agro-climatic conditions, allowing farmers to diversify crops planted and minimize the production risk and price risk (Hung et al., 2007). Morduch (1990) finds that in India, the most vulnerable households tend to grow crops in different plots to anticipate the weather shocks that vary by locations.

Income diversification is commonly adopted by farmers to minimize the risk. Income diversification involves several activities that are not perfectly correlated to reduce the variability of incomes (Dercon, 2000). Rosenzweig & Stark (1989) state that farmer households experiencing greater variability of incomes from farming tend to have a household member with steady employment. Kochar (1999) finds that if the labor market is well functioning, to anticipate the variability of incomes from farming, males in the household are more likely to increase their hours of work in off-farm work, even if the insurance can be accessed by the households. Similarly, using survey data of rural Indian households, Rose (2001) indicates that around one-third of households supplies the labor on off-farm work to increase household income.

Rotating savings and credit associations (ROSCA) is an informal financial institution that has been widely implemented in developing countries. ROSCA is defined as a group of individuals voluntary formed who agree to financially contribute to the creation of funds at each of a set of uniformly-spaced dates. The fund will be allotted to each member of the group in turn based on some prearranged principle (Calomiris & Rajaraman, 1998). ROSCA can be viewed as the response to credit market exclusion by socially connected people (Besley et al., 1993). Each country has a different name of ROSCA. For example, *tontines* in Senegal, *chit fund* in India, *susu* in Ghana, *cheetu* in Sri Lanka, *njangis* in Cameroon, *pasanakus* in Bolivia, and *arisan* in Indonesia. Moreover, there are various types of ROSCA. Random ROSCA is commonly used by

households. In the random ROSCA, members are committed to putting a fixed amount of money and collect it into a "pot". A lot is drawn in each period of the life of ROSCA, and one of the members will receive the pot. The process is repeated in the next period, and the member receiving the pot from the previous process is excluded (Besley et al., 1993). Calomiris & Rajaraman (1998) argue that ROSCA has an insurance function to anticipate the negative impacts of risks.

In rural areas, to respond to the variability of incomes and to buffer consumption, people can conduct self-insurance via savings (Dercon, 2000). Moreover, savings can be used as a risk-sharing device across households through mutual support by transferring savings from one household to another (Dercon, 1996; Ligon, 2000). Risks and the occurrence of shocks influence savings. As risks on household incomes increase, household savings will increase (Dercon, 1996). Udry (1995) concludes that savings are essential for smoothing consumption after the occurrence of shocks. When there are shocks, farmers' income reduces significantly. Therefore, farmers try to increase their current savings to anticipate future shocks. Saving some incomes can be implemented in good years of harvests to provide a buffer in bad years of harvests.

2.3.2 Ex-Post Coping Strategies

Ex-post coping strategies are implemented after disasters occur. They have an objective to smooth consumption. Maintaining the level of household consumption is crucial for households during and after disasters. Indeed, households fall to poverty when the households' per capita consumption is below the defined poverty line. Thus, to secure the living standard, households have to adjust between smoothing consumption and income variability (Sawada, 2007). Farmers might adopt several strategies after disasters occur. First, farmers might reduce the level of consumption, particularly after the occurrence of covariate shocks (shock occurring in large areas and affecting many households). Dercon & Christiaensen (2007) and Harrower & Hoddinott (2005) find that reducing the level of consumption is commonly used by households in rural areas when there is a covariate shock. Meanwhile, it is unlikely to be conducted by households if

the shock is an idiosyncratic shock (affecting a few households).

Second, farmers can reduce unnecessary expenditures while maintaining the level of consumption. In extreme cases, particularly in developing countries, poor households might reduce expenditure by taking out children from school and default on loans. Third, households can shift the use of future assets to current consumption through credit from formal and informal institutions. Sometimes it contributes to the loss of their production assets that are used as collateral (Boucher et al., 2008). Fourth, households might use the accumulation of physical and financial assets or savings (Burke et al., 2010; Morduch, 1990; Sawada, 2007). Lastly, households can force the household's members to get jobs in other places (Cooper et al., 2008; Morduch, 1995; Sawada, 2007).

According to Cohen & Sebstad (2005) and Montgomery (1996), ex-ante coping strategies can be divided into three stress levels: low, middle, and high. The stress level depends on the allocated resource value and its degree of reversibility. Summary of ex-post coping strategies based on stress level is presented in Table 2.2. The low-stress includes modifying consumption and improving family budgeting by reducing unnecessary expenditures. The allocated resource value is low and reversible. The impact of coping strategies is lifestyle changes. The middle-

Table 2.2 Types of ex-post coping strategies based on stress level

Stress Level	Characteristic	Strategy	Impact
Low	Resources allocated are low and reversible.	▪ Change consumption pattern ▪ Increase in the household budget	▪ Change lifestyle ▪ Households asset reallocation
Middle	▪ Resources allocated are high and less reversible. ▪ Reduce adaptive capacities in the future	▪ Utilize savings ▪ Borrow from formal and informal sources ▪ Get help from relatives ▪ Migrate to find a job	▪ Reduce financial assets ▪ Debt ▪ Increase social obligation
High	▪ Resources allocated are difficult to reverse. ▪ Increase vulnerability to future shocks	▪ Sell consumption assets ▪ Sell production assets ▪ Default on loan(s) ▪ Take children out of school	▪ Reduce household productivity ▪ Income loss ▪ Reduce accessibility to financial markets ▪ Social isolation

Source: Cohen & Sebstad (2005) and Montgomery (1996).

stress consists of utilizing savings, borrowing from formal and informal sources, migrating to find jobs, and getting help from relatives. The allocated resource value is high and less reversible. This can reduce the coping capacity in the future. The impacts of the coping strategies are the decrease in assets, the increase in social obligation, and indebtedness. The high-stress includes the sale of production and consumption assets, default on loans, and taking out children from school. The allocated resource value is difficult to reverse and consequently increases the vulnerability to future shocks. The impacts of coping strategies are the decrease in household productivity, income loss, social isolation, and reduction in the financial market accessibility.

Theoretically, the decision to adopt ex-ante coping strategies and ex-post coping strategies is often determined by various factors. According to previous studies (Kochar, 1999; Bryan et al., 2009; Dillon et al., 2011; Reardon & Vosti 1995), variables that might determine the decision include personal (age, education, sex, risk behavior, discount rate, disaster experience, percentage of damage, risk perception, and coping appraisal), economic (per capita living expenditure), farming (farmland size), financial (institutional access), and geographical factors.

Age can positively or negatively influence adopting coping strategies (Kochar, 1999). Education positively determines the adoption of coping strategies (Bryan et al., 2009; Dillon et al., 2011). Sex is considered to influence the decision (Bryan et al., 2009). However, studies differ in terms of whether women or men are more likely to adopt the strategies (Dillon et al., 2011; Kochar, 1999). Risk-averse farmers are more likely to adopt ex-ante coping strategies to minimize the adverse impacts of risk (DiFalco & Chavas, 2009; Ellis, 2000). Discount rate influences the decision, particularly strategies involving long-term investments such as savings (Reardon & Vosti, 1995). Trust among community members is predicted to influence the adoption of the strategies. Higher trust among communities improves connection (social relation) (Adger, 2003; Stone, 2001). As a result, risk coping capacity increases as there are many alternative risk coping strategies that are available due to higher connection with other community members, such as borrowing and rotating savings and credit association (ROSCA).

Disaster experience is a positive determinant of adopting strategies (Alam & Collins, 2010; Freedy et al., 1992). The percentage of damage was reported to reduce individuals' resources (Warner et al., 2012). Therefore, it decreases the capacity to adopt risk coping strategies. Risk perception (risk impact perception and risk probability perception) and coping appraisal (coping efficacy appraisal, self-efficacy appraisal, and cost appraisal) are found to be significant determinants of adopting ex-ante coping strategies (Gebrehiwot & van der Ven, 2015; Grothmann & Patt, 2005; Grothmann & Reusswig, 2006).

Per capita living expenditure positively determines the decision to adopt risk coping strategies (Dorward, 1999; Morduch, 1995; Reardon et al., 1992; Rosenzweig & Wolpin, 1993). The influence of farmland size can be positive or negative. Farmers with small farmland size are reported to adopt ex-ante coping strategies, particularly income diversification, whereas farmers who manage middle-sized farmland are not likely to adopt ex-ante risk coping strategies, and allocate all their time to farming (Reardon et al., 2000; Shand, 1987). Access to financial institutions such as bank account ownership positively influences the decision on ex-ante risk coping strategies. Borrowing money from financial institutions can be invested in non-farm income-generating activities (Barret et al., 2001; Dercon, 1998; Jacob, 1994; McPeak & Barret, 2001).

2.4 Approaches to Study on Households' Adoption of Risk Coping Strategies

Study on household' adoption of risk coping strategies (adaptation) can be investigated through several approaches as follows:

2.4.1 Governance of Adaptation

The first is, what commonly called, the governance of adaptation approach. This approach investigates how multiple societal actors collectively contribute to addressing problems to minimize the adverse impacts of risks. Governing involves the creation of rules, institutions, and the selection of normative principles to guide solutions to problems. Scholars using this approach

are Agrawal (2008) and Huitema et al. (2016). Agrawal (2008) argues that adaptation to risks due to climate change is highly local. Thus, local institutions are essential to determine the effectiveness of the adaptation through which the incentive for collective action is structured. The local institutions might facilitate and mediate external intervention (for example, information, technology, and funds) into adaptation practices.

2.4.2 Adaptive Capacity and Social Capital

The second approach is the adaptive capacity and social capital. The approach emerges because there is the fact that decisions on risk coping strategies (adaptation to risk) are made by various actors. Some risk coping strategies are undertaken by individuals, and others are undertaken by groups of individuals. The government, on behalf of the society, also conducts necessary actions to enhance the individual capacity to cope with risks. Scholars using this approach are Adger (2003), Pelling & High (2005), and Smith & Wandel (2006). Adger (2003) argues that to improve the effectiveness of risk coping strategies adopted by multiple actors, it needs collective action. However, collective action cannot properly work if there are no good networks in society. This factor (networks) is described as an asset of the society, which is called social capital. According to Pelling & High (2005), there are four possible rules of social capital that make collective actions work properly in adoption of risk coping strategies: First, it is used to generate a material intervention directed to reduce the adverse of risks such as using collective action to reduce floods by raising the level of river embankments; Second, it is used to generate material intervention to background stress response, for example, using collective action to invest in childhood education to increase the resiliency of household to future socio-economic risks; Third, social capital is used to modify an institution that responds to risks such as individuals developing social capital to enhance his/her access to resources to provide material intervention; and Fourth, social capital is used to modify institution that responds to background stress, for example, individuals involved in the collective decision-making process with the objective to participate in change by voting in elections (local and national).

2.4.3 Adaptation Pathways

The third approach is the adaptation pathways. Scholars using this approach are Barnett et al. (2014), Burnham & Ma (2018), Eriksen et al. (2005), Feola et al. (2015), and Osbahr et al. (2008). Adaptation is an adjustment process to change that is conducted sustainably over a long period (Hurlimann et al., 2013; Smith et al., 2011). According to Barnett & Mahul (2007), the adaptation pathways are sequences of risk coping strategies that have linked these strategies. The strategies result from manageable steps that are triggered by environmental change over time. The first step might lead to low regret and preserve strategy options for future generations. Burnham & Ma (2018) find that adaptation decision is shaped by the ongoing and historical multi-scalar social and ecological process. Whether or not a strategy is conducted over time is determined by the extent to which the strategy can overcome the adverse of risks in the present and the future.

2.4.4 Adaptation and Risk Management

The fourth approach is the adaptation and risk management. This approach utilizes the international risk management standards (ISO:31000) for adaptation assessment. Scholars applying this approach are Jones & Preston (2011) and Thomalla et al. (2006). According to Jones & Preston (2011), risk management assessment (ISO:31000) is compatible with adaptation assessment, and it is recommended for the adaptation assessment for both local and national levels. There are five stages in risk management that can be applied for adaptation assessment: scoping exercise (the context of assessment is exercised), risk identification, risk consequences (risk impact analysis), risk evaluation (to evaluate the weaknesses and strengths of adaptation and mitigation), and risk management or treatment (selecting adaption and mitigation) that will be implemented.

2.4.5 Socio-Cognitive Model of Adaptation and Adaptive Capacity

The sixth approach is the socio-cognitive model of adaptation and adaptive capacity. This

approach investigates the decision of individuals on risk coping strategies based on individuals' psychological aspects. Scholars applying this approach are Bubeck et al. (2018), Grothmann & Patt (2005), Mankad et al. (2013), and Martin et al. (2007). The socio-cognitive model of adaptation and adaptive capacity use protection motivation theory (PMT) developed by Rogers (1975) to explain how psychological variables influence individuals' decisions on taking risk coping strategies (protective response). Previously, the theory was applied in health behavior research. Currently, the PMT-based model can be applied in studies on natural hazards such as earthquakes, floods, and droughts (Bubeck et al., 2018; Mankad et al., 2013; Martin et al., 2007).

This study will use the socio-cognitive model of adaptation and adaptive capacity. Even though the theory is mainly used in psychological research on health behavior, it has been also successfully applied in other research fields, including risk management (Grothmann & Reusswig, 2006). The application of the socio-cognitive model of adaptation and adaptive capacity to explain farmers' risk coping behavior in developing countries is still limited, particularly in Southeast Asia, including Indonesia. Therefore, the study will contribute to the possibility of the use of the socio-cognitive model of adaptation and adaptive capacity approach (socio-economic and psychological factors) in explaining risk coping strategies adopted by farmers (risk management study in farming).

There are new variables that will be introduced to the present study and predicted to influence the decision on adopting risk coping strategies. These include assets, landholding (sharecropping, rent in cash, owner), type of farmland (irrigated, rain-fed), and location of farmers. Sharecropping, rent in cash, and owner might have a different level of income. Therefore, they have different capacities to adopt risk coping strategies. Type of farmland and location might influence the level of risk. Therefore, it is predicted that these two variables will influence farmers' decisions on risk coping strategies.

The study will investigate whether or not the cropping pattern adopted by farmers is a strategy to minimize the negative impacts of risks in farming. Farmers' motivation for farming,

risk perception, and risk behavior will be analyzed to find out the association among these variables to determine the cropping pattern selected. Therefore, the study will contribute to enhancing the understanding of cropping patterns (on-farm strategies) as a risk coping strategy (risk management) in farming.

2.5 Agricultural Insurance as Risk Management Tool

Farmers adopt risk coping strategies (ex-ante and ex-post coping) to minimize the adverse impacts of risks. However, when covariate disasters (systemic risks) occur, risks coping strategies adopted by farmers might be ineffective for several reasons. First, diversification strategies (crop diversification and income diversification) may fail as disasters affect farmers' incomes from all sources. Crop diversification will be ineffective because disasters may affect both cash crops and subsistence crops. Income diversification, particularly by taking off-farm work such as transporting and processing agricultural products, may also suffer from disasters because the disasters will affect all agricultural production. Second, when the disasters affect a whole community, strategies of reciprocity and risk pooling among family members and neighbors may fail (World Bank, 2011).

Government intervention is needed when disasters affect a whole community, and farmers' risk coping strategies are not well functioning. One of the ex-ante coping strategies categorized as market-based and implemented by the government is agricultural insurance. Not only does agricultural insurance deliver benefits for farm households, but also it will provide benefits for the government. According to the World Bank (2011), agricultural insurance has the potential to reduce government expenditure on humanitarian relief and compensation for catastrophic events. Meanwhile, for farm households, agricultural insurance has a function as the complement of other ex-ante risk coping strategies. When one or a combination of risk coping strategies adopted by farmers fail to reduce the adverse impacts of risks, agricultural insurance acts as a buffer, particularly to make farmers stay away from using ex-post risk coping strategies that make them more vulnerable to future shocks such as selling production assets and withdrawing savings.

Agricultural insurance can also increase farmers' accessibility to credit. In some countries, such as the Philippines, agricultural insurance is one of the requirements to access credit of financial institutions (Bangsal & Mamhot, 2012). When they have more access to credit, farm households may increase their production. They are potentially experiencing a safer condition.

According to Mahul & Stutley (2010), almost half of the countries (104 countries) have implemented agricultural insurance. Among these countries, middle-income countries are the majority of countries that implement agricultural insurance (48 countries, 44.4 percent) followed by high-income countries (38 countries, 36.5 percent) and lower-income countries (18 countries, 17.4 percent). Farmers' participation rate in agricultural insurance in high-income countries is higher than that in both middle- and low-income countries.

2.5.1 Type of Agricultural Insurance

According to World Bank (2011), agricultural insurance products are broadly grouped into two: indemnity-based agricultural insurance (traditional agricultural insurance) and index-based agricultural insurance (presented in Table 2.3). Each group of agricultural insurance is explained as follows.

2.5.1.1 Indemnity-Based Agricultural Insurance

Indemnity-based agricultural insurance is divided into two: *damage-based agricultural* insurance and *yield-based agricultural insurance*. Damage-based agricultural insurance is agricultural insurance, of which the insurance claim is determined by the percentage of damage after disasters occur. It is also called *named peril crop insurance* because the insurance only covers crops damaged by a certain disaster (peril). Before purchasing the insurance, there is an agreement between the insurers and the farmer concerning the percentage of damage that will be applied to determine the payout of the sum-insured (indemnity). The sum-insured can range from production cost to expected revenue.

Table 2.3 Characteristics of agricultural insurance products

Product		Characteristics	Advantages	Challenges
Indemnity-Based Agricultural Insurance (Traditional Agricultural Insurance Product)	Damage-Based Agricultural Insurance/ Named Peril Agricultural Insurance	▪ Specific peril: Main: hail Other: freeze, frost, wind. ▪ Indemnity is paid out based on the percentage of damage. ▪ It is sold by private companies. ▪ Generally without the government's subsidy.	▪ Loss assessment is transparent. ▪ The policy is simpler. ▪ Moral hazards and adverse selection are more manageable.	▪ Loss assessment is conducted at an individual farmer level. ▪ Loss assessment is more costly. ▪ Difficult to be applied for a specific disaster such as droughts and pests and diseases.
	Yield-Based Agricultural Insurance	▪ Cover almost all types of perils. ▪ Indemnity is paid out according to the actual yield compared to historical average yield. ▪ It generally involves subsidy from the government due to a high cost.	▪ Cover a wide variety of agricultural products. ▪ It can guarantee both yield and income.	▪ Loss assessment is conducted at an individual farmer level. ▪ Difficult to avoid moral hazards and adverse selection. ▪ Poor data at the individual farmer level (historical yield data). ▪ High administrative cost resulting in a high premium.
Index-Based Agricultural Insurance	Area Yield Index Insurance	▪ Policyholders (farmers) are grouped into assigned areas (district, sub-district). ▪ All farmers in the same area are treated equally. ▪ Cover all types of perils.	▪ Moral hazards and adverse selection can be minimized. ▪ Individual loss assessment is not needed. ▪ It can cover loss for all perils. ▪ The administrative cost is lower, resulting in a lower premium paid by farmers.	▪ Peril occurs in a small area may not result in paid out. ▪ The historical yield of the area (districts, sub-district) may not be available.
	Weather Index Insurance	▪ Indemnity is paid based on a weather parameter data reported by a weather station. ▪ The weather index is formulated to reflect the expected loss of yield. ▪ The insurance design may be complex. ▪ A specific weather parameter: Main: excessive and deficit rainfall and low and high temperature. Others: high wind.	▪ There will be no moral hazards and adverse selection. ▪ Data collected are more transparent (provided by a weather station).	▪ Setting up the weather index will be complex. ▪ It needs good modeling to relate the weather index with agronomics data (agricultural production/yield). ▪ Difficult to correlate sudden-impact weather with the change in yield.

Source: Modified from World Bank (2011).

Agricultural insurance for hail, frost, and excessive rainfall are examples of well-known damaged-based agricultural insurance products in the market. They are sold by private insurance

companies, and the insurance market can work without the government's subsidy allocated for the insurance premium. According to Mahul & Stutley (2010), named peril crop insurance for individual farmers is the most common product sold in the market, particularly in high-income countries.

Yield-based agricultural insurance is agricultural insurance that covers the yield of farmland (for example, in tons/ha). It is also called Multiple Peril Crop Insurance (MPCI) as the insurance covers the reduction in agricultural production due to many types of risks (not specific for a certain risk). The yield is determined by measuring the historical average yield of farmland, in which its value will be used to determine the coverage/insured yield. The insured yield can range from 50 to 70 percent of the historical average yield. Indemnity that will be paid out by the insurer is the difference between the insured yield and the actual yield when a disaster occurs. Commonly, yield-based crop insurance is implemented to minimize the adverse impacts of highly correlated risks (covariate/systemic risks) that will affect large areas. Therefore, it requires a premium subsidy from the government because the premium collected may not cover indemnity when a disaster occurs. Yield-based agricultural insurance (MPCI) is the second common agricultural insurance product sold in the market after named peril crop insurance. Mahul & Stutley (2010) note that MPCI is more popular in middle-income countries than that in high-income countries.

2.5.1.2 Index-Based Agricultural Insurance

There are two types of index-based agricultural insurance: *area yield index insurance* and *weather index insurance (WII).* Area yield index insurance is agricultural insurance, of which the indemnity is based on the actual average yield of an area such as district or sub-district. It does not rely on the actual yield of farmland insured by a farmer. Before implementing the insurance, data regarding the historical average yield of the area have to be identified. The indemnity will be paid by the insurer to the insurance holders if the average actual yield of the area is less than the historical average yield of the area where the insurance holders are located, even if the actual

yield of farmland of the insurance holders is higher than the actual yield of the area.

Weather index insurance is agricultural insurance, of which the indemnity is based on the realization of a weather parameter (for example, rainfall) in an area where the insurance holders are located at a specific period. The weather data is usually provided by a weather station. The insurance is to protect farmers' losses due to an excessively low or excessively high weather parameter (index weather realization). The indemnity will be paid out by the insurers if the realization of the weather parameter exceeds a pre-specified threshold (for example, too much rainfall/floods) or less than the threshold (for example, too little rainfall/droughts). The indemnity is calculated according to the pre-agreed sum insured per unit index.

2.5.2 Moral Hazards and Adverse Selection

The most common problems in the determination of an agricultural insurance scheme are the failures of measuring risks and monitoring farmers' behavior (asymmetric information). These take place because the cost to measure risks and monitor farmers' behavior is relatively high. Even if the insurers can provide the risk data and monitor farmers' behavior, transaction costs may be high. This condition is one of the reasons why there is a lack of agricultural insurance development for smallholder farmers provided by private entities (Mahul & Stutley, 2010).

There are two essential problems due to asymmetric information: adverse selection and moral hazards. The adverse selection appears when the insurer cannot calculate a premium accurately due to failure in measuring risks. As a result, farmers who have a higher risk are likely to purchase agricultural insurance. Meanwhile, farmers who have a lower risk will not participate in agricultural insurance. To avoid the existence of adverse selection, it requires the identification of risks faced by farmers. Thus, farmers having a similar risk can be identified (homogenous risk groups). Grouping farmers who have a similar risk is the prerequisite for a successful insurance contract (Mahul & Stutley, 2010). Premiums and indemnities have to be differentiated among homogenous risk groups. For example, a higher premium rate must be allocated to a group that has higher risks. Therefore, the premium rate will reflect the risks faced by farmers (Goodwin &

Smith, 1995; Miranda, 1991).

Moral hazards take place when insured farmers modify their agricultural production practices to get benefits from indemnities. This includes reducing fertilizer, water, pesticides, and so on (Goodwin & Smith, 1995). The root of moral hazard problems is the difficulty in monitoring farmers' behavior and determining the cause and magnitude of the loss (asymmetric information). The insurer often relies on information provided by the insured regarding the cause of the loss. Moral hazards commonly occur in yield-based agricultural insurance (MPCI), in which the insurer has an adversity to determine whether the loss is due to the negative impacts of risks or bad agricultural management (Mahul & Stutley, 2010). Moral hazards rarely occur in named-peril agricultural insurance because the cause of the loss can be easily identified, such as hail, freeze, and frost, and the indemnity will be paid only because of the occurrence of a specific peril. Many studies identify the impacts of moral hazards on agricultural insurance participation.[6]

2.5.3 Alternative Agricultural Insurance Programs

There are many alternative agricultural insurance programs besides the two common types (indemnity- and yield-based agricultural insurance). The alternative insurance programs are designed to minimize the weaknesses of conventional agricultural insurance (indemnity- and yield-based agricultural insurance). This consists of independent insurance for price and yield, target price insurance, whole-farm insurance, and production cost insurance.

2.5.3.1 Independent Insurance for Price and Yield

Independent insurance for price and yield is proposed by Harrington & Doering (1993). The insurance protects farmers' revenue by ensuring yield and price separately when the shocks occur. Traditional agricultural insurance (for example, MPCI) can be used to cover the reduction in yield, while price shortfall in the market will be covered by insurance for the price. According

[6] Horowitz & Lichtenberg (1993) and Babcock & Hennessy (1996) find that there are changes in pesticides and fertilizer used by corn growers who participate in agricultural insurance.

to Goodwin & Smith (1995), the potential weakness of such insurance is that there is always a correlation between price and yield. When yields decline in a large area, they tend to increase prices. Thus, the predicted price used in the insurance contract may not reflect the actual price when there are shocks, in which the actual price can be higher than the predicted price. As a result, farmers only gain the indemnity from yield insurance, and as a whole, their revenue might be lower.

2.5.3.2 Target Price Insurance

Barnaby (1990) proposes to replace the agricultural insurance, which covers yield shortfall at a market price by that at a target price. Such proposed insurance guarantees the amount of indemnity at a fixed targeted price (for example, the market price at harvest). Thus, the objective of the insurance is to guarantee farmers' revenue at a targeted price. The scheme will minimize the lower indemnity gained by farmers when they use conventional agricultural insurance. For example, when farmers experience loss during the high price period, they will get lower indemnity than the actual worth of their crops. The insurance has the potential to reduce moral hazards. For instance, when the market price is significantly below the guaranteed price, farmers who guarantee their crop for yield shortfall at a fixed price, when they experience loss, will find out that they are much better off experiencing loss (gain indemnity) than harvesting their crop and selling it in the market. The target price insurance may reduce this behavior.

2.5.3.3 Whole-Farm Insurance

Whole-farm insurance is an insurance that guarantees yield shortfall for all crops grown by farmers. Current agricultural insurance programs are only limited to cover yield shortfall for one crop. Whole-farm insurance can be used by farmers who grow various crops (crop diversification). However, there are several weaknesses in such insurance. First, this is difficult to determine the expected yield of each crop when they are grown in the same area. According to Tilman et al. (2002), yield among crops may be dependent on each other. Therefore, the yield of

a single crop might be different when they are grown with other crops. Second, with many crops planted, there will be difficulties in determining risks. Thus, premium rates might not reflect the actual risk faced by farmers. As a result, moral hazards and adverse selection may take place.

2.5.3.4 Agricultural Production Cost insurance

Agricultural production cost insurance is an insurance that guarantees agricultural production cost when there is a shock. The logic behind such insurance is that growers should be assured to have a return to their investment in growing a crop, at least for the production cost. In some countries, such as India and the Philippines, agricultural production cost insurance is part of MPCI (Reyes et al., 2015; MoAI, 2013). According to Goodwin & Smith (1995), the weakness of such insurance is the determination of a farm's production cost. It may vary from one to another location. Measurement of individual farm's production cost requires detailed farm records over a long period. Agricultural production cost might be effective in minimizing moral hazards because its indemnity is only limited to production cost, but it still suffers from adverse selection due to the difficulties in determining farms' production cost.

2.6 Farmers' WTP for Agricultural Insurance

As a whole, farmers' participation in agricultural insurance in developing countries is lower than that in developed countries (Mahul & Stutley, 2010). This condition takes place because of many reasons. One of the reasons is that the premium is hardly affordable for farmers. As a result, they are not willing to join and pay (Goodwin, 2001; Habb & McConnell, 2002; Barnett & Mahul, 2007). When the premium (after being deducted from the government subsidy) is higher than the willingness to pay (WTP) of farmers, the participation rate might be lower. When the premium can be set at the level of farmers' WTP, it will enhance farmers' participation in the insurance.

Generally, the premium of the agricultural insurance is directly determined by the government (producer value) based on cost approaches (MoA, 2015), such as estimating

administration cost, indemnity, and profit value. As the government determines the insurance price, this might not reflect market price or social exchange value. The identification of consumer value (farmers' WTP) for the insurance is important to be identified to determine an appropriate market price of the insurance.

Valuation of the insurance based on consumer value (WTP) can be investigated by the contingent valuation method (CVM). According to Bennett (1996), there are three elements in CVM for estimating consumers' WTP. First, a hypothetical program or project that will be proposed to the consumers, for example, a proposal for agricultural insurance for smallholder farmers that may minimize a huge loss of agricultural production when experiencing shocks. Second, a mechanism for eliciting the consumers' values on the program or project is established. Two common methods used in CVM are an "open-ended" question and a "dichotomous choice". Third, the socio-economic and behavioral characteristics of consumers are identified for WTP's estimation.

Several variables are considered for analyzing the probability of the farmers' willingness to pay for agricultural insurance at a certain level of a bid. In addition to farmers' characteristics like age, sex, education, farmland (size, landholding arrangement, irrigation), finance (asset, access to capital), per capita living expenditure, and contact with extension service (Ali, 2013; Long et al., 2013; McCharty, 2003; Sarris et al., 2006) that are influential to decision making, this study takes premium/bid (Just et al., 1999; Smith & Baquet, 1996), risk behavior (Barret et al., 2001; Sherrick et al., 2004), discount rate or time preference (Fukui & Miwa, 2016; Ito & Kono, 2010), disaster experience (Alam & Collins, 2010; Liu et al., 2019), percentage of damage (Ito & Kono, 2010; Rothschild & Stiglitz, 1976), expected next season production (Fraser, 1992; Sherrick et al., 2004; Smith & Baquet, 1996), trust (Adger, 2003; Stone, 2001), and previous purchase of agricultural insurance (Boyd et al., 2011) as variables into account due to attributes of the insurance.

Premium (Bid). Just et al. (1999) and Smith & Baquet (1996) argue that the premium

determines the expected benefit from taking agricultural insurance. The expected benefit will be the difference between indemnity and premium. An increase in the expected benefit is likely to encourage farmers to participate in agricultural insurance.

Risk Behavior. Barret et al. (2001) argue that risk-averse farmers are more likely to take risk coping strategies (for example, agricultural insurance) to minimize the adverse impacts of risks. Sherrick et al. (2004) find that risk behavior significantly influences farmers' participation in agricultural insurance.

Trust. Social relation (connection) among community members might improve if there is a higher trust among them (Adger, 2003; Stone, 2001). When social relation improves, there will be many alternative risk coping strategies such as farmers' self-help groups and rotating savings and credit association (ROSCA). These strategies might substitute agricultural insurance as a risk coping strategy. There is also a condition that a higher social relation might improve farmers' willingness to participate in agricultural insurance because it will improve information concerning benefits of the agricultural insurance when some community members (farmers) have a good experience in utilizing the agricultural insurance as one of the alternative risk coping strategies. Therefore, trust among community members might positively or negatively influence agricultural insurance take-up.

Discount Rate. Insurance purchase involves a comparison of current cost (premium) with expected loss due to disaster in the future. Farmers who have a higher discount rate will value present money higher than that in the future. Therefore, they might spend their money at present rather than investing in agricultural insurance. Meanwhile, farmers who have a lower discount rate might invest in agricultural insurance to minimize the loss due to disaster in the future. There are no previous studies which have taken discount rate into account as a parameter (variable) of farmers' WTP for agricultural insurance. Though being a case of micro-insurance in Cambodia, Fukui & Miwa (2016) find that individuals who have a higher discount rate are associated with lower participation in health insurance.

Disaster Experience. If farmers are more often exposed to disasters, they are more likely to purchase agricultural insurance to minimize losses due to disasters. Freedy et al. (1992) argue that a range of adverse experiences due to the occurrence of natural hazards influence an individual's risk coping strategy adoption.

Percentage of Damage. The percentage of damage might positively or negatively influence farmers' participation in agricultural insurance. It reflects the degree of risk faced by farmers. Rothschild & Stiglitz (1976) and Ito & Kono (2010) state that riskier individuals tend to purchase the insurance to minimize the negative impacts of risks. On the other hand, Warner et al. (2012) argue that a higher percentage of damage might reduce individuals' resources. As a result, their capacity to purchase the insurance might reduce.

Expected Next Season Production. The expectation of next season production is predicted to influence farmers' participation in agricultural insurance. When farmers expect that the next season production is higher than that of the previous season, the willingness to pay for the insurance might reduce. On the other hand, when they expect that the next season production is lower than that of the previous season, their willingness to pay might increase (Fraser, 1992; Sherrick et al., 2004; Smith & Baquet, 1996).

Previous Purchase of Insurance. Boyd et al. (2011) find that last year's purchase of agricultural insurance positively influences the purchase of the insurance this year. Repeating the purchase of agricultural insurance might indicate that there is a lucrative benefit from the insurance. Cohen & Houston (1972) argue that the consumption experience of goods or services develops consumers' perception of the performance of goods and services.

Contact with Extension Service. Kabede & Bogale (1992) find that there is a significant positive impact of contact with extension service on WTP for agricultural insurance. Extension service provides farmers with information (of management and technology and so on) and removes their doubts/worries derived from innovation in farming. Moreover, extension service might improve farmers' trust to the government who channels agricultural insurance to farmers

through the agent.

Production Cost. In Indonesia, the indemnity of agricultural production cost insurance is limited only to production cost fixed at a certain level. Feeling of premium payment burden is dependent on farmers' own production cost, while production cost itself means a scale of risk/loss. When the production cost is high, the WTP for the insurance will be high.

2.7 Farmers' Satisfaction with Agricultural Insurance

Farmers' satisfaction with agricultural insurance is essential because it may determine the continuity of farmers' participation in the insurance. Farmers who are not satisfied with the insurance are unlikely to repeat purchases in the next cropping season. In addition, farmers' personal experience (satisfied or unsatisfied) in insurance purchases might be utilized by other farmers who have not yet purchased to determine their decision. According to Hekkert et al. (2009) and Rubin et al. (1993), customer satisfaction is considered as the major indicator in the evaluation of goods and service quality. It can be utilized by the providers to increase the quality of goods and services to meet customer expectations.

There are two definitions of satisfaction that are commonly used in the existing literature. First, satisfaction is defined as the response of the consumer to the perceived discrepancy evaluation between the actual performance and prior expectation as perception after its consumption (Day, 1984). Second, satisfaction is defined as a dynamic flow of interaction in affective domains and cognitive after experiencing a service (Tse & Wilton, 1988). These definitions have been used to determine approaches to estimating customer's satisfaction with goods and services.

According to Gilbert et al. (2004), there are four approaches to measuring customer satisfaction. The first is the "expectancy-disconfirmation" approach. It follows the first definition of satisfaction, which involves the identification of customer expectations and their experiences in consuming services. This approach has been used in the creation of the American Customer Satisfaction Index (ACSI) (Fornell et al., 1996). The second is the "performance" approach that

assesses service quality and product features by asking the level of customer satisfaction during a service period. The third is the "technical and functional dichotomy" approach, which identifies customer satisfaction by dividing the service into two components: technical and temporal quality. The technical quality of service is determined by characteristics such as physical features, durability, reliability, and security. Meanwhile, the temporal quality of service is related to the relationship between a service provider and customer, such as the speed of delivery, helpfulness, and pleasantness of the service. The fourth is the "service quality versus satisfaction" approach, which identifies the customer satisfaction level by estimating perceived quality during or shortly after the service delivered and the overall satisfaction with service quality and product features. This approach identifies the level of customer satisfaction without measuring customers' prior expectations. The second, third, and fourth approaches follow the second definition of satisfaction, which measures customer satisfaction without considering their prior expectations of goods and services.

This study uses a "service quality versus satisfaction" approach because it investigates overall satisfaction with the quality of goods (value), services, and outcomes. Other approaches have several weaknesses when they are applied to the investigation of farmers' satisfaction with agricultural production cost insurance. The "expectation-disconfirmation" approach has two major weaknesses. Firstly, it involves the measurement of customer expectation, which is usually estimated after customers have experienced services or goods. Therefore, according to Gilbert et al. (2004), the measurement of customer expectation may not be accurate because there will be a contamination effect when customers recall their expectations after having encountered the service. Secondly, customer satisfaction may be dynamic. Danahar & Mattson (1994) and Weber (1997) find that customer expectation is not static. It changes during the actual consumption of service. The "performance" approach would not sufficiently explain customer (farmers) satisfaction with the agricultural production cost insurance, because in this study the variables that are predicted to influence farmers' satisfaction with the insurance is not limited to the quality

of goods and service, but include outcomes of the insurance purchase and socioeconomic characteristics. The "technical and functional dichotomy" approach cannot be applied to identify farmers' satisfaction with agricultural production cost insurance because the insurance does not have technical quality (for example, physical features, durability, and so on). This approach is more appropriate for investigating customer satisfaction with material goods (tangible), which have certain technical qualities.

One of the most remarkable studies using the "service quality versus satisfaction" approach is Kane et al. (1997) on health care service. The study defines customer satisfaction as a function as follows:

$$Satisfaction = Outcomes + Severity + Procedure + Demographic\ charcateristics \tag{2.1}$$

The model developed by Kane et al. (1997) has several strengths in comparison to the conventional model used for agricultural insurance satisfaction studies.[7] Firstly, the model incorporates variables of outcome and severity, which are essential in determining customer satisfaction (Hall et al., 1993; Jackson et al., 2001). Secondly, the influence of personal characteristics and their magnitude on customer satisfaction can be observed.

There are various determinants of customer satisfaction with insurance that can be grouped into five: personal characteristics, perceived value, perceived service, severity, and outcomes.

Personal characteristics. They consist of age, education, sex, and the number of enrolment (Lange et al., 2012). Farmers' age might have a negative impact on satisfaction. This is because old farmers are viewed as being less willing to adopt an innovation (that is, taking agricultural insurance) due to fear of risk (Elias et al., 2013). Therefore, although the results of agricultural

[7] Studies on customer satisfaction with agricultural insurance mainly apply the expectation confirmation/disconfirmation approach such as Yazdanpanah et al. (2013) and Hasdemir & Ozudogru (2018). By applying a structural equation model, the study analyzes the relationship between farmers' satisfaction with perceived value, perceived quality, and customer attitude.

insurance were equal among farmers, older farmers might be more unsatisfied compared to younger farmers. The level of farmers' education might positively influence satisfaction. It broadens farmers' expected rewards from an innovation (Elias et al., 2015). Farmers with higher education might appreciate that the benefit of purchasing insurance is not only limited to indemnity but also other outcomes such as the feeling of security and so on. Sex and the number of enrollment might positively or negatively influence customer satisfaction with the insurance service (Lange et al., 2012).

Perceived value. It is defined as a customer's valuation on benefit (what they get) and sacrifice (what they give) (Zeithaml, 1988). There are two variables of perceived value: product quality and price (Sweeney et al., 1997). In marketing, the value is considered as the ratio of quality and price, and it determines a competitive advantage (Cravens et al., 1988; Dodds, 1991; Monroe, 1990; Parasuraman, 1997). Most customers expect to receive a higher quality of product at a lower price. Crosby & Stephens (1987) and Nguyen et al. (2018) show that perceived value determines customer satisfaction. By assessing the American Customer Satisfaction Index (ACSI), Fornell et al. (1996) find that customer satisfaction is influenced by the quality of goods and services rather than price.

Perceived service. Tse & Wilton (1988) argue that perceived service is an essential determinant of customer satisfaction. Post-consumption evaluation could be dominated by the perception of the customer on the quality of service. Cohen & Houston (1972) find that there is a direct link between satisfaction and perception on service. They state that if customer motivation is learning from experience, then if a product has a good performance, customers tend to be satisfied, regardless of their expectations before consuming the service. Curry & Sinclair (2002) and Van der Wall et al. (2002) show that there is a positive relationship between perceived service and satisfaction.

Severity. In the health care service, Jackson et al. (2001) and Kane et al. (1997) find that severity significantly influences customer satisfaction. Higher satisfaction with the health care

service is associated with a higher severity level experienced by customers.

Outcomes. Hill et al. (2013) and Cole et al. (2014) find that there is a positive effect of indemnity payout (tangible outcome) on repeating the insurance purchase conducted in response to their satisfaction with the insurance. As a similar finding in the health care service, Jackson et al. (2001) and Kane et al. (1997) show that outcomes of the service determine customer satisfaction.

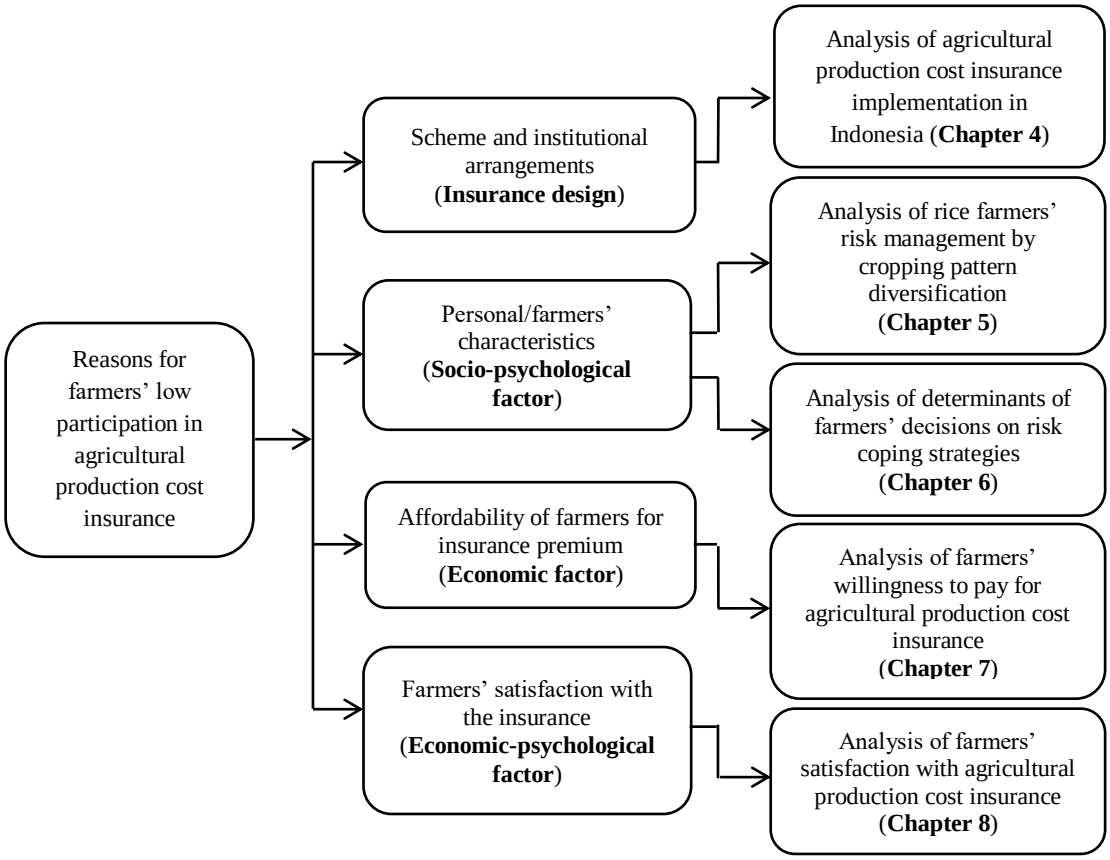
The present study uses a "service quality versus satisfaction" approach to measure farmers' satisfaction with agricultural production cost insurance. The approach is different from other previous studies, which mainly applied the "expectancy-disconfirmation approach". Therefore, the study will contribute to providing an alternative approach to measure farmers' satisfaction with a certain innovation in farming (economic-psychological studies in agriculture).

CHAPTER 3. METHODOLOGY

3.1 Framework of Study

As it is mentioned in Chapter 1, there might be various reasons why farmers' participation in agricultural production cost insurance remains low: failure in designing the scheme (premium, guaranteed yield, and indemnity) and institutional arrangements, personal characteristics of farmers (socio-psychological factors and farming practices), unaffordable insurance premium (economic factors), and farmers being unsatisfied with the insurance scheme and services (economic-psychological factors). Most of the existing literature investigate the farmers' low participation in agricultural insurance by examining one of the reasons (insurance design, personal characteristics, farmers' affordability, and farmers' satisfaction) such as Goodwin (1994), Sherrick et al. (2004), and Yazdanpanah et al. (2013). This study will investigate all those possible reasons that may trigger the farmers' low participation in agricultural production cost insurance.

The framework of the study is presented in Figure 3.1. As explained in the framework, the scheme and institutional arrangements of the agricultural production cost insurance in Indonesia will be compared with those in other countries (comparison study) to identify its strengths and weaknesses. Two analyses will be conducted to investigate whether farmers' characteristics influence their participation in agricultural production cost insurance. The first is the analysis of rice farmers' risk management by cropping pattern diversification. Cropping pattern diversification, one of the common risk management adopted by farmers, is selected to analyze the influence of farmers' motivation for farming, risk perception, risk behavior, and their association on risk management. The second is the analysis of the determinants of farmers' decisions on risk coping strategies. The affordability of farmers for the insurance premium of the agricultural production cost insurance will be investigated by analyzing farmers' willingness to pay (WTP). The analysis can provide the value of farmers' mean WTP (consumers' value) for the



Source: Author.

Figure 3.1 The framework used in the study

insurance. The analysis of farmers' satisfaction with agricultural production cost insurance will be conducted by investigating farmers' satisfaction with the insurance, including value, services, and outcomes.

3.2 Area and Data Collection

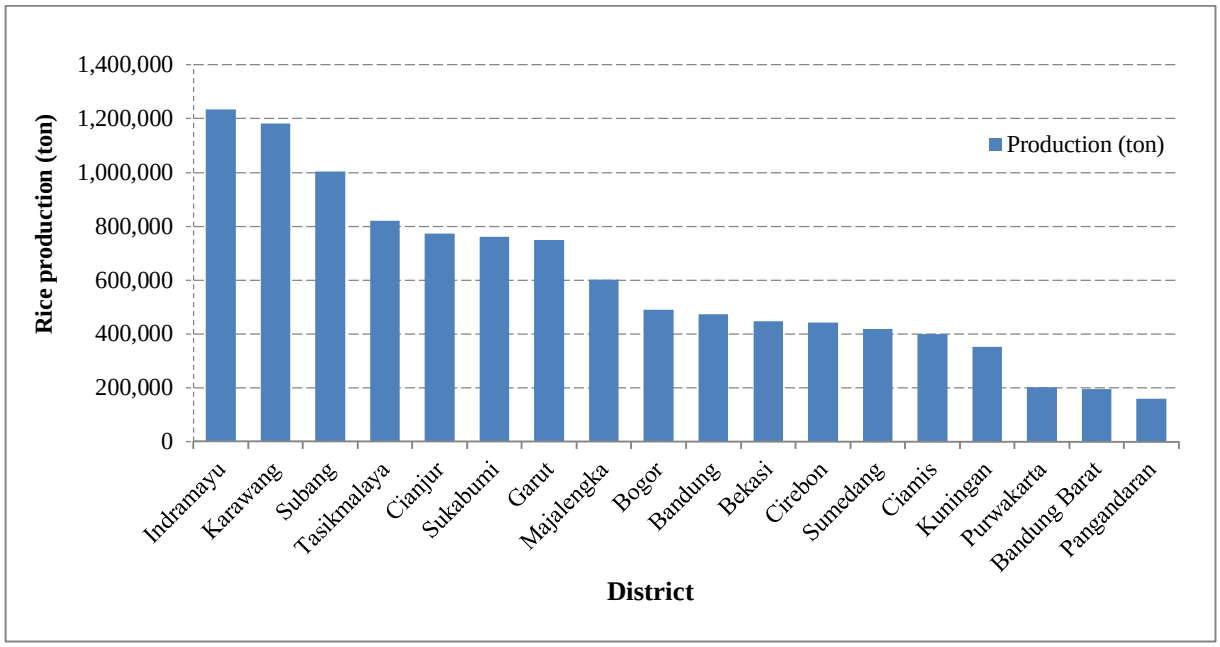
3.2.1 Study Area

3.2.1.1 Area Selection and Rationale of Its Selection

Garut District in West Java Province was chosen as a study area. Most people in the district rely on agriculture for their livelihood. Because of its agro-climatic condition (located

approximately 64 to 1300 masl), the district becomes one of the agricultural production centers in West Java Province, where farmers produce various agricultural products, such as rice, corn, groundnuts, chili, mustard, cabbage, tomatoes, and so on (CBS, 2016).

The district has approximately 120,789 ha of farmland, which accounts for around 10 percent of the total rice area in the province (MoA, 2013). Farmlands can be divided into three types: irrigated (37,645 ha, 31.2 percent), non-irrigated (10,563 ha, 8.7 percent), and mix irrigated (72,581 ha, 60.1 percent) (MoA, 2014). In 2016, Garut District produced around 749,960 tons of rice (Figure 3.2). Thus, it was one of rice production centers in West Java Province (the seventh-highest rice producer in the province).



Source: CBS (2017b).

Figure 3.2 Rice production in the major districts in West Java Province in 2016

Currently, the district has become one of the most vulnerable areas to natural hazards (BNPB, 2017). The natural hazards include floods, excessive rainfall, and pests and diseases (MoA, 2017a). For example, a flood at the end of 2016 was the worst flood in the district (BNPB, 2017). As a result, rice production has steadily declined in the last five years. For instance, rice

production in the district in 2017 (749,960 tons) was lower by 18.9 percent than that in 2012 (925,239 tons). In 2012, Garut District was the fourth-highest rice producer in West Java Province (CBS, 2013c). Garut's poverty rate was around 12.5 percent, which was one of the highest poverty rates in the province in 2014 (CBS, 2016). Moreover, in 2016, the number of farmers purchasing agricultural production cost insurance was the lowest among all districts (27 districts) in the province (Jasindo, 2017). Therefore, Garut District is appropriate for the study area to investigate the reasons for the farmers' low participation in agricultural production cost insurance.

3.2.1.2 General Information of Garut District

Garut District is located in the southern West Java Province and is bordered by the Indonesian Ocean to the south, the districts of Bandung and Sumedang to the north, Tasikmalaya to the east, and Cianjur to the west. The district has a strategic position because it is a buffer zone of the capital city of West Java Province, Bandung City. Garut District has a population of 2,548,723 (the majority is Sundanese) with an area of around 306,519 km^2. The district is divided into 42 sub-districts with 421 villages (CBS, 2016).

In 2013, there were around 268,678 farmer households in Garut District. This number is lower by 16.1 percent than that in 2003 (320,242 farmer households) (CBS, 2013a). The reduction of farmer households commonly takes place in sub-districts located surrounding Garut City, the capital city of the district (such as Karang Pawitan, Tarogong Kidul, and Tarogong Kaler). According to CBS (2013a), the age of farmers is around 45-54 years old, and the majority is male (91 percent). They manage about 0.3-0.49 ha of farmland per farm household.

According to Koppen's climate classification, Garut's climate is categorized as a humid tropical climate. There are two seasons in the study area: wet season and dry season. The wet season is from September to May, while the dry season extends from June to August (CBS, 2016). Table 3.1 presents the precipitation in West Java Province for the last five years. The highest average precipitation during the last five years in West Java Province (including Garut

Table 3.1 Precipitation in West Java Province during 2012-2016 (mm)

Month	2012	2013	2014	2015	2016	Average
January	82.9	216.0	309.0	188.0	48.0	168.8
February	303.7	250.0	89.0	189.1	34.5	173.3
March	155.5	305.0	419.0	318.6	86.3	256.9
April	155.5	286.0	218.0	285.2	112.6	211.5
May	290.8	171.0	177.0	322.4	74.7	207.2
June	60.5	231.5	196.0	58.0	38.2	116.8
July	34.2	159.0	181.0	0.3	44.6	83.8
August	0.0	74.0	120.0	6.9	49.7	50.1
September	27.0	172.0	1.0	43.2	46.8	58.0
October	125.0	234.0	65.0	37.9	83.5	109.1
November	537.0	164.0	297.0	455.0	87.1	308.0
December	637.0	418.0	316.0	311.5	15.2	339.5
Total	2,409.1	2,680.5	2,388	2,216.1	721.2	2,083.0

Source: CBS (2017b).

District) occurred in December (339.5 mm), while the lowest one was recorded in August (50.1 mm) (CBS, 2017b).

3.2.2 Data Collection

3.2.2.1 Questionnaire Development

The questionnaire was used to collect data for four analyses: 1) the influence of farmers' motivation for farming, risk behavior, and risk perception on rice farmers' risk management by cropping pattern diversification; 2) the determinants of farmers' decisions on risk coping strategies; 3) farmers' WTP for agricultural production cost insurance; 4) farmers' satisfaction with the agricultural production cost insurance.

The questionnaire was designed to collect data on all members of households, including socio-demographic, economic, financial, farming, institutional, and psychological characteristics. The data also included risk coping strategies (ex-ante and ex-post risk coping strategies) adopted by farmers.

Socio-demographic characteristics include the general information of households, which consists of age, education level, sex, household size and its composition, and employment of all household members. In this study, the household head is defined as the person who makes the majority of the economic decisions in the household.

Economic characteristics are household income (including their sources) and expenditure as follows: farming income (such as rice production, other crops, livestock, fishery, and agricultural labor), non-farming income (wage employment and self-employment), income from other sources (remittance, pension, land rent, and machinery rent), expenditure (food and non-food), asset (production asset and consumption asset), and savings (money, agricultural product, gold, and so on).

Financial characteristics cover the use of financial institutions by farmers such as formal institutions (banks and cooperatives) and informal institutions (money lenders, relatives, and social groups) for their saving and borrowing. They consist of financial institutions used for economic activities, bank account ownership, and ownership of savings and loans from the financial institutions and their values.

Farming characteristics explain farmlands that are managed by farmers and crops planted, including their production value. Farmland size, landholding (privately owned, rent in cash, and sharecropping), type of farmland (irrigated, rain-fed), crop production in each season (rice and other crops), and production cost are included.

Institutional characteristics concern a membership of farmer groups (farming group, irrigation group, and so on) and contact with the extension service, including its frequency of contact. This characteristic is predicted to influence farmers' adoption of innovation in farming, including risk coping strategies.

Psychological characteristics consist of risk perception (risk impact and risk probability perception), coping appraisal (coping efficacy, self-efficacy, and cost appraisal), farmers' motivation for farming, risk behavior, trust, and discount rate. Risk and trust games (economic

experiment) are played following procedures used by Schechter (2007) to investigates farmers' risk behavior and trust. The discount rate is identified by examining farmers' choices between delayed and immediate rewards applied by Kirby et al. (2002).

3.2.2.2 Pre-testing and Enumerators

Before the survey, the questionnaire was discussed with stakeholders and key informants such as local government officials (district and sub-district) and farmers. After getting comments and reviews from them, pre-testing was conducted involving farmers and enumerators. After getting feedback from farmers and enumerators, the questionnaire was revised.

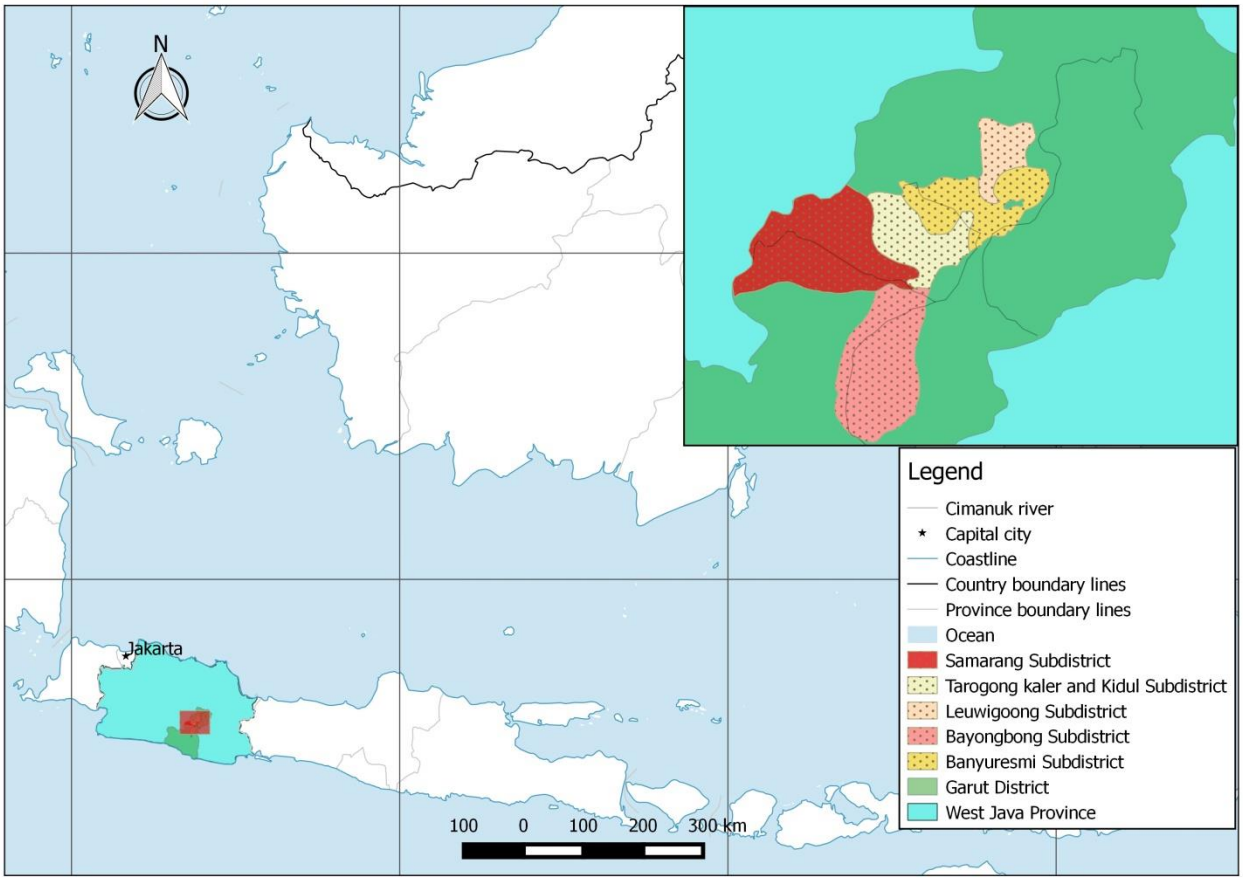
Three enumerators were recruited to carry out the survey. All of the enumerators were local people who were familiar with the local culture, and they also spoke in the same language with the locals. Therefore, it would minimize potential misunderstandings between enumerators and farmers during the survey. The enumerators were trained during the pre-testing of the questionnaire (14 days). During pre-testing, they learned the content of each part of the questionnaire and how the questions were asked to farmers.

3.2.2.3 Sample Selection

The field survey was conducted from August to October 2017 and February 2018 in the north of Garut District. There are 21 sub-districts in the upstream, midstream, and downstream areas of the Cimanuk River. Respondents were selected using multistage cluster sampling. Steps of the multistage cluster sampling were as follows: First, the 21 sub-districts were grouped into three areas: upstream, midstream, and downstream areas. Second, two sub-districts were randomly selected from each of these three areas (upstream, midstream, and downstream). Third, from each sub-district, two villages were randomly chosen. Fourth, from each village, the respondents were randomly selected.

The sub-districts sampled are Samarang and Bayongbong in the upstream area, Tarogong Kidul and Tarogong Kaler in the midstream area, and Banyuresmi and Leuwigoong in the

downstream area (Figure 3.3). These sub-districts are located at different altitudes like 973 masl of Bayongbong and 815 masl of Samarang in the upstream area, 731 masl of Tarogong Kaler and 714 masl of Tarogong Kidul in the midstream area, and 698 masl of Banyuresmi and 638 masl of Leuwigoong in the downstream area (CBS, 2016). Due to high altitude, many crops can be planted in Bayongbong and Samarang compared to those in other areas (midstream and downstream). Main agricultural products, the number of farmers and villages of the selected sub-districts are presented in Table 3.2.



Source: BIG (2017).

Figure 3.3 Study area

Table 3.2 Characteristics of selected sub-districts

Sub-district	Altitudes (masl)	Number of Farmers	Number of Villages	Main Agricultural Products
Downstream				
Leuwigoong	638	7,794	8	Rice, corn, tomato, chili, cauliflower, bean, cucumber
Banyuresmi	698	8,022	15	Rice, corn, tomato, chili, cauliflower, bean, cucumber
Midstream				
Tarogong Kaler	731	5,448	13	Rice, corn, tomato, chili, cauliflower, bean, cucumber
Tarogong Kidul	714	2,613	12	Rice, corn, tomato, chili, cauliflower, bean, cucumber
Upstream				
Samarang	815	4,829	13	Rice, corn, groundnut, soybean, cassava, potato, cabbage, chili shallot, tomato, celery, mustard, bean
Bayongbong	973	7,794	18	Rice, corn, groundnut, soybean, cassava, potato, cabbage, chili shallot, tomato, celery, mustard, bean

Source: CBS (2016).

The number of respondents was calculated using an equation as follows:

$$N = \frac{Z^2(P) \times (1 - P)}{CI^2} = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.075^2} \tag{3.1}$$

where Z is the confidence level, CI is the level of margin error, and P is the degree of variability. By using a 50 percent degree of variability, 95 percent confidence level (Z = 1.96), and 7.5 percent margin error, the total number of farmer respondents was around 180-240 farmers.

There are differences in the number of farmers taken in each analysis. Farmers who had not yet utilized agricultural production cost insurance (240 farmers) were taken to analyze rice farmers' risk management by cropping pattern diversification. Meanwhile, 180 farmers who had not yet utilized agricultural production cost insurance were taken for investigating the determinants of farmers' decisions on risk coping strategies. There were 240 farmers for investigating farmers' willingness to pay for agricultural production cost insurance. The farmers taken as respondents were both farmers who had already utilized and not yet utilized agricultural production cost insurance with the same proportion. For farmers' satisfaction with agricultural production cost insurance, 180 farmers who had already utilized agricultural production cost insurance were taken. Table 3.3 presents the number of respondents for each analysis.

Table 3.3 Number of respondents

Analysis	Respondents		Number of Respondents	
	Farmers had not yet utilized agricultural production cost insurance	Farmers had already utilized agricultural production cost insurance	Per village	Total
Chapter 5. Rice farmer's risk management by cropping pattern diversification	✓	-	40	240
Chapter 6. Determinants of farmers' decisions on risk coping strategies	✓	-	30	180
Chapter 7. Farmers' willingness to pay for agricultural production cost insurance	✓	✓	40	240
Chapter 8. Farmers' satisfaction with agricultural production cost insurance	-	✓	30	180

Source: Author.

3.3 Data Analysis

A comparative study of agricultural insurance implementation in Indonesia and other countries was conducted to answer the first objective, as described in Chapter 4. In Chapter 5, Cluster Analysis (CA) and Principal Component Analysis (PCA) were used to investigate the influence of farmers' motivation for farming, risk behavior, and risk perception on cropping pattern diversification and their association. Three econometric models, namely the binomial logit model, Zero Truncated Poison Regression Model (ZTPRM), and multinomial logit model, were applied to investigate determinants of farmers' decision on risk coping strategies in Chapter 6. As shown in Chapter 7, the Contingent Valuation Method (CVM) and the logit model were used to estimate farmers' WTP for agricultural production cost insurance. In Chapter 8, probit adapted ordinary least square (POLS) is used to examine farmers' satisfaction with agricultural production cost insurance.

CHAPTER 4. IMPLEMENTATION OF AGRICULTURAL PRODUCTION COST INSURANCE IN INDONESIA: A COMPARISON WITH AGRICULTURAL INSURANCE SCHEMES AND INSTITUTIONAL ARRANGEMENTS IN DEVELOPING COUNTRIES

4.1 Introduction

Farmers use a variety of strategies to overcome risks. These are categorized as informal (individual- or community-based) and formal strategies (provided by the public or market-based). One of the ex-ante coping strategies is agricultural insurance as the formal strategy provided by the public. According to FAO (2011), there are several benefits of agricultural insurance. These include reducing the potency of falling into the poor, sustaining rural enterprises (farming), and preventing loan default. Purchasing agricultural insurance can enhance farmers' access to credit provided by financial institutions. In some countries, agricultural insurance can be used as collateral. In many cases, financial institutions will be more willing to give credit to farmers if their farming is protected by agricultural insurance.

Currently, there is a growing concern about the possibility of agricultural insurance to reduce risks, particularly in developing countries. In Indonesia, agricultural insurance has been implemented since 2015. The type of agricultural insurance is production cost insurance. To understand agricultural production cost insurance implementation in Indonesia, it is important to review the scheme and institutional arrangements and identify its strengths and weaknesses. Therefore, the present study has two objectives: The first is to review the scheme and institutional arrangements of agricultural production cost insurance in Indonesia; and the second is to investigate its strengths and weaknesses.

The implementation of agricultural production cost insurance in Indonesia will be compared to those in India and the Philippines. The reason for taking these countries as samples is that they are also located in the Asia-Pacific region, meaning they are similar in terms of exposure to risks.

Moreover, these countries have a similar economic level, and the agriculture sector is still an essential sector in the countries (FAO, 2011).

The study is divided into three stages. The first stage is a review of agricultural production cost insurance implementation in Indonesia, including its establishment, scheme, institutional arrangements, and farmers' participation in the insurance. The scheme of the insurance covers premium, coverage, guaranteed yield, subsidy, insurance products, and so on. The institutional arrangements are the role of the central and local governments, implementing agencies, financial institutions, farmers, and farmer groups. The second stage is an explanation of agricultural insurance implementation in India and the Philippines. The third stage is a comparison of schemes and institutional arrangements among Indonesia, India, and the Philippines. The agricultural insurance in the period 2015-2016 will be compared. This period has been selected because agricultural production cost insurance in Indonesia was implemented in 2015. Moreover, because rice is the only crop covered by agricultural production cost insurance in Indonesia, the insurance scheme for rice is the scheme that will be analyzed.

4.2 Agricultural Production Cost Insurance in Indonesia

4.2.1 Establishment Process

The effort to implement agricultural insurance in Indonesia began in 1982 (Sumaryanto & Nurmanaf, 2007). Three ad hoc teams (in 1982, 1984, and 1985) were formed by the government involving stakeholders to formulate an agricultural insurance scheme. However, during this period, agricultural insurance was not a priority program in the agriculture sector. In fact, between 1984 and 1996, Indonesia achieved rice self-sufficiency (rice production exceeded total consumption) (UNDP, 2001). This condition made it relatively unimportant for the government to implement agricultural insurance. In 1999, when rice production reduced significantly after the economic crisis, the implementation of agricultural insurance became a priority program for the government. Several discussions were conducted among stakeholders concerning agricultural

insurance implementation. However, for several reasons, including the economic situation and the readiness of institutions, the government postponed agricultural insurance implementation (Sumaryanto & Nurmanaf, 2007).

In 2008, the Ministry of Agriculture initiated a study concerning the possibility of agricultural insurance implementation in Indonesia. The study recommended a regulation that could serve as the basic law to implement agricultural insurance. In the same year, public hearings were implemented in two districts: Simalungun District of North Sumatera Province and Tabanan District of Bali Province. The objective of the public hearings was to analyze the responses of farmers and other stakeholders and to provide a clear picture of agricultural practices in Indonesia. Based on the public hearing in Tabanan, the farmers' participation in agricultural insurance was estimated to be around 75 percent. Nevertheless, only 35 percent of farmers could afford to a 100 percent premium (Insyafiah & Wardhani, 2014).

During the period 2005-2010, the impacts of climate change began to hamper the agriculture production. In this period, the losses of the rice farmers increased dramatically, owing to natural disasters and pests and diseases. To minimize the adverse impacts of disasters, the government decided to allocate a budget to compensate for the harvest failures. The objective of the budget allocation was to maintain food security. The policy was strengthened by Presidential Instruction No.5/2011, Securing National Rice Production to Deal with Extreme Climate Conditions. This budget allocation policy encouraged the implementation of agricultural insurance.

The Ministry of Agriculture implemented agricultural insurance pilot projects during the period 2013-2014. The objectives of these pilot projects were to enhance farmers' awareness of minimizing the impacts of risks in farming by utilizing agricultural insurance and to improve the skills and knowledge of farmers in farm management. The type of insurance was agricultural production cost insurance. The budget of the first pilot project was funded by Japan International Cooperation Agency (JICA) and three state enterprises (as part of their Corporate Social Responsibilities (CSR)): PT Pupuk Sriwijaya, PT Pupuk Kujang, and PT Petro Kimia Gresik.

The insurance company chosen as the agricultural insurance provider was PT Jasindo, a state-owned company in the insurance business (Insyafiah & Wardhani, 2014; Bappenas, 2013).

Three pilot projects were implemented (Bappenas, 2013). The first pilot project was implemented from October 2012 to March 2013. The target area was 3,000 ha, and it was implemented in three districts: Oku Timur District (South Sumatera Province), Tuban District, and Gresik District (East Java Province). However, in this pilot project, the area that could be covered by the agricultural insurance was only around 623.12 ha. The premium was Rp180,000/ha, and the amount of indemnity was Rp6,000,000/ha. Around 80 percent of the premium was paid by the state-owned companies' CSR and JICA, and farmers paid 20 percent of the premium. The loss ratio was extremely high, at around 857 percent.

The second pilot project was implemented from October 2013 to March 2014 in three districts: Oku Timur District (South Sumatera Province), Nganjuk District, and Jombang District (East Java Province). The second pilot project had a similar scheme to the first one. The area covered by the insurance was around 2,202.87 ha, and the loss ratio was lower than that of the first project, at around 68 percent. In the first and second pilot projects, the major weakness was that the insurer did not have experts on agricultural production because agricultural insurance was not the main business of PT Jasindo, the insurer. Moreover, all areas involved in the pilot projects had equal risks. Thus, the insurer failed to distribute the risks from the areas that had higher risks to lower risks (Insyafiah & Wardhani, 2014; Bappenas, 2013).

The third pilot project was implemented from November 2013 to April 2014 in Jombang District and Nganjuk District (East Java Province). It was different from the previous two pilot projects as JICA fully funded it. The third pilot project was better planned, and there were agricultural insurance experts involved. The area covered was 1,436 ha of the target of 1,500 ha. The loss ratio was relatively low, at around 12.6 percent. This happened due to several reasons, like the availability of experts in loss assessment and enough human resources in the field of monitoring and evaluation (Insyafiah & Wardhani, 2014; Bappenas, 2013).

After implementing these pilot projects, the government issued Law No.19/2013, the Protection and Farmer Empowerment Act. According to Article 37, the central and local governments have to protect agriculture production through agricultural insurance. This is the basic regulation for the central and local governments when implementing agricultural insurance in Indonesia. At the end of 2015, the first agricultural production cost insurance, known as *Asuransi Usahatani Padi* (AUTP), was implemented in around 60 districts across 17 provinces. Agricultural production cost insurance only covers the production cost and is limited to rice. Agricultural production cost insurance was selected to minimize the problem faced by conventional agricultural insurance programs (indemnity-based and yield-based agricultural insurance), particularly moral hazard problems.

4.2.2 Agricultural Insurance Scheme

Currently, agricultural insurance in Indonesia for smallholder farmers is only limited to rice and cattle (presented in Table 4.1). The type of agricultural insurance for rice is production cost insurance. This means that the indemnity is equal to the value of the cost of rice production. The indemnity is set equally for all regions (34 provinces) at Rp6,000,000/ha ($444.44/ha). Farmers who own a maximum of 2 ha of farmlands (smallholder farmers) can purchase the insurance. The premium is set at about 3 percent of the production cost, and the government subsidizes around 80 percent of the premium. The guaranteed yield is 25 percent of average production. This means

Table 4.1 Agricultural insurance for rice and cattle

Insurance Product	Insurer	Type of Implementation	Agriculture Product	Sum of Insured	Premium (Percentage of Indemnity)	Premium Subsidy
Rice Insurance	PT Jasindo	Voluntary	Rice	The cost of production, which is equal to Rp6,000,000 per hectare.	3%	80%
Cattle Insurance	PT Jasindo	Voluntary	Cattle	The average of market value, which is equal to Rp10,000,000 per head of cattle.	2%	80%

Source: MoA (2017b, 2017c).

that the indemnity will be paid by the insurer if the percentage of damage is more than 75 percent by natural hazards, including floods, droughts, and pests and diseases (MoA, 2017a). For cattle insurance, the indemnity is equal to the average value of the cattle aged over one year, which is equal to Rp10,000,000 ($740.7). The premium is set at around 2 percent of the indemnity, and the amount of subsidy is 80 percent of the premium (MoA, 2017b).

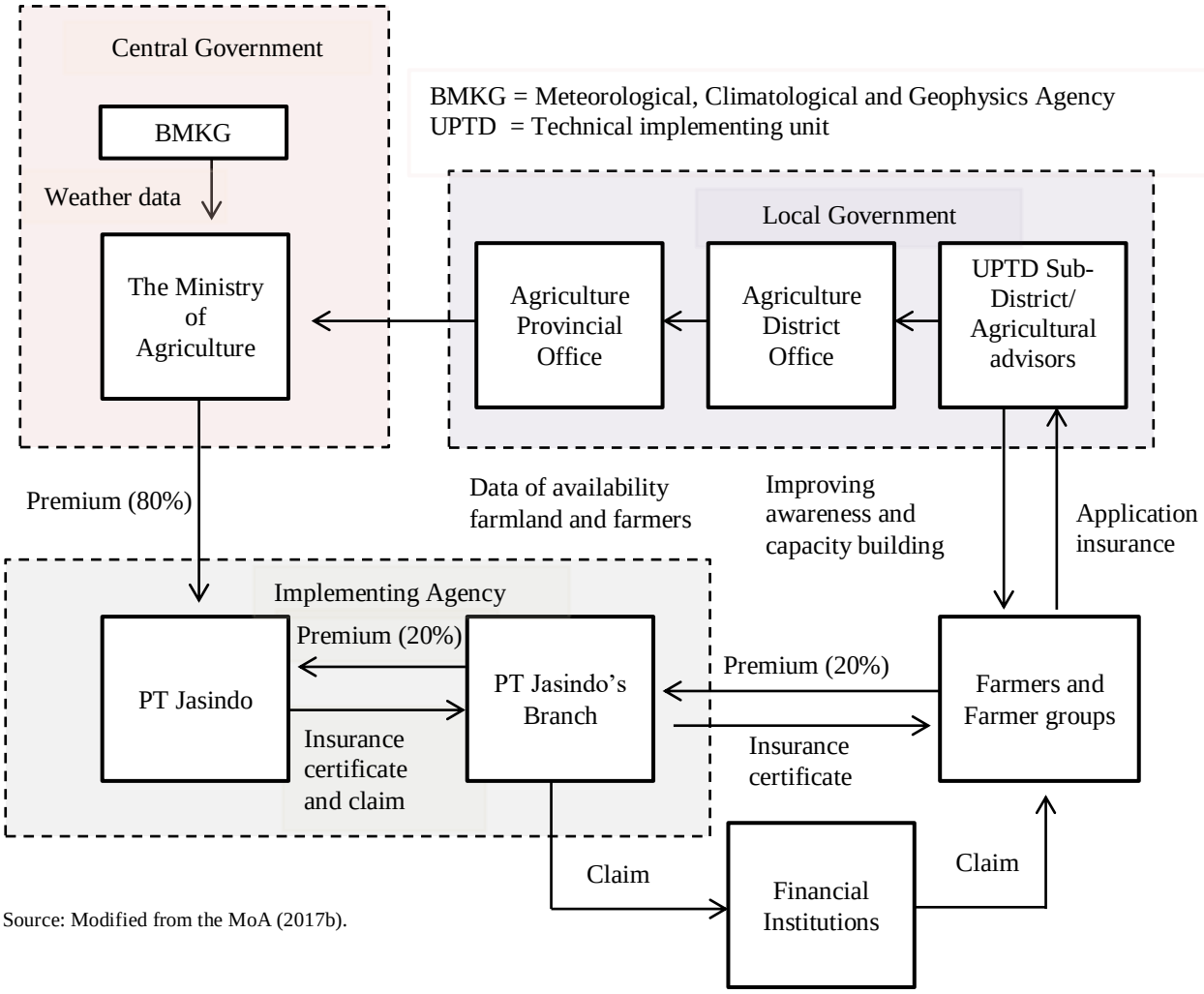
4.2.3 Institutional Arrangements

There are four stakeholders (presented in Figure 4.1) involved in the agricultural production cost insurance implementation: the central government (MoA and BMKG), the local government (provinces and districts), the implementing agency, and farmers and farmer groups.

According to the guidance of the agricultural production cost insurance implementation issued by the MoA (2017b, 2017c), the central and local governments have crucial roles. The central government, through the MoA, has a responsibility to direct the agricultural production cost insurance policy. It includes setting the target area of farmland to be covered in the insurance and making the criteria by which farmers can be involved in the insurance. Furthermore, the central government provides the budget for the premium subsidy and other activities related to the agricultural production cost insurance implementation, such as monitoring, improving farmers' awareness, and research and development.

The function of the local government (provinces and districts) is similar to that of the central government, except for making policy direction. The local government should provide a budget for the premium subsidy. Currently, the source of the subsidy comes from either the central or local governments.[8] The local government is responsible for collecting data about farmers and farmlands that are permitted to be covered in agricultural production cost insurance and to make endorsements on which farmers are eligible to be covered and given the subsidy. The result of the assessment is reported to the MoA. Moreover, evaluation of the agricultural insurance

[8] A few districts can provide the subsidy (such as Purwakarta District), and most districts use the subsidy from the central government.



Source: Modified from the MoA (2017b).

Figure 4.1 Institutional arrangements

implementation at the province and district levels is also conducted by the local government.

Regarding implementing agencies, based on the Law No.19/2013 article 38, it is stated that the central and local governments should use the state or local government-owned enterprises to implement agricultural production cost insurance. Currently, because there are no local governments that implement agricultural production cost insurance independently, the insurance is fully implemented in all regions by PT Jasindo, a central government-owned enterprise. The responsibility of PT Jasindo as the implementing agency is to manage the premium from farmers

and the subsidy from the government, issue the insurance certificate for farmers, report to the local government concerning the insurance purchased by farmers, and pay the claim. To enhance services, PT Jasindo has branch offices, which provide services for two to three districts.

Farmers who are willing to purchase agricultural production cost insurance can be individuals or a farmer group. Currently, most of the farmers are forming farmer groups, which will coordinate all members to submit an application to the insurer and to pay the premium. When there are claims, the farmer group will coordinate the claims.

4.2.4 Farmers' Participation Rate

The target farmlands covered by the insurance is 1 million ha annually or around 12.3 percent of the total rice field (8.1 million ha). However, in the first season of implementation (October 2015 to January 2016), the area of rice fields covered by insurance was only around 233,397 ha (23.3 percent from the target area). Data in 2017 confirms that the accumulative farmland covered was about 555,866 ha (50.9 percent of the target) or 185,288 ha/cropping season. Even though there was an increase in the area of farmland covered, it was still below the target area (1 million ha/year).

Table 4.2 presents farmlands covered by agricultural production cost insurance in 2017 in 28 provinces. Among the targeted provinces, East Java Province and Central Java Province had the largest farmlands covered by the insurance, around 131,921.41 ha and 131,678.46 ha, respectively. Even though West Java Province had the largest targeted farmlands covered by the agricultural production cost insurance (304,000 ha), only 112,213.78 ha of farmlands were covered by the insurance (36.9 percent). The provinces that could fulfill the target were mostly located outside Java Island, namely West Kalimantan (230.9 percent), Central Kalimantan (196.6 percent), South East Sulawesi (518 percent), and Bali (150.6 percent). Meanwhile, though Papua Province was not targeted, there were around 42.3 ha of farmland covered by the insurance.

Table 4.2 Farmlands covered by agricultural production cost insurance in 2017

No	Province	Target (ha)	Realization (ha)	Percentage (%)
1	Aceh	100,000	833.21	0.83
2	North Sumatera	30,000	15,774.13	52.58
3	West Sumatera	35,000	7,785.35	22.24
4	Riau	10,000	505.25	5.05
5	Jambi	5,000	1,799.72	35.99
6	Bengkulu	1,000	94.50	9.45
7	South Sumatera	50,000	22,568.65	45.13
8	Lampung	25,000	5,565.24	22.26
9	Bangka Belitung	3,000	477.75	15.92
10	Banten	32,000	4,895.24	15.29
11	West Java	304,000	112,213.78	36.91
12	Central Java	180,000	131,678.46	73.15
13	D.I Yogyakarta	15,000	1,723.92	11.49
14	East Java	155,000	131,921.41	85.11
15	Bali	11,000	16,571.62	150.65
16	West Nusa Tenggara	10,000	9,597.70	95.97
17	South Kalimantan	20,000	24,185.06	120.92
18	West Kalimantan	10,000	23,099.44	230.99
19	Central Kalimantan	10,000	19,658.82	196.58
20	East Kalimantan	2,000	890.08	44.50
21	South Sulawesi	60,000	8,635.08	14.39
22	Central Sulawesi	10,000	3,324.42	33.24
23	West Sulawesi	2,000	65.90	3.29
24	North Sulawesi	2,000	0	0
25	South East Sulawesi	2,000	10,360.74	518.04
26	Gorontalo	5,000	1,599.00	31.98
27	East Nusa Tenggara	1,000	0	0
28	Papua	0	42.3	-
Total		1,090,000	555,866.77	50.99

Source: MoA (2018).

4.3 Agricultural Insurance in India and the Philippines

4.3.1 Agricultural Insurance in India

4.3.1.1 Agricultural Insurance Scheme

The first agricultural insurance implementation in India was in 1972. It was implemented under the General Insurance Corporation of the Life Insurance Corporation of India (GIC). The insurance used individual data for determining the standard yield and calculating the percentage of loss. Initially, the insurance was limited only to cotton, and it was implemented in Gujarat

(Agricultural Finance Corporation, 2011; LARRDIS, 2015; Singh, 2004).[9] However, in the first six years of its implementation (1972-1978), the number of farmers involved in the insurance program was relatively low, at around 3,110 persons, and the loss ratio was quite high at around 834 percent (Agricultural Finance Corporation, 2011). This failure occurred owing to the use of the individual-level data. The individual approach faced several difficulties. First, there was no data available at the individual level. Thus, it was difficult to estimate the average yield of each farmer to determine the coverage and the premium. Second, there were many farming practices and climatic conditions. Third, it needed a lot of effort to pick up the premium from a large number of farmers. Hence the administration cost was remarkably high (AIC, 2016).

In 1979, there was an effort to increase the performance of agricultural insurance by using a new approach called homogenous area, in which the data used to determine the average production came from certain areas that had similar characteristics in terms of risks. This system was useful when the individual data could not be identified properly. Some pilot projects using the new approach were implemented in several areas, which were called the Pilot Crop Insurance Scheme (PCIS). In the PCIS, insurance coverage was increased from 100 percent to 150 percent of the standard yield. The government subsidized 50 percent of the premium, and the premium and claim were shared between the GIC and the state government at a 2:1 proportion

[9] According to Singh (2004), the first effort to implement agricultural insurance in India was initiated in 1947 by conducting a feasibility study. The Indian Council of Agricultural Research (ICAR) carried out an agricultural insurance implementation pilot project. The pilot project was implemented in five years in four states, namely Bombay, Madras, Uttar Pradesh, and Madhya Pradesh. Four agriculture products were covered in the project: rice, wheat, sugarcane, and cotton. The indemnity was 50 percent of the historical yield, and the guaranteed yield was 75 percent of the normal yield in those areas. The premium was around 2.5 to 4.5 percent for cotton, and 3 to 5 percent for wheat, rice, and sugarcane. In 1965, the government initiated formalization of the implementation of agricultural insurance by proposing a crop insurance bill that allowed all states to implement agricultural insurance in their region. However, it took seven years for the government to implement the bill owing to many considerations, including economic conditions.

(Agricultural Finance Corporation, 2011; LARRDIS, 2015; Singh, 2004).[10] The PCIS was implemented in 13 states, and the number of farmers participated in the PCIS increased dramatically from the previous scheme (individual approach) to around 627,000. Moreover, the scheme successfully reduced the loss ratio to around 79 percent (Agricultural Finance Corporation, 2011).

From 1985 to 1999, there was an improvement in the insurance scheme. The scheme was called the Comprehensive Crop Insurance Scheme (CCIS) (Agricultural Finance Corporation, 2011).[11] According to Singh (2004), the CCIS had three objectives. The first was to support the financial capacity of farmers in the occurrence of natural hazards. The second was to prevent the failure of credit payment. The third was to increase agricultural production, particularly pulses, cereals, and oilseeds. Many institutions were involved in the CCIS, including the GIC, the central government, several state governments, and financial institutions. The CCIS was conducted in 16 states, and around 7.62 million farmers (cumulatively) were involved. Nevertheless, the loss ratio was quite high, at about 570 percent. This occurred because there were some successive natural hazards in large areas during the implementation. Another problem was that many states could not provide the Crop Cutting Experiment (CCE) data properly. To estimate the premium and coverage, it needed a minimum of 16 CCEs per block (tehsil), but in many cases, the data were taken from less than 16 CCEs (Agricultural Finance Corporation, 2011; LARRDIS, 2015).

The government implemented a new agricultural insurance scheme called the National Agricultural Insurance Scheme (NAIS) in 1999. The agricultural products that could be insured were those which had data of historical yield (IRDA, 2015). Generally, the agricultural products were divided into three categories: food crops, oilseeds, and annual commercial crops. The

[10] The PCIS was linked with banks' credit to reduce the failure on credit payments. It was on a voluntary basis, but farmers who could purchase the insurance were only borrowing farmers.

[11] The CCIS used the homogenous area approach (similar to the PCIS). However, the CCIS was compulsory for borrowing farmers.

commodities covered in the insurance and premium were differentiated based on the season (AIC, 2016).[12] Moreover, the scheme was compulsory for borrowing farmers and voluntary for others (Reddy, 2004). The insurance under the NAIS could cover 100 to 150 percent of the loan and could be increased from 100 to150 percent of the standard yield. The total number of farmers purchasing the insurance until the end of the scheme implementation was around 221 million. However, the loss ratio was high, at around 320 percent (LARRDIS, 2015). According to the Agricultural Finance Corporation (2011), there were some factors influencing the failure of the NAIS. First, the value of the premium was too low. Second, the unit to determine the average yield was too large, and it could not describe the historical yield of individual farmers. Third, most of the data were collected from the previous five years. As a result, they may not have reflected the individual yield. Fourth, the average indemnity for essential crops was only 60 percent of the average yield, which reduced the attractiveness of the insurance.[13]

The government finally revised some rules and launched a new scheme, the Modified National Agricultural Insurance Scheme (MNAIS), to improve the performance of the NAIS.[14] Some weaknesses in the NAIS were revised in order to make the scheme more efficient (GIZ, 2013; LARRDIS, 2015). To improve the quality of measurement in determining the average yield, the MNAIS used the data at village levels and were taken from the preceding seven years of production by excluding the maximum of two years with catastrophes. The minimum number

[12] There were around 35 crops during the Kharif season (April-September) and 40 crops during the Rabi season (October-March) (AIC, 2016).

[13] During the implementation of the NAIS, the government also implemented an income insurance scheme, the Pilot Farm Income Insurance Scheme (FIIS). The scheme was appropriate for all types of farmers, and the only commodities insured were wheat and rice. The government subsidized the premium ranging from 50 to 75 percent. The number of farmers involved in the scheme was around 200,000, and the loss ratio was approximately 101 percent (Agricultural Finance Corporation, 2011).

[14] Even though there was the MNAIS, the NAIS scheme was still implemented in several states until 2013 (IRDA, 2015).

of CCEs was four.[15] In the MNAIS, the indemnity level was increased from a minimum of 60 percent to 70, 80, and 90 percent of the average yield, depending on the farmer's choice. In this scheme, the private insurance companies were allowed to be involved, and therefore the market was more competitive. The number of farmers who participated in the insurance until 2015 was around 179 million (LARRDIS, 2015; MoAI, 2013).

The Government of India launched the National Crop Insurance Program (NCIP) in 2013. The program was an effort to merge all agricultural insurance schemes, which consisted of the MNAIS with two other insurance schemes, the Coconut Palm Insurance Scheme (CPIS)[16] and Weather Based Crop Insurance Scheme (WBCIS)[17]. The NCIP was compulsory for borrowing farmers and voluntary for non-borrowing farmers. The premium, indemnity, and guaranteed yield were determined by the ten-year historical CCE data. If the historical data was not available, the nearest CCEs' data were used. The farmers that could purchase the insurance included sharecroppers, tenants, and individual growers. In the NCIP, the indemnity increased to 80 to 90

[15] The CCE data could also be collected at the *mandal*, *taluka*, and district level. The minimum number of CCEs for the *mandal*, *taluka*, and district level must be 10, 16, and 24, respectively.

[16] The CPIS was the insurance to cover the coconut product. It is essential to protect coconut trees with insurance because their characteristics are vulnerable to natural hazards and pests and diseases. Moreover, growing coconut trees generally use rain-fed management, and hence will be influenced by many factors, both biotic and abiotic. Coconut palm trees can be covered from the age of 4 to 60 years. The sum of insurance and premium was differentiated into two groups: 4 to 15 years and 16 to 60 years. In contrast to other schemes, around 50 percent of the premium was paid by the Coconut Development Board (CBD) and 25 percent by the state government and farmers, respectively (IRDA, 2015; MoAI, 2013).

[17] The WBCIS was an insurance to prevent financial loss due to the negative impacts of the changes on weather parameters, such as excessive rainfall, temperatures, and humidity disturbances. The WBCIS could be used to cover agricultural products, including cereals, millets, oilseeds, and pulses. The scheme was compulsory for borrowing farmers and voluntary for non-borrowing farmers. Moreover, the farmers could choose their insurance, whether under the MNAIS scheme or the WBCIS scheme. The premium was set at 8 to 12 percent, and the subsidy was paid equally by the central and state government (IRDA, 2015; MoAI, 2013).

percent of the standard yield (LARRDIS, 2015; MoAI, 2013).

4.3.1.2 Institutional Arrangements

Agricultural insurance in India is implemented by the AIC, a state-owned company (GFDRR, 2011). The main responsibility of the AIC is to develop agricultural insurance systems using a scientific basis, increase services, and improve farmers' awareness (AIC, 2016). Therefore, not only does the AIC have the capacity to implement agricultural insurance, but it also acts as a research institution. In addition, in the NCIP, the implementing agency is not only the AIC but also private companies, which implement agricultural insurance using a similar scheme to the AIC (MoAI, 2013).[18]

The central and state governments have several roles in the implementation of agricultural insurance. The main responsibility of the central government is to provide the direction of the agricultural insurance program. The central government is also responsible for providing the premium subsidy, conducting reinsurance, and monitoring and evaluation. The state government, besides providing the share of the premium along with the central government, has crucial functions in the implementation of agricultural insurance. These include providing the data of the historical yield, making decisions regarding which agricultural products can be covered in agricultural insurance, and determining areas for the WBCIS (Sinha, 2007). The state government also conducts monitoring and evaluation through the State Level Coordination Committee on Crop Insurance (SLCCI), an agency established at the state level involving related stakeholders in agricultural insurance. The SLCCI has a responsibility to select the private companies which will implement the MNAIS and the WBCIS (MoAI, 2016).

Financial institutions have crucial roles in agricultural insurance implementation in India. Not only do they act to collect the insurance application and the premium, but they also consolidate the areas and agricultural products that can be covered in agricultural insurance

[18] During the implementation of agricultural insurance, there were several changes to the implementation unit. The first institution was the GIC in 1972. In 1999, for the implementation of the NAIS, the AIC was set up.

(World Bank, 2007). Financial institutions are also responsible for managing the payment of claims and issuing insurance certificates, including coverage of the list of benefiting farmers (Sinha, 2007). The financial institutions could be regional rural banks, commercial banks, and cooperative banks (MoAI, 2013).

Farmer groups have an essential function in the implementation of agricultural insurance. Their function is to coordinate farmers who are willing to purchase agricultural insurance. The responsibility of an insured farmer is to submit the proposal and premium to a financial institution as well as to the farmer groups (MoAI, 2013).

4.3.2 Agricultural Insurance in the Philippines

4.3.2.1 Agricultural Insurance Scheme

The government of the Philippines started to implement agricultural insurance in 1981. The first agricultural product to be covered by the insurance was rice, and afterward, corn in 1982, tobacco in 1991, and High-Value Commercial Crops (HVCC) in 1993 (Reyes & Domingo, 2009). Livestock insurance was implemented in 1988 under the Philippines Livestock Management Service Corporation (PLMSC), which consisted of 14 private insurance companies (Reyes et al., 2015). Furthermore, in 1996, the PCIC implemented a new type of insurance to maintain farmers' assets, such as equipment, machinery, building, transportation facilities, and others, called Non-Crop Agricultural Asset (NCAA). In 2005, the term insurance power package was implemented. The insurance was to cover accidents and repayment of farmers', fishers', and other stakeholders' bank credit (PCIC, 2017f; Reyes et al., 2015). In 2011, the PCIC launched fishery insurance. This insurance provides protection for several types of fish structures, including fish cages, ponds, and pens. Through fishery insurance, fish growers are protected from the reduction of fish stock due to natural hazards (PCIC, 2017b). The last type of insurance was the RSBSA insurance, initiated in 2015. Farmers who can participate in the RSBSA insurance are farmers and fishers registered in the Registry System for Basic Sectors in Agriculture (RSBSA) (PCIC, 2017a).

Rice insurance is the major product of agricultural insurance. The insurance covers not only the cost of production but also the expected yield, which can reach 120 percent of the standard yield. The insurance premium is divided based on the type of farmers in terms of financing the crops, risk covered, and risk group. There are two types of farmers: borrowing farmers and self-finance farmers. Regarding the risk covered, there are two types of risks covered: multi-peril risks and natural hazards. Meanwhile, the risk group is divided into three categories: low, middle, and high. For example, for borrowing farmers choosing the coverage of multi-peril risks, the premium values range from 9.4 percent to 12.3 percent of the sum insured, while if they select to cover risks only from natural hazards, the range of the premium is lower, from 6.8 percent to 9.1 percent. The premium subsidy for borrowing farmers is higher than that of self-financed farmers because there is an additional subsidy from the lending institutions for borrowing farmers which is around 63 percent to 84 percent. In contrast, the subsidy for self-financed farmers is only around 46 percent to 63 percent (PCIC, 2017d).

Corn insurance is the second major agricultural insurance product in the Philippines, comprising approximately 15 percent of the agricultural insurance market (Bangsal & Mamhot, 2012). The scheme of the insurance is generally the same as that of the rice insurance, in which the premium is divided based on the type of farmers in terms of financing the crop, risk covered, and the risk group. For instance, the premium for borrowing farmers with the multi-peril risk covered is about 16.4 percent to 22.1 percent of the sum insured, while for natural hazards, the premium range is around 11.4 percent to 15.2 percent. The premium subsidy for borrowing farmers is around 63 percent to 83 percent, while the subsidy for self-financed is lower at around 48 percent to 66 percent. The minimal coverage is the production cost of corn, which can be increased to 120 percent of the standard yield (PCIC, 2017c).

Livestock insurance protects the death of livestock due to accidents, diseases, and other risks that affect livestock production. Livestock, such as horse, carabao, goat, swine, and poultry, can be covered by the insurance, and are divided into two types: non-commercial and commercial.

The sum insured is differentiated based on the purpose, species, and age of the livestock. The insurance is voluntary for both borrowing and non-borrowing farmers (PCIC, 2017e).

HVCC insurance has an objective to cover the standing crops in farmland. This insurance protects the cost of production and the expected yield, which can reach 120 percent of its expected value. The duration of insurance is from planting to harvesting. The premium ranges from 2 percent to 7 percent of the sum insured, which varies among products and depends on several factors such as the type of soil, agro-climatic condition, farm management practices, and loss and production records (PCIC, 2017e).

Fishery insurance is to cover the loss of stock in a fishery farm due to natural hazards. The insurance comprises the costs of production stated in the Fishery and Farm Plan and Budget (FFPB). The coverage period is from the stocking up to the harvest. The premium varies across the type of fishery farm, agro-climatic condition, and historical loss and production. Those who are eligible to be covered are individual farmers (both non-borrowing and borrowing farmers), farmer cooperatives, and farmer groups (PCIC, 2017d).

NCAA Insurance is insurance to cover equipment, machinery, and transportation facilities used in agricultural activities such as production, distribution, and marketing; for example, tractor, trailer, truck, warehouse, machinery, and so on. The premium for equipment ranges from 1 percent of the sum insured to a maximum of ₱1,000 if the value of the equipment is remarkably high. For cars and machinery, the premium ranges from 1 percent of the sum insured to a maximum of ₱3,000 (PCIC, 2017f).

Credit life term insurance consists of three types of insurance: Loan Repayment Protection Plan (LRP2), Accident and Dismemberment Security (ADS), and Agriculture Producer Protection Plan (AP3). The objective of LRP2 is to guarantee the repayment of loans or credit related to agriculture finance due to the death or the total disability of insured borrowers. The insurance covers the value of loans or bank credit of farmers and fishers upon accidents causing permanent disability or death. ADS covers death and dismemberment of the insured due to an

accident. AP3 covers the death of farmers, fishers, and other stakeholders due to accident, murder, assault, and natural causes (PCIC, 2017g).

The last insurance is RSBSA insurance. The government provides a 100 percent premium for this insurance scheme. The requirement is that farmers and fishers must be registered in RSBSA, and they do not receive subsidies in any insurance programs provided by the central or local governments. There are many types of insurance in RSBSA covering rice, corn, HVCC, fishery, livestock, and non-crop insurance (PCIC, 2017a).

4.3.2.2 Institutional Arrangements

The Philippine Crop Insurance Corporation (PCIC) implements agricultural insurance in the Philippines, established by the government in 1978 (PCIC, 2015). PCIC is a business corporation that is operated without government support (Bangsal & Mamhot, 2012). From 1978 to 2009, the PCIC was only the institution that implemented agricultural insurance. In 2009, a new institution was developed to accommodate the demand for livestock insurance: the Philippine Livestock Management Service Corporation (PLMSC). The PLMSC consisted of 14 insurance companies, including the PCIC. The operation of the PCIC has been decentralized to the regional level to make its services more accessible for farmers and fishers. Currently, there are around 13 Regional Offices (RO) of the PCIC, some of which are allocated to delivering service for more than one region. Because not all areas can be serviced by the RO, the PCIC has established 33 provincial extension offices (Reyes et al., 2015).

The central and local governments have different responsibilities. The central government is responsible for making the direction of the agricultural insurance policy and providing the premium subsidy (Bangsal & Mamhot, 2012). The local government (provinces and the districts) is responsible for providing data of eligible farmlands that can be covered by the insurance, give recommendation for which farmers can purchase insurance for the RSBSA scheme, conduct loss assessment with the PCIC, and receive applications from farmers and submit them to the PCIC

(Reyes & Domingo, 2009; Reyes et al., 2015).

Financial institutions have important roles in the implementation of agricultural insurance in the Philippines. A farmer who applies for bank credit compulsorily purchases agricultural insurance, and the bank will provide some proportion of the premium subsidy. This is because the function of agricultural insurance in the Philippines is not only to protect farmers from natural catastrophes but also to reduce the risk of farmers' failures in the bank's credit payment. Agricultural insurance can be used as collateral when farmers need a loan from a bank for growing crops. Credit allocated to farmers will be more secure when they purchase agricultural insurance. This condition provides an incentive to the lending institutions to give more credit to farmers. Therefore, the government usually links agricultural insurance with credit programs (Bangsal & Mamhot, 2012).

The government and financial institutions share the insurance premium. However, the premium from the financial institutions is only provided for borrowing farmers (PCIC, 2017g). As a result, the subsidy of the premium for borrowing farmers is higher than that of self-financed farmers, as the subsidy for borrowing farmers not only comes from the government but also from the lending institution.

Farmer groups (such as irrigator associations and farmer cooperatives) are responsible for collecting and submitting an application as a group to the PCIC. Meanwhile, farmers are responsible for submitting an application to the PCIC or farmer groups. Borrowing farmers have to submit a borrowing application to a lending institution. If the application is accepted, they have to purchase insurance, and the lending institution will provide a premium subsidy.

4.4 Comparison of Schemes and Institutional Arrangements

4.4.1 Insurance Schemes

Table 4.3 shows the agricultural insurance scheme in India, the Philippines, and Indonesia. Among these countries, India was the first country to implement agricultural insurance five

decades ago. Since the implementation, India has already changed their system almost five times to enhance the effectiveness of the insurance scheme. In the Philippines, even though agricultural insurance has been implemented since 1981, there is more variety of insurance products. This includes not only crop insurance but also other types of insurance that are usually the main business of private insurance companies, such as assets, life, and loan insurance. Moreover, although the effort to implement agricultural insurance in Indonesia began in 1982, it was only actually implemented in 2015. The insurance products are only limited to rice and cattle.

Table 4.3 Comparison of agricultural insurance schemes

Component	India	the Philippines	Indonesia
First implementation	1972	1981	2015
Current insurance product (until 2016)	NCIP consisted of three schemes: 1. MNAIS 2. WBCIS 3. CPIS	1. Rice Crop Insurance 2. Corn Crop Insurance 3. HVCC Insurance 4. Livestock Insurance 5. Fishery Insurance 6. Non-Crop Agricultural Asset (NCAA) Insurance 7. Loan Repayment Protection Plan (LRP2) insurance 8. Accident and Dismemberment Security Insurance 9. Agriculture Producer Production Plan (AP3) Insurance 10. Registry System for Basic Sector in Agriculture (RSBSA)	1. Rice Insurance 2. Cattle Insurance
Rice Insurance			
Risk cover	1. Multi-Peril Risk (MNAIS/CPIS) 2. Index Basis (WBCIS)	1. Multi-Peril Risks 2. Natural hazards	Natural hazards
Method of basic data estimation	CCE minimal previous seven years. The number of CCEs is as follows: 1. Village = 4 CCEs 2. *Manda*l = 10 CCEs 3. *Taluka* =16 CCEs 4. District = 24 CCEs	Historical data	Historical data
Guaranteed yield	MNAIS Guaranteed yield is 80 percent and 90 percent from the average yield it depends on the contract.	Guaranteed yield is 90 percent from the expected yield.	Guaranteed yield is 25 percent from historical yield.

(Continued)

Component	India	the Philippines	Indonesia
Coverage	MNAIS 1. Borrowing farmers: Equal to the amount of loan and it can be increased to the value of threshold yield. 2. Non-borrowing farmers: Equal to the value of normal yield and it can reach from 100 to 150 percent the value of normal yield but without subsidy.	Equal to the amount of the production cost plus the additional covers. It depends on the farmers' option that can reach 120 percent from the average yield.	Equal to the value of production cost (Rp6,000,000/ha).
Farmland size/insurance Unit	It depends on the type of crop and level of areas (district, *mandal, taluka,* village).	No limitation except for RSBSA Insurance. In RSBSA rice field maximum of 7 ha.	Individual maximum of 2 ha
Premium	It depends on the scheme MNAIS = 2-15 percent (actuarial basis) from the sum insured.	It depends on varieties, risk of areas, and risk cover = 6.84-12.27 percent of the sum insured.	Around 3 percent of the sum insured (production cost)
Season differentiation	Season divided into two seasons, Kharip (April-September) and Rabi (October-March) and this influences the type of crops covered by the insurance and the premium value.	No differentiation	No differentiation
Subsidy (percentage of premium)	Depends on scheme MNAIS = 40-75 percent	Depends on the risk of area (low, middle, high risks) = 46.5-84.4 percent. Except for RSBSA, the subsidy is 100 percent.	80 percent
Premium subsidy composition	Depends on scheme MNAIS= Divided equally between the government and the states.	1. For borrowing farmers, the premium is divided between the government and the financial institution with the proportion government is 46.5-63 percent, and the financial institution is around 16.3-22 percent. 2. For non-borrowing farmers, the premium is only from the government (46.5-63 percent).	The subsidy is fully funded either by the central government or local governments.
Purchasing scheme	Compulsory for borrowing farmers. Voluntary for non-borrowing farmers.	Compulsory for borrowing farmers. Voluntary for non-borrowing farmers.	Voluntary

Source: Modified from ICFA (2016), LARRDIS (2015), PCIC) (2017g), Reyes et al. (2015), MoAI (2013), MoA (2017b, 2017c).

Comparing the insurance scheme for rice, each country has a different risk cover. In Indonesia, based on the guidance for agricultural insurance implementation issued by the Ministry of Agriculture (MoA, 2017b), the risk that can be covered is only natural hazards, including floods, droughts, and pests and diseases. Other risks, such as fire and theft, cannot be

covered. In the Philippines, the agriculture insurance covers two types of risks: multi-peril risks and natural hazards. The risks covered will determine the amount of the premium. The premium for multi-peril risks is higher than that for natural hazards by around 3 percent. In India, because the government implements WBCIS, there is a cover for change in climatological indicators. Meanwhile, multi-peril risks are covered by the MNAIS.

There were differences among countries in estimating basic data for determining insurance schemes (premium, guaranteed yield, coverage, and the insurance unit). In India, the data are collected from the previous seven years of CCEs' data. The number of CCEs for village, *mandal*, *taluka*, and district levels are 4, 10, 16, and 24, respectively. In Indonesia and the Philippines, the data are calculated by using historical data. In India (the MNAIS), the guaranteed yield is 80 percent and 90 percent of the standard yield, depending on the contract. Meanwhile, in the Philippines, the guaranteed yield is 90 percent of the standard yield. On the contrary, in Indonesia, it is only 25 percent. This means that indemnity will be paid if the loss is above 75 percent. Regarding coverage, in India, there are differences between borrowing and non-borrowing farmers. For borrowing farmers, the coverage is equal to the value of a loan and can be increased to the standard yield. For non-borrowing farmers, the coverage can reach the standard yield, and it increases to 100 percent to 150 percent of the standard yield, but without subsidy. In the Philippines, the coverage is the amount of the production cost plus the additional coverage that can reach 120 percent of the standard yield. Meanwhile, in Indonesia, the coverage is equal to the value of the production cost, which is Rp6,000,000/ha. Concerning the insurance unit, in India, the farmland size depends on the type of crop and the level of administration (such as district, *taluka*, *mandal*, and village). In Indonesia, the maximum farmland size that can be insured is 2 ha per farmer. In the Philippines, there is no limitation for the farmland size insured except for RSBSA (maximum 7 ha).

The insurance premium is set differently among the countries. Agricultural insurance in Indonesia provides the lowest premium rate, at around 3 percent of the sum insured (cost of

production). In India and the Philippines, the premium varies depending on the type of insurance. For example, the average premium for rice insurance in India (the MNAIS) and the Philippines is 8.5 percent and 9.5 percent of the sum insured, respectively. In India, the premium is also differentiated by season. Moreover, the three countries provide a premium subsidy to increase the affordability of the premium for farmers. Indonesia provides the highest subsidy for the premium, in which the government subsidizes 80 percent. In India, the average premium subsidy (the MNAIS) is around 57.5 percent, while in the Philippines the premium subsidy is approximately 65.4 percent.

The source of the subsidy for each country comes from different sources. In the Philippines, around 20 percent of the subsidy comes from financial institutions and around 45 percent from the government. The subsidy from financial institutions can be accessed only by borrowing farmers, and therefore the premium for borrowing farmers will be much higher than that for self-financed farmers. In India, for the MNAIS, the subsidy was funded equally by the central government and the states. In Indonesia, according to the law, the local government has a responsibility to protect agriculture businesses by providing a subsidy. Currently, the subsidy is fully funded by the central government. Concerning the policy to purchase insurance, in India and the Philippines, purchasing agricultural insurance is compulsory for borrowing farmers, while for non-borrowing farmers, it is voluntary. Meanwhile, in Indonesia, purchasing agricultural insurance is voluntary for all farmers.

4.4.2 Institutional Arrangements

As shown in Table 4.4, there are similarities and differences in the role of the central government in three countries. The function of the central government is to direct agricultural insurance policy and provide the premium subsidy. In India and Indonesia, the central government is responsible for conducting evaluation and monitoring of the program, which is the responsibility of the implementing agency in the Philippines. Moreover, the central government in India has the important role of reinsuring agricultural insurance by providing a catastrophic

fund. This will protect the implementing agency from a huge loss when hazards occur in large areas. The reinsurance program has not yet been implemented in the Philippines and Indonesia. In Indonesia, the central government makes a target of farmlands to be covered by the agricultural insurance because agricultural insurance is one of the priority programs in the agriculture sector. On the contrary, in India and the Philippines, the target of farmlands covered by agricultural insurance is the main responsibility of the implementing agency.

Table 4.4 Comparison of institutional arrangements

Institution	Country/Responsibility		
	India	the Philippines	Indonesia
Central government a. The Ministry of Agriculture	▪ Making the direction of agricultural insurance implementation ▪ Providing some proportion of premium subsidy ▪ Monitoring and evaluation. ▪ Determining the value of premium, coverage, and subsidy ▪ Providing share of claim payment ▪ Providing catastrophic fund (reinsurance)	▪ Making the direction of agricultural insurance implementation ▪ Providing some proportion of premium subsidy	▪ Making the direction of agricultural insurance program ▪ Providing some proportion of premium subsidy ▪ Monitoring and evaluation ▪ Determining the amount of premium, subsidy, and coverage ▪ Research and development ▪ Making criteria for the eligible farmers who can purchase agricultural insurance ▪ Improving farmers awareness ▪ Setting the target of covered farmlands by agricultural insurance
b. Other central government institution	Indian Meteorological Department ▪ Providing data weather condition as a reference in WBCIS		Indonesian Geophysics and Meteorological Agency (BMKG) ▪ Providing weather information as the requirement for the insurance claim
State/local government a. State/province/ district	▪ Providing data agricultural products that can be covered by insurance ▪ Providing yield data from the CCEs ▪ Conducting monitoring and evaluation ▪ Providing data on borrowing and non-borrowing farmers ▪ Determining the areas for WBCIS ▪ Approving the premium rates and coverage ▪ Providing fund for claim ▪ Sharing subsidy of premium	▪ Providing data of eligible farmlands that can be covered by agricultural Insurance ▪ Providing recommendation which farmers can purchase insurance for RSBSA scheme ▪ Receive application from the farmers and submit to the PCIC	▪ Collecting data of eligible farmlands that can be covered by agricultural insurance and reporting the data to the central government ▪ Receipt application from the farmers and submit to the implementing agency ▪ Monitoring and evaluation ▪ Improving farmer awareness ▪ Providing premium subsidy

(Continued)

Institution	Country/Responsibility		
	India	the Philippines	Indonesia
b. Other local government institutions	State Level Coordination Committee on Crop Insurance (SLCCI) ▪ Coordinating monitoring and evaluation at the state level ▪ Selecting private companies for implementing the MNAIS and the WBCIS ▪ Approving the notification of the indemnity level submitted by private insurance companies		
Implementing agency a. Main implementing agency	AIC (a state-owned company special to implement agricultural insurance) ▪ Implementing the policy of agricultural insurance program ▪ Selling insurance ▪ Operational delivery ▪ Monitoring and evaluation ▪ Loss assessment ▪ Research and development ▪ Enhancing farmers' awareness	1. PCIC (a state-owned company special to implement agricultural insurance) ▪ Implementing agricultural insurance policy ▪ Processing the application for crop and non-crop insurance ▪ Determining and issuing covering policy ▪ Paying the insurance claim ▪ Loss assessment ▪ Conducting evaluation and monitoring ▪ Determining the premium and coverage ▪ Receiving the Certificate of Insurance Cover (CIC) from the lending institutions for the borrowing farmers	1. PT Jasindo (a state-owned company which the core business not only agricultural insurance) ▪ Implementing agricultural insurance policy ▪ Selling insurance ▪ Operational delivery ▪ Issuing the insurance certificate for the farmers ▪ Reporting farmers covered by insurance to the local government ▪ Loss assessment ▪ Paying the insurance claim
		2. PCIC Regional office, PCIC extension office, and PCIC accredited underwriter ▪ Processing the application from the regional level and provincial level	2. PT Jasindo Branch Office ▪ Issuing insurance certificate ▪ Making a contract between farmers and the company ▪ Claim payment ▪ Loss assessment
b. Other implementing agency	CBD ▪ Provides premium subsidy for the CPIS	PLMSC ▪ Processing application for livestock insurance ▪ Implementing livestock insurance ▪ Loss assessment for livestock insurance ▪ Claim payment	

(Continued)

Institution	Country/Responsibility		
	India	the Philippines	Indonesia
c. Private insurance company	▪ Implementing the policy of agricultural insurance program for the MNAIS and the WBCIS ▪ Submit to the SLCCI the proposed rate of premium, indemnity, and total insured for areas in a state for implementing agricultural insurance ▪ Measuring the actual yield for each season (the MNAIS and the WBCIS) ▪ Establishing the data of the crop yield and weather and sharing the data with the government ▪ Monitoring and evaluation. ▪ Loss evaluation and paying the claims ▪ Paying the charge of insurance implementation	Example: Cooperative Life Insurance and Mutual Benefit Services (CLIMBS) ▪ Implementing the policy of agricultural insurance program ▪ Loss assessment ▪ Monitoring and evaluation ▪ Paying the claim	
Lending institutions /Banks	Nodal Banks, including regional rural banks, commercial banks, and cooperative banks ▪ Submit the insurance purchased by the farmers to insurance companies ▪ Issuing certificate insurance including the coverage ▪ Collecting the premium ▪ The disbursement of Claims	Land Bank of Philippine (LBP) and People Credit Financing Cooperation (PCFC): ▪ Processing applications and evaluating the eligibility to receive credit by reviewing farm information and farm plan and budget ▪ Providing the share of the premium for borrowing farmers ▪ Issuing the Certificate of Cover (CIC) for borrowing farmers	Commercial Banks ▪ Claim delivery
Farmer groups	Submit insurance as a group to a financial institution	Irrigator's association, cooperative, and other type farmer organizations collect and submit group application to the PCIC	Submit insurance application as a group to PT Jasindo via the UPT
Farmers	▪ Submit the proposal to the financial institution ▪ Report the loss to a financial institution, channel partner, or bank branch ▪ Paying the premium	▪ Submit an application to the PCIC or a farmer group ▪ For borrowing farmers submit a lending application to a lending institution (LBP and PCFC) ▪ Paying the premium ▪ Registered in RSBSA for RSBSA insurance scheme	▪ Submit application to the farmer group or the local government (UPT) ▪ Paying the premium

Source: Modified from ICFA (2016), LARRDIS (2015), PCIC) (2017g), Reyes et al. (2015), MoAI (2013), MoA (2017b, 2017c).

There are similarities and differences in the function of the local government in the

agricultural insurance implementation. In India and Indonesia, the function of the local government is to provide data about the eligible farmland that can be covered by agricultural insurance, conduct monitoring and evaluation, and provide a premium subsidy. In India, the premium subsidy is shared with the central government, while in Indonesia, the premium subsidy has to come from one source, either the central government or the local government. In India, the local government has more functions. The local government is responsible for measuring standard yield from CCEs, providing data of non-borrowing and borrowing farmers, and making recommendations for which commodities can be covered by the insurance at the beginning of the season. There is an institution in India at the state level consisting of many stakeholders with crucial roles, namely SLCCI. This institution is responsible not only for conducting monitoring and evaluation but also for selecting private companies to implement the MNAIS and the WBCIS. In the Philippines, the local government gives data about farmers that can be covered by the insurance, especially for the RSBSA scheme, and they also function as the channeling program, in which farmers can purchase insurance and submit their application.

The type of implementing agency in the three countries has a different form and function. In India and the Philippines, agricultural insurance was implemented by the AIC and the PCIC, respectively. These two institutions are state-owned companies established only to implement agricultural insurance. The difference between these two institutions is in terms of responsibilities. For example, the PCIC can determine the premium and the coverage, while in India, the premium and the coverage are set by the central government through the Ministry of Agriculture. In Indonesia, agricultural insurance is implemented by PT Jasindo. In contrast with the AIC and the PCIC, PT Jasindo does not solely provide agricultural insurance, but various insurance types. Moreover, in Indonesia, all aspects of agricultural insurance, such as determining standard yield, premium, coverage, indemnity, and research and development, are the main responsibilities of the Ministry of Agriculture. Therefore, PT Jasindo only implements agricultural insurance that has already been designed by the government.

The implementing agency forms branch offices or regional offices to improve its service. In Indonesia, every branch office of PT Jasindo provides services in two or three districts. In the Philippines and India, there are around 12 and 17 regional offices, respectively. The function of regional and branch offices is to make a contract between farmers and the insurer, claim payment, and loss assessment. They are also responsible for collecting premiums, except in India, where the premium is collected by financial institutions. In addition, In India and the Philippines, to improve the service, there are other implementing agencies that provide services for certain agricultural insurance products. For instance, in the Philippines, the PLMSC provides services for livestock insurance, while in India, the CBD gives a share of the premium subsidy for the CPIS.

Allowing private companies to enter the agricultural insurance business might enhance market competitiveness. In India, private companies can sell agricultural insurance and get a subsidy from the government, in which the value of the subsidy is equal to the premium allocated to the AIC. Similarly, in the Philippines, private companies can enter the agricultural insurance market. However, they only operate the insurance without premium subsidies, such as life and asset insurance. In Indonesia, the subsidy for agricultural insurance cannot be allocated to private companies. Therefore, there are no private companies involved in the insurance for smallholder farmers because they cannot compete with the insurance implemented by the government.

The financial institutions are an essential stakeholder in India and the Philippines. In India, borrowing farmers have to be covered by agricultural insurance. The objective of this policy is to protect farmers from the failure of the loan payment to the financial institution. Hence, in India, borrowing farmers automatically purchase agricultural insurance, and the indemnity of the insurance is, at a minimum, equal to the value of the loan. Similarly, in the Philippines, agricultural insurance is linked with the credit taken by the farmer. The financial institutions are also responsible for giving a share of the premium subsidy. This mechanism becomes an incentive for farmers who have loans or credit to purchase agricultural insurance because the premium subsidy from the financial institutions is not provided for non-borrowing farmers. In

Indonesia, financial institutions are not involved directly in agricultural insurance implementation. The function of the financial institutions (banks) is only to transfer the claim payment.

In each country, farmer groups are important stakeholders in agriculture insurance implementation. They coordinate farmers to purchase the insurance and submit the application to the implementing agency or financial institution.

4.5 Conclusions

Based on the comparative study, there are found several strengths and weaknesses of the agricultural insurance scheme in Indonesia (Table 4.5) from the viewpoint of data estimation, coverage, guaranteed yield, premium, and subsidy.

Table 4.5 Strengths and weaknesses of the agricultural insurance scheme

Component	Scheme	Strengths	Weaknesses
Basic data estimation	The average of nation-wide historical data	Overcome the problem when the data of the individuals and homogenous areas are not available.	The variance of the historical data will be high. It leads to a high loss ratio may.
Coverage	Cost of production	It has a potency to avoid moral hazards due to the coverage only limited to the production cost.	Reduce the attractiveness because the opportunity to get benefit from the insurance is lower compared to other types of insurances such as yield production insurance, in which the coverage is not limited to the production cost.
Guaranteed yield	Guaranteed yield is 25 percent from the yield production	Low guaranteed yield may reduce the loss ratio as the indemnity will be paid if the production reaches the guaranteed yield.	Low guaranteed yield reduces the attractiveness.
Premium	3 percent from the indemnity	Low premium increases the participation rate.	The low premium might cause a high loss ratio because the premium collected from the insured farmers cannot cover the indemnity when the hazards occur in large areas at the same time.
Subsidy (percentage of premium)	80 percent	A high subsidy increases the attractiveness of the insurance.	The high subsidy needs a huge government budget, and the number of farmers who can be subsidized will be much lower if the subsidy is too high.

Source: Author.

Concerning the data estimation, because there are no historical production data for individuals and homogenous area, the MoA has used the average historical production data of all

regions (nation-wide data) for estimating premium, guaranteed yield, and indemnity (the production cost). This method can overcome the lack of data at regional levels. However, it is the weakness since data variance will be high, leading to a high loss ratio. The lack of historical data at regional levels was one of the reasons for the failures of the CCIS and the NAIS in India.

In Indonesia, the agricultural production cost insurance was chosen because the objective of agricultural insurance in Indonesia is to guarantee that farmers can continue farming by securing the production costs for insured farmers. It has the potential to avoid moral hazards owing to the coverage being limited to the production cost. However, if the coverage is only limited to the production cost, it reduces attractiveness. In the Philippines and India, farmers have many options for coverage: it is not limited to production cost, but it can be increased to 120 percent and 150 percent of the standard yield. Increasing coverage might improve participation rates; for example, in the PCIS, when the coverage was increased, farmers' participation in the insurance rocketed from 450 farmers/year to 104,000 farmers/year.

The agricultural insurance scheme in Indonesia has a lower guaranteed yield being 25 percent of the average production. Although the low guaranteed yield has the potential to reduce the loss ratio, it might reduce its attractiveness. One of the reasons for the low participation rate in the NAIS in India was the low guaranteed yield (60 percent of the expected yield). Therefore, in the next scheme (the MNAIS), the guaranteed yield was increased from 60 percent to 70, 80, and 90 percent of the expected yield depending on the contract between farmers and the insurer. As a result, the participation rate increased significantly from 20 million farmers/year to 35 million farmers/year.

Agricultural production cost insurance in Indonesia provides a low premium. The low premium can enhance the attractiveness and significantly improve farmers' participation in the insurance (Makki & Somwaru, 2001). However, this condition creates other problems. If the premium is too low, the loss ratio can be high because the premium will not be able to cover the number of claims, particularly when shocks occur at the same time in large areas. This situation

arose in India when implementing the MNAIS, in which the low premium caused the high loss ratio.

The Indonesian government highly subsidizes (80 percent) the premium. This increases the attractiveness of the insurance. Makki & Somwaru (2001) state that the premium subsidy is an important factor in farmers' participation in agricultural insurance. A high subsidy is associated with high farmers' participation. However, if the premium subsidy is too high, it will burden both the central and local governments.

Regarding institutional arrangements, the role of the central government in the decision-making process, the implementing agency, and the source of the premium subsidy are concerned (Table 4.6). Most of the responsibilities regarding the agricultural insurance implementation in

Table 4.6 Strengths and weaknesses of the institutional arrangements

Institution	Role	Strengths	Weaknesses
Central government	▪ Making direction of agricultural insurance implementation ▪ Providing premium subsidy ▪ Monitoring and evaluation. ▪ Setting the target of covered farmland ▪ Determining the amount of premium, subsidy, and coverage ▪ Research and development ▪ Making criteria for the eligible farmers ▪ Improving farmers' awareness ▪ Providing administrative cost of the program	The central government is more powerful and easier to make a decision.	The decision making can be not effective because the central government might not be well informed about the real situation in the field.
State/local government	▪ Collecting data of the eligible farmland for agricultural insurance ▪ Reporting the eligible farmland for agricultural insurance to the central government ▪ Receipt application for the farmers and submit to implementing agency ▪ Providing subsidy of premium ▪ Monitoring and evaluation in the local government level ▪ Improving farmers' awareness	Data provided by the local government as well as monitoring and evaluation can be more accurate as they are a better understanding of the real condition in the field.	Few local governments are able to finance the premium.
Implementing agency (PT Jasindo, a state-owned company which has the core business not only agricultural insurance)	▪ Selling insurance ▪ Operational delivery ▪ Issuing the insurance certificate for the farmers ▪ Reporting the farmers covered by insurance to the local government ▪ Loss assessment ▪ Paying the insurance claim	The company has experience in implementing commercial insurances. It will avoid the failure of claim payment.	Agricultural insurance is only implemented by PT Jasindo, A state-owned company. It will reduce market competitiveness and service quality.

Source: Author.

Indonesia are concentrated to the central government. This condition means that activities (the insurance implementation) and the decision-making process may be accelerated, while having a weakness that not all activities can be properly carried out by the central government. For example, research and development should be carried out by the implementing agency as it can collect information and has a better understanding of the real situation in the field.

The implementing agency of agricultural production cost insurance is PT Jasindo. It operates many insurance businesses. This allows the company to distribute the risk among the different types of insurance: when there is a high loss ratio in one type of insurance, it can be compensated by other types of insurance. This means that the reinsurance scheme provided by the Indian and the Philippine governments is not needed in the Indonesian agricultural production cost insurance. However, because PT Jasindo is only the institution that can utilize the premium subsidy, no other companies can enter the agricultural insurance market, which will reduce competitiveness to provide services. In India and the Philippines, the subsidy can be used by private insurance companies. Therefore, the insurance market is more competitive.

There is a weakness regarding the premium subsidy composition. According to regulations, the local government has a responsibility to provide the premium subsidy. However, currently, the entire source of the premium subsidy is the central government. Therefore, the premium subsidy always burdens the central government budget. The premium subsidy should be divided between the central and local governments to alleviate the budget burden. The contribution of the local government could enhance the local government's awareness of the agricultural insurance program. In India, the premium subsidy is divided between the central government and the states, while in the Philippines, there is a contribution from financial institutions.

CHAPTER 5. RICE FARMERS' RISK MANAGEMENT BY CROPPING PATTERN DIVERSIFICATION IN RURAL WEST JAVA: MOTIVATION, BEHAVIOR, AND PERCEPTION

5.1 Introduction

Corbett (1988) and Zimmerman & Carter (2003) state that the first line of farmers' efforts to reduce the adverse impacts of risks is modifying farming practices (on-farm strategy). One of the most important on-farm strategies is diversification of cropping pattern (Binswanger, 2012; Carter, 1997). To minimize risks in farming, farmers try to find the best combination of crops or cropping patterns that can maximize the outcome in a year (Hardaker et al., 2015). To encourage more rice farmers to take agricultural insurance, as far as agricultural insurance is an ex-ante risk coping strategy, it could be the first step to being practically aware of farmers' current risk management through cropping pattern diversification.

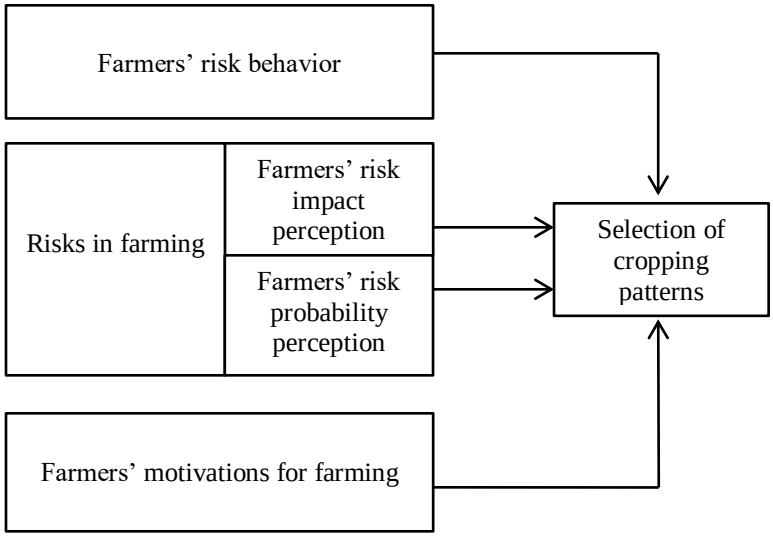
Farmers decide their cropping pattern based on their economic, technical, and social motivations for farming (Gasson, 1973; Greiner et al., 2009). In the process of selecting cropping patterns, risk perception plays an essential role. Farmers might have different perceptions about outcomes and risks when they select a certain type of innovation, including the cropping pattern (Anderson et al., 1988). Another aspect is the farmers' risk behavior. For instance, Feder (1980), Kabede (1992), and Moscardi & de Janvry (1977) report that risk behavior is associated with the level of technology adoption and the level of input allocated for production. Therefore, this study aims to clarify the feature of farmers' motivation for farming, behavior, and perception underlying their practical cropping patterns in rural West Java, focusing on risk management.

5.2 Methodology

5.2.1 Framework

As shown in Figure 5.1, the selection of cropping patterns must be influenced by three

factors: risk in farming, behavior towards risk, and motivation for farming. Risk in farming is perceived as a risk impact and risk probability (Rogers & Prentice-Dunn, 1997).



Source: Author.

Figure 5.1 The framework used in the study

There are various risks in farming, which are grouped into production, price, personal/human capacity, government policy, and finance (Harwood et al., 1999; Hardaker et al., 2015). Production risk is related to soil fertility, water availability, and unpredictable weather (Loomis et al., 1971; DiFalco & Chavas, 2009). The risk of price change/fluctuation in products and inputs is influential in the sustainability of farming owing to high cost and low profit. Government policies and regulations, such as import policy, more taxes, and high standards of products, might have adverse impacts on farming income (Goetz & Zilberman, 2007). Personal/human risk is associated with poor health or injury. Financial risk is related to losing assets owing to production failure (Harwood et al., 1999).

Farmers have different preferences of risks in farming. Those who are risk-averse might try to reduce the adverse impact of risk exposure by taking risk coping strategies (DiFalco & Chavas, 2009; Menezes et al., 1980). The other two preferences are risk-neutral and risk-taker.

It is said that rational farmers pursue profit maximization in farming (Binswanger & Rosenzweig, 2007; Gasson, 1973). However, farmers' motivations for farming are not limited to profit maximization. They may include technical, cultural, and social motivations. As understood through indigenous knowledge or tradition, some crops are resilient to risks and indispensable to livelihood, which is likely to be one reason for willingness to cultivate crops with lower profit in cropping patterns. Some farmers might select a cropping pattern to technically adapt to biological and geographical conditions such as soil fertility and water availability (Leemans & Born, 1994).

5.2.2 Data Collection

5.2.2.1 Motivation for Farming

Farmers were asked to select their motivations for farming. They were allowed to mention a specific motivation that was not in the list of choices. There were eleven motivations in the list that could be divided into economic, cultural, and technical motivations (Table 5.1), and they could select either one or more than one motivation.

Table 5.1 List of motivations

Type	Motivation
Economic	Gain higher profit
	Attain higher yield
	Avoid commodity price fluctuation
	Avoid higher input cost
	Get a higher cash flow
	Follow market demand
Cultural	Never change the crop grown
Technical	Have knowledge and skill
	Reduce the occurrence of pests and diseases
	Reduce the impacts of environmental factor change
	Improve soil fertility

Source: Author.

5.2.2.2 Risk Behavior

There are different approaches to measuring farmers' risk behavior. For example, Mariano et al. (2012) use the existence of crop diversification as an indicator of risk behavior. Greiner et al. (2009) apply the relative risk attitude method. Feder (1980) and Moscardi & de Janvry (1977)

take the amount of fertilizer used in production to measure the risk behavior characteristics. Schechter (2007) uses a risk game (an economic experiment) to measure the risk behavior of indigenous people in rural areas. For the present study, the risk game is more appropriate for measuring farmers' risk behavior than other approaches because diversification of cropping patterns involves a decision on financial asset allocation, which is similar to the nature of the risk game. Moreover, as an advantage, the risk game enables measurement of farmers' risk behavior, specifically in the form of continuous data.

At the end of a face-to-face interview at farmers' houses in the afternoon, that is after farming work was over, the risk game was played as follows. Based on the risk game conducted by Schechter (2007), the farmer is given real money of Rp30,000 ($2.2). This is around two-thirds of the daily wage in the study villages (Rp50,000 = $3.7). The proportion of the value of money used in the game to the daily wage is almost equal to that in the risk game conducted by Schechter (2007). The daily wage is a meaningful reference for the risk game because the farmer will try to generate income for the day that is at least equal to the daily wage in the location. If the farmer cannot get income on the day when the risk game is played, he/she is given Rp30,000, but this is still low compared to the daily wage of Rp50,000 (that is the expected income on the day). In the risk game, the farmer has an opportunity to increase Rp30,000 to Rp50,000 by allocating some money as a bet. In this opportunity, the decision to bet or not depends on individual characteristics. If a farmer has a diminishing marginal utility of wealth, he/she will avoid allocating the money as a bet. Conversely, if a farmer has an increasing marginal utility of wealth, he/she may try to allocate some amount of the money as a bet.

In the risk game, a farmer can bet the amount of 0 (not to bet), 5000, 10,000, 15,000, 20,000, 25,000, or 30,000. The betting farmer takes a piece of paper out of a transparent plastic bag, in which there are six pieces of paper numbered 1 to 6. As shown in Table 5.2, he/she is supposed to bet Rp30,000. If the number 6 is printed, he/she could gain Rp75,000, while if the number is being 0, he/she would lose the Rp30,000. In addition, for this study, based on how much of

Rp30,000 the farmer wishes to bet, his/her risk behavior is categorized as risk-taker, risk-neutral, or risk-averse (Table 5.3).

Table 5.2 The rule of the risk game

Result of Bet		
Number Taken in the Game	Value	Meaning
1	0	Lose all of the money allocated for bet
2	0.5 x money for the bet	Gain half of the money allocated for bet
3	1 x money for the bet	Gain all of the money allocated for bet
4	1.5 x money for the bet	Gain one and half of the money allocated for bet
5	2 x money for the bet	Gain two times of the money allocated for bet
6	2.5 x money for the bet	Gain two and half of the money allocated for bet

Source: Schechter (2007).

Table 5.3 Types of farmers' risk behavior

Value of Money Allocated for Bet	Type
$0 \leq 10{,}000$	Risk-averse
$10{,}000 \leq 20{,}000$	Risk-neutral
$20{,}000 \leq 30{,}000$	Risk-taker

Source: Author.

5.2.2.3 Risk Perception

This study divides risk perception into two kinds: risk impact and risk probability. The former is farmers' perception of the impact of risk on his/her income from farming. The latter is the farmers' perception of the probability of risk occurrence. Each perception was measured by a Likert scale, presented in Table 5.4.

Table 5.4 Likert scale for risk perception measurement

Perception	Likert Scale
Risk impact	1= very low, 2 = low, 3 = high, 4 = very high
Risk probability	1= very low, 2 = low, 3 = high, 4 = very high

Source: Author.

5.2.2.4 Diversification of Cropping Patterns

This study focuses on the diversification of cropping patterns as a farming practice to understand farmers' risk management in farming. This is because farmers try to minimize the

adverse impacts of risks by adjusting cropping patterns (O'Donoghue et al., 2005; Mandal, 2010). There are several methods of estimating the degree of diversification: Herfindahl Index, Simpson Diversity Index, Ogive Index, Entropy Index, Modify Entropy Index, and Composite Entropy Index (Chand & Ramesh, 1996; Kelley & Ryan, 1995; Shiyani & Pandya, 1998). Since the degree of diversification can be captured by incorporating the number of crops planted and the proportion of area cultivated for each crop in a cropping pattern, this study uses the Composite Entropy Index (CEI) to measure the diversification of the cropping patterns. The equation of CEI is as follows:

$$\mathrm{CEI} = \left[-\sum_{i=1}^{N} P_i \log \mathrm{N} P_i\right] \times \left[1 - \frac{1}{N}\right] \tag{5.1}$$

where N is the number of crops planted, and P_i is the proportion of ith crop to the total cropped area. The value of CEI ranges between 0 and 1. For example, the CEI of two rice crops on the paddy field is 0, since the number of the crop planted is just 1.

5.2.3 Data Analysis

In this study, Cluster Analysis (CA) is conducted to identify the groups of farmers with similar characteristics based on the value of CEI, motivation for farming, risk behavior, and risk perception. It is also used to describe the overall association between motivation for farming, risk behavior, risk perception, and CEI. Meanwhile, Principal Component Analysis (PCA) is applied to investigate the common factors of motivation for farming and risk perception.

5.3 Results and Discussions

5.3.1 Farmers' Characteristics

As shown in Table 5.5, the average age of farmers was 51.9 years old, and the average level of education was around 7.5 years. The majority (90.4 percent) of farmers were male. The average per capita income and asset value were Rp9.7 million/year and Rp98.3 million,

respectively. Around one-third of farmers had a bank account. The highest proportion of landholding arrangement was 48.8 percent of sharecropping, followed by owner (45.8 percent) and rent in cash (5.4 percent). On average, farmers managed 0.43 ha of farmland. The percentage of farmers who implemented cropping pattern diversification was 54.6 percent.

Table 5.5 Summary of farmers' characteristics

Variable		Average, Percentage
Demographic characteristic	Age of farmer (year)	51.9
	Education of farmer (year)	7.5
	Gender (percentage of male)	90.4
Economic characteristic	Per capita income (Rp mil/year)	9.7
	Asset value (Rp mil)	98.3
	Bank account ownership (%)	31.7
Farming characteristic	Farmland size (ha)	0.43
	Type of farmland	
	Irrigated farmland (%)	77.1
	Rain-fed farmland (%)	22.9
	Landholding	
	Owner (%)	45.8
	Sharecropping (%)	48.8
	Rent in cash (%)	5.4
	Farmers with the diversification of cropping patterns (%)	54.6

Source: Field survey data.

5.3.2 Cropping Patterns

As shown in Table 5.6, five kinds of cropping patterns were practiced by farmers in three cropping seasons: (a) paddy-paddy-paddy; (b) paddy-paddy-horticulture; (c) paddy-horticulture-paddy; (d) paddy-horticulture-horticulture; and (e) paddy/horticulture-paddy/horticulture-paddy/horticulture. The number of cropping patterns practiced by a farmer during the last five years ranged between one and four.

One hundred and nine farmers (45.4 percent) practiced just single cropping pattern, namely paddy-paddy-paddy. The second was a combination of three cropping patterns, practiced by 63 farmers (26.3 percent) and based on selecting three out of four cropping patterns. The majority (58) of these farmers selected the combination of paddy-paddy-paddy, paddy-paddy-horticulture, and paddy-horticulture-paddy. The value of CEI for this combination (that is, three cropping

patterns) ranged from 0.28 to 0.56. In the case of selecting two out of four cropping patterns, there were 42 farmers (17.5 percent), and the value of CEI ranged from 0.17 to 0.46. The majority (32) of these farmers selected paddy-paddy-paddy combined with paddy-paddy-horticulture. In contrast, there were fewer farmers (26 farmers, 10.8 percent) who practiced four out of five cropping patterns, though the value of CEI ranged from 0.29 to 0.61. In this group, the majority (20) of these farmers practiced the combinations of paddy-paddy-paddy, paddy-paddy-horticulture, paddy-horticulture-paddy, and paddy-horticulture-horticulture.

Table 5.6 CEI and the number of farmers by cropping patterns

Number of Cropping Patterns	Cropping Pattern Selected					CEI	Number of Farmers				
	a	b	c	d	e		Down-stream	Mid-stream	Up-stream	Total	%
1	+					0	46	27	36	109	45.4
2	+	+				0.17-0.46	10	17	5	32	13.3
	+		+			0.17-0.44	2	1	1	4	1.7
	+			+		0.28-0.44	3	1	2	6	2.5
3	+	+	+			0.28-0.56	16	32	10	58	24.2
	+	+		+		0.28-0.51	1	0	4	5	2.1
4	+	+	+	+		0.29-0.59	1	2	17	20	8.3
	+	+	+		+	0.44-0.58	0	0	2	2	0.8
	+	+		+	+	0.44-0.51	1	0	2	3	1.3
		+	+	+	+	0.61	0	0	1	1	0.4

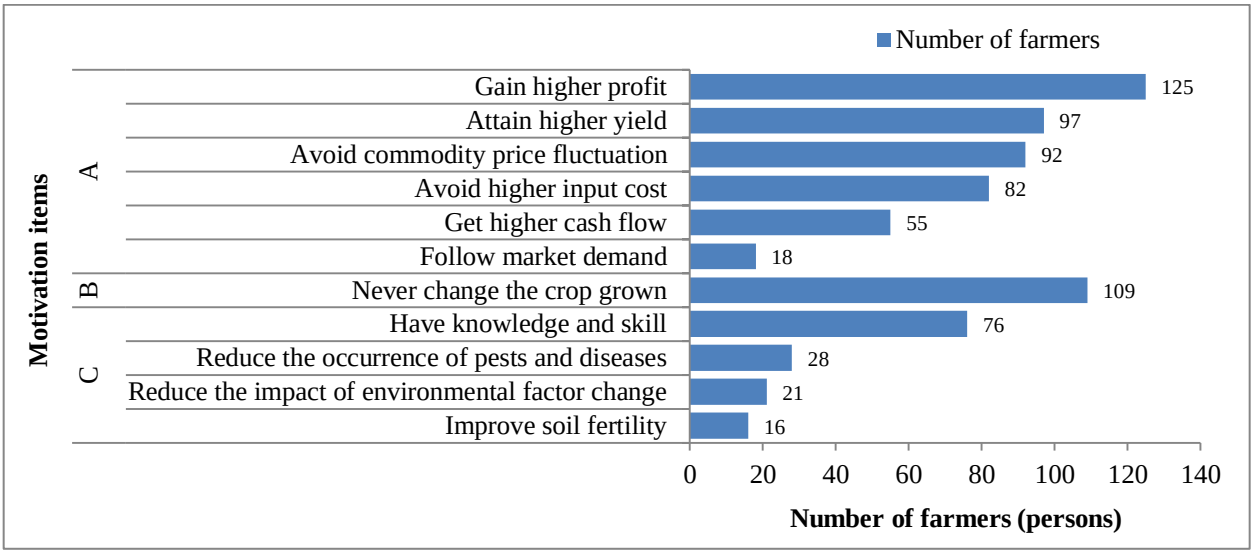
Source: Field survey data.
Note: + = cropping pattern selected; a = paddy-paddy-paddy; b = paddy-paddy- horticulture; c = paddy-horticulture-paddy; d = paddy-horticulture-horticulture; e = paddy/horticulture-paddy/horticulture-paddy/horticulture.

As to farmers' preference of cropping patterns among the downstream, midstream, and upstream areas, there were differences in cropping patterns practiced. That is, (1) in the downstream area, the majority of farmers practiced one cropping pattern; (2) in the midstream area, the majority of farmers practiced three cropping patterns (32 farmers, 40 percent) and one cropping patterns (27 farmers, 33.7 percent); and (3) in the upstream area, the majority of farmers practiced one cropping pattern. The percentage of farmers who practiced four cropping patterns, compared to those in the other areas is the highest.

5.3.3 Farmers' Motivation

As shown in Figure 5.2, the main motivations for selecting crops were "Gain higher profit"

(125 farmers, 52.1 percent), “Never change the crop planted” (109 farmers, 45.4 percent), “Attain higher yield” (97 farmers, 40.4 percent), and “Avoid commodity price fluctuation” (92 farmers, 38.3 percent). As a whole, economic objectives were farmers’ major motivation.



Source: Field survey data.
Note: A = economic motivation; B = cultural motivation; C = technical motivation.

Figure 5.2 The rank of farmers’ motivations for farming

As to the range of motivations, the majority (208 farmers, 86.7 percent) had more than one motivation. There were around 63 combinations of farmers’ motivations. Table 5.7 presents the top 10 farmers’ motivations (comprising 147 farmers, 61.3 percent). There were differences in farmers’ motivations among the downstream, midstream, and upstream. In the downstream area, the majority of farmers (18 farmers, 22.5 percent) were driven by three economic motivations, namely “Gain higher profit”, “Attain higher yield”, and “Avoid commodity price fluctuation”. In the midstream area, two combinations of two motivations, namely “Avoid higher input cost + Never change crop grown” and “Avoid higher input cost + Have knowledge and skill” motivated the majority of farmers, around 14 farmers (17.5 percent) and 13 farmers (16.2 percent), respectively. Meanwhile, in the upstream area, the majority of farmers (19 farmers, 23.7 percent) were driven by cultural motivation (“Never change crop grown”) and the combination of four

economic motivations (16 farmers, 20 percent): “Gain higher profit + Attain higher yield + Avoid commodity price fluctuation + Get higher cash flow”. As a whole, the combination of farmers’ motivation for farming was diversified, but the core motivation was economic, while the single motivation for farming was limited to “Never change crop grown”.

Table 5.7 Top 10 motivation combinations

No	Motivation											Location			Total	
	Economic						Cultural	Technical								
	HP	HY	CP	IC	CF	MD	NC	KS	PD	SF	EC	D	M	U	N	%
1							+					11	2	19	32	13.3
2	+	+	+									18	4	4	26	10.8
3				+			+					7	14	0	21	8.8
4				+				+				4	13	0	17	7.1
5	+	+	+		+							0	0	16	16	6.7
6							+	+				0	12	1	13	5.4
7	+	+					+					7	0	0	7	2.9
8							+		+			5	1	0	6	2.5
9	+		+		+							0	0	5	5	2.1
10	+	+	+					+				0	3	1	4	1.7

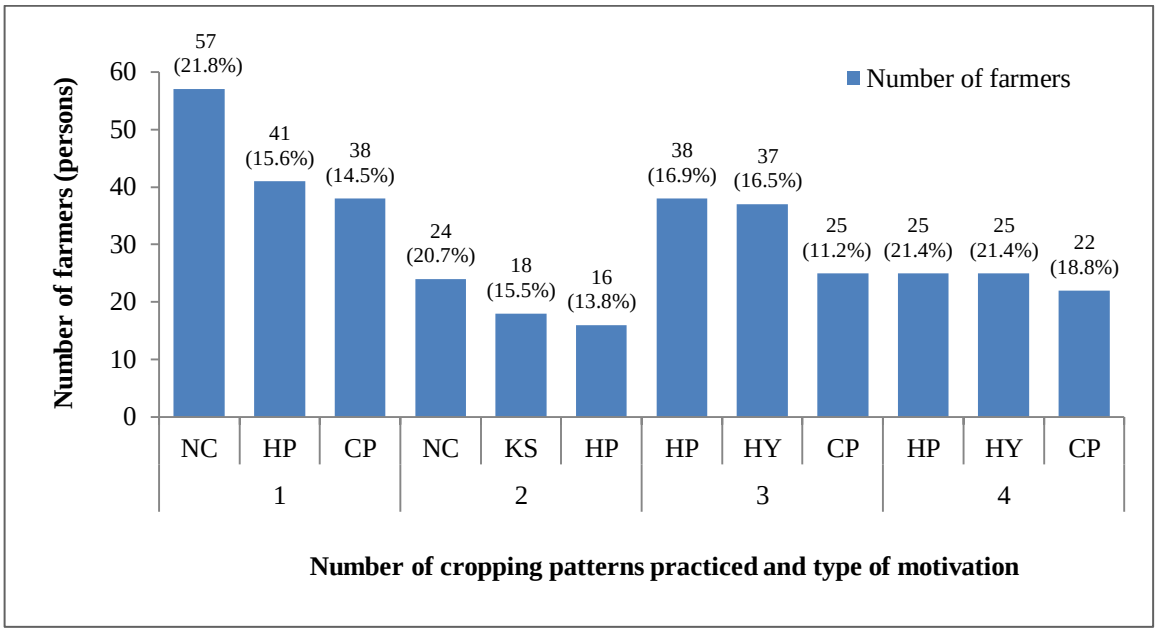
Source: Field survey data.
Note: + = motivation selected; N= number of farmers; HP = Gain higher profit; HY = Attain higher yield; CP = Avoid commodity price fluctuation; IC = Avoid higher input cost; CF = Get higher cash flow; MD = Follow market demand; NC = Never change crop grown; KS = Have knowledge and skill; PD = Reduce pests and diseases; SF = Improve soil fertility; EC = Reduce the impacts of environmental change; D = Downstream; M = Midstream; U = Upstream.

Figure 5.3 presents the top three farmers’ motivations by the number of cropping patterns practiced. There were several findings as follows:

(1) Cultural motivation (“Never change crop grown”) was the main motivation of farmers who practiced one or two cropping patterns. Moreover, these two groups had economic motivation as one of the top three motivations, namely “Gain higher profit”. The difference between farmers who practiced one or two cropping patterns, was that farmers who practiced two cropping patterns had technical skill motivation (“Have knowledge and skill”), while farmers who practiced one cropping pattern did not have this motivation.

(2) The economic motivation was the main motivation for farmers who practiced three or four cropping patterns: “Gain higher profit”, “Attain higher yield”, and “Avoid commodity price fluctuation” as the top three motivations. The difference between the two groups was that farmers practicing three cropping patterns were more likely to select “Gain higher profit” and

"Attain higher yield" as their motivation. Meanwhile, farmers practicing four cropping patterns almost had equal proportions in selecting the three motivations ("Gain higher profit", "Attain higher yield", and "Avoid commodity price fluctuation").



Source: Field survey data.
Note: HP = Gain higher profit; HY = Attain higher yield; CP = Avoid commodity price fluctuation; NC = Never change crop grown; KS = Have knowledge and skill. The percentage was calculated by dividing the number of farmers selected motivation by the number of farmers.

Figure 5.3 Farmers' main motivations for farming by the number of cropping patterns

In general, it can be concluded that the number of cropping patterns practiced has a relationship with farmers' motivation. For example, "Have knowledge and skill" has become an essential motivation for farmers to implement cropping pattern diversification. If farmers have knowledge and skill, they might change their farming practice from one cropping pattern to two cropping patterns.

5.3.4 Farmers' Risk Behavior

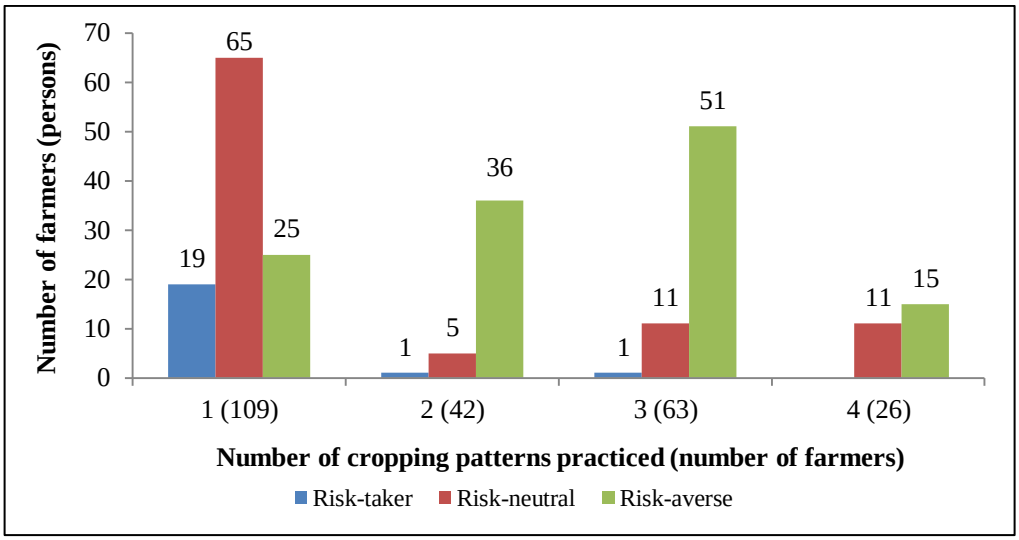
As shown in Table 5.8, almost half of the farmers (52.9 percent) had risk-averse behavior. On average, they betted only Rp7,142 (24 percent) out of Rp30,000, and consequently reduced

the Rp30,000 to Rp28,704 owing to less gain from the risk game, while risk-taker farmers (only 8.8 percent) betted Rp25,629 out of Rp30,000 (85.4 percent) and increased the Rp30,000 to Rp36,038 owing to much gain from the risk game. As for risk-neutral farmers (38.3 percent), they betted Rp18,750 out of Rp30,000, but they had a little gain from the risk game (Rp31,848 from Rp30,000). On average, risk-taker farmers could increase their value of money compared to risk-averse and risk-neutral farmers. Risk-averse farmers might not increase their value of money because their willingness to bet in a high-risk game was very low. It is of interest that the value of money for risk-neutral farmers did not increase significantly compared to risk-taker. The percentages of the risk-taker, -neutral, and -averse farmers who could increase the value of the money were 62 percent, 83 percent, and 41percent, respectively.

Table 5.8 Result of the risk game

Risk Behavior	Average Money Allocated for Betting (Rp)	Number of Farmers (%)	Average Money Gained from Betting (Rp)	Average Money Owned after Betting (Rp)	Number of Farmers with the Amount of Money ≤ Rp30,000 and Rp30,000 < after Betting	
					≤Rp 30,000	Rp30,000 <
Risk-taker	25,629	21 (8.8%)	31,667	36,038	8 (38%)	13 (62%)
Risk-neutral	18,750	92 (38.3%)	20,597	31,848	16 (17%)	76 (83%)
Risk-averse	7,142	127 (52.9%)	5,846	28,704	75 (59%)	52 (41%)

Source: Field survey data.



Source: Field survey data.

Figure 5.4 Farmers' risk behavior by the number of cropping patterns

As shown in Figure 5.4, it can be seen that (1) risk-averse farmers diversified cropping patterns; (2) risk-taker farmers remained in single cropping pattern, that is, triple rice crops; and (3) risk-neutral farmers were dispersed in terms of number of cropping patterns practiced but the majority practiced single cropping pattern, that is, triple rice crops.

5.3.5 Farmers' Risk Perception

As shown in Figures 5.5 and 5.6, as far as top five risk perceptions were concerned, there were some interesting findings on farmers' risk perception (impact and probability) in the downstream, midstream, and upstream areas as follows:

(1) Risk impact perception

(a) "Yield variability", "Commodity price", "Pests and diseases", and "Water scarcity" were common risks that had impacts on farming income in the downstream, midstream, and upstream areas.

(b) "Yield variability", "Commodity price', "Pests and diseases", and "Water scarcity" had impacts on farmers in the upstream area compared to farmers in downstream and midstream.

(c) "Government policy" was a common risk that impacted on farming income in the downstream and midstream areas.

(d) "Soil fertility" risk was limited to farmers in the upstream area.

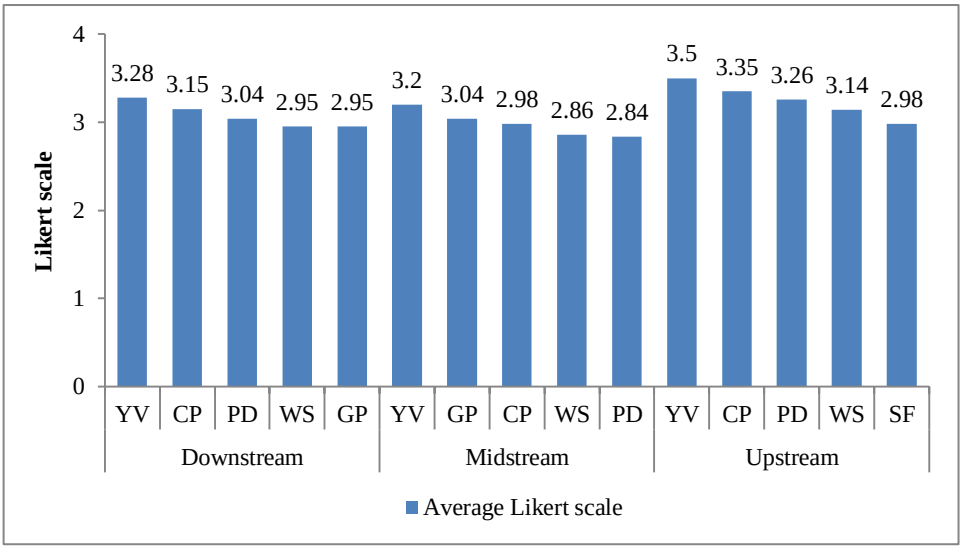
(2) Risk probability perception

(a) "Yield variability", "Commodity price', and "Pests and diseases" were common risks that occurred in the downstream, midstream, and upstream areas.

(b) "Yield variability" was the risk with the highest probability to occur both in the downstream and upstream areas, while in the midstream area was "Commodity price fluctuation".

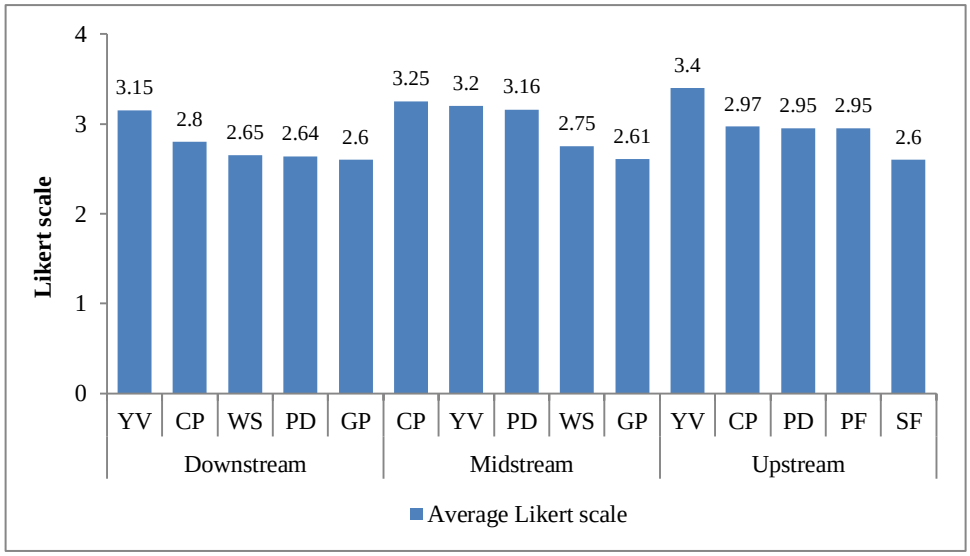
(c) "Water scarcity" and "Government policy" were risks that commonly occurred in the downstream and midstream areas.

(d) “Pollination failure” and “Soil fertility” were limited to farmers in the upstream area.



Source: Field survey data.
Note: YV = Yield variability; PD = Pests and diseases; CP = Commodity price fluctuation; WS = Water scarcity; GP = Government policy; SF = Soil fertility; 1= very low; 2 = low; 3 = high; 4 = very high.

Figure 5.5 Risk impact perception



Source: Field survey data.
Note: YV = Yield variability; PD = Pests and diseases; CP = Commodity price fluctuation; WS = Water scarcity; GP = Government policy; PF = Pollination failure; SF = Soil fertility; 1= very low; 2 = low; 3 = high; 4 = very high.

Figure 5.6 Risk probability perception

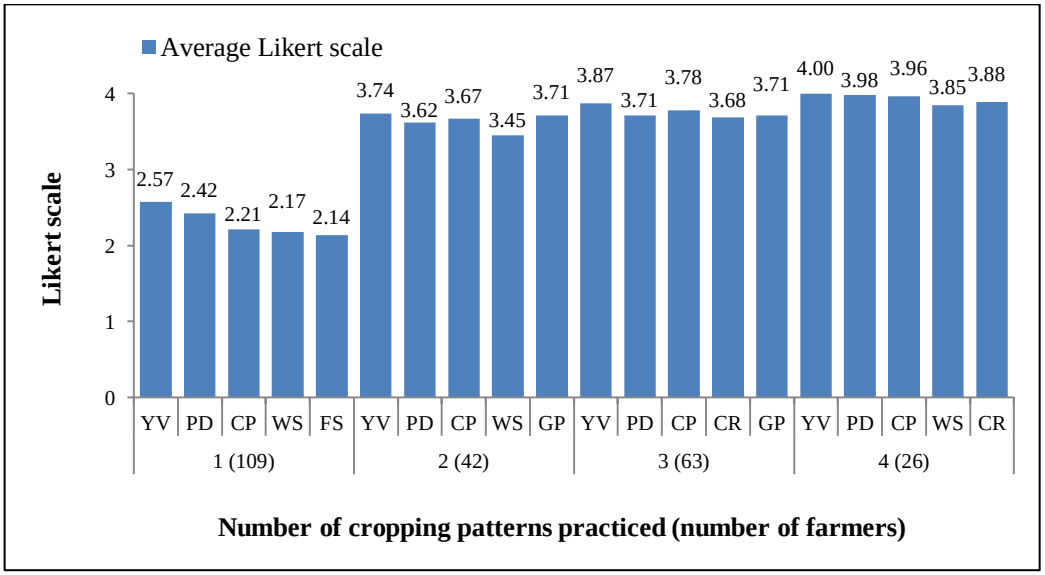
It could be concluded that the type of risks perceived by farmers in the midstream and downstream areas was almost similar. Risks that were limited to farmers in the upstream area were “Pollination failure” and “Soil fertility”.

The top five risk impact and risk probability perceptions are presented by the number of cropping patterns in Figures 5.7 and 5.8. As far as the top five perceptions were concerned, what was of interest were as follows:

(1) Risk impact perception

(a) Farmers who practiced single cropping pattern (paddy-paddy-paddy) had an average Likert scale score of less than 2.5 (excluding 2.57 of “Yield variability”), while it was over 3.5 for the other groups (farmers practicing two, three, and four cropping patterns).

(b) The average score of the Likert scale of risk impact perception of farmers who practiced four cropping patterns for each type of risk was higher compared to farmers practicing other cropping patterns.



Source: Field survey data.
Note: YV = Yield variability; PD = Pests and diseases; CP = Commodity price; WS = Water scarcity; FS = Farmers’ skill; GP = Government policy; CR = Capital return; 1= very low; 2 = low; 3 = high; 4 = very high.

Figure 5.7 Farmers’ risk impact perception by the number of cropping patterns

(c) "Yield variability", "Commodity price", and "Pests and diseases" risks were risks that had impacts on all groups.

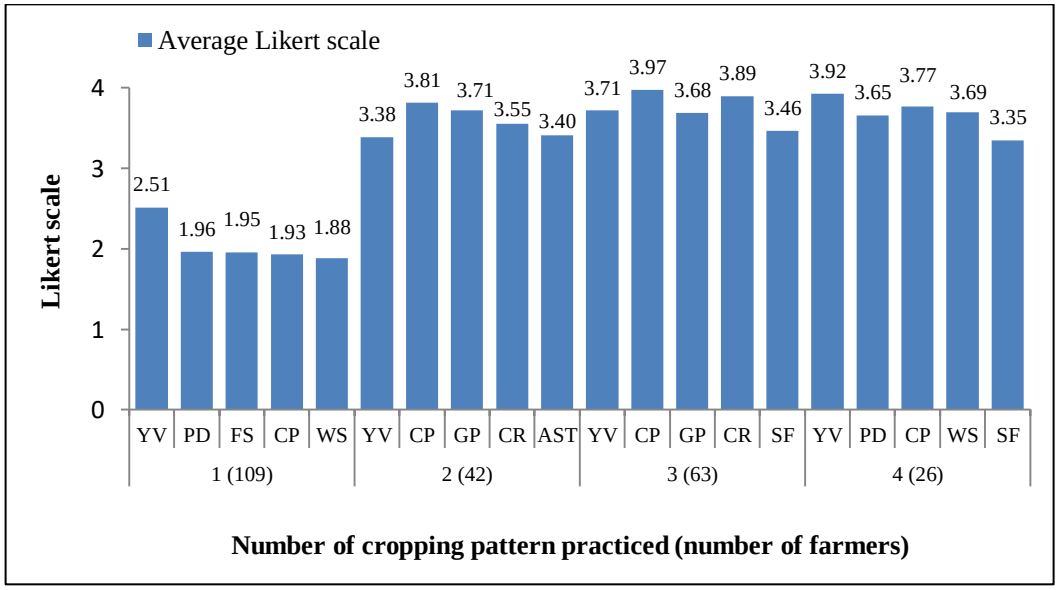
(d) "Water scarcity", "Government policy", and "Capital return" were risks that had impacts on farming income to three out of four farmer groups. "Farmers' skill" risk impacted on farmers who practiced single cropping pattern.

(e) "Yield variability" was the top risk that impacted on farming income for each of the farmer groups.

(2) Risk probability perception

(a) Farmers who practiced single cropping pattern (paddy-paddy-paddy) had an average Likert scale score of less than 2.0 (excluding 2.51 of yield variability), while it was over 3.5 for the other groups.

(b) "Yield variability" and "Commodity price fluctuation" were risks that had a probability to occur in all groups.



Source: Field survey data.
Note: YV = Yield variability; PD = Pests and diseases; FS = Farmers' skill; CP = Commodity price; WS = Water scarcity; GP = Government policy; CR = Capital return; AST = Asset; SF = Soil fertility; 1= very low; 2 = low; 3 = high; 4 = very high.

Figure 5.8 Farmers' risk probability perception by the number of cropping patterns

(c) “Pests and diseases”, “Water scarcity”, “Government policy”, “Capital return”, and “Soil fertility” were risks that commonly occurred for two out of four farmer groups. “Farmers’ skill” was limited to the farmer group who practiced single cropping pattern (paddy-paddy-paddy), and “Asset” was limited to farmers who practiced two cropping patterns.

(d) The occurrence of the “Soil fertility” risk was common to farmers who practiced three or four cropping patterns.

(e) “Yield variability” was the top risk to occur for all groups.

On the whole, there was a relationship between the number of cropping patterns practiced by farmers and their risk perception. Farmers who diversified their cropping patterns had higher risk impact and risk probability perception than those practicing single cropping pattern (paddy-paddy-paddy). However, regarding risks of comparatively high interest, there was a slight difference between the risk impact perception and the risk probability perception of farmers practicing cropping pattern diversification. There were risks that were not considered as the top five risks in terms of impacts by farmers practicing cropping pattern diversification, but they were considered as one of the top five risks that had a high probability to occur, namely soil fertility and asset risk.

5.3.6 Association of Motivation for Farming, Risk Behavior, Risk Perception, and Cropping Patterns

As shown in Table 5.9, the association between motivation for farming, risk behavior, and risk perception behind cropping pattern diversification can be explained as follows:

(1) Risk behavior and risk perception (impact and probability) might influence farmers’ decision to practice single cropping pattern or two cropping patterns. Although they had similar motivations (cultural and economic), the majority of farmers who practiced single cropping pattern had risk-neutral and risk-averse behavior, while those who practiced two cropping patterns had risk-averse behavior. Regarding risk perception, the impact and probability

Table 5.9 Major motivations for farming, risk behavior, and risk perception by the number of cropping patterns

Number of Cropping Patterns	Indicator				
				Risk Perception (3.0<)	
	Motivation		Risk Behavior	Risk Impact Perception	Risk Probability Perception
1	1. Never change crop grown 2. Gain higher profit 3. Avoid commodity price fluctuation	Cultural Economic Economic	1. Risk-neutral 2. Risk-averse	1. Yield variability[3] 2. Pests and diseases[2] 3. Commodity price[2] 4. Water scarcity[2] 5. Farmers' skill)[2]	1. Yield variability[3] 2. Pests and diseases[1] 3. Farmers' skill[1] 4. Commodity price[1] 5. Water scarcity[1]
2	1. Never change crop grown 2. Gain higher profit 3. Attain higher yield	Cultural Economic Economic	1. Risk-averse	1. Yield variability[3] 2. Pests and diseases[3] 3. Commodity Price[3] 4. Water scarcity[3] 5. Government policy[3]	1. Yield variability[3] 2. Commodity price[3] 3. Government policy[3] 4. Capital resturn[3] 5. Asset[3]
3	1. Gain higher profit 2. Attain higher yield 3. Have knowledge and skill	Economic Economic Technical	1. Risk-averse	1. Yield variability[3] 2. Pests and diseases[3] 3. Commodity Price[3] 4. Capital return[3] 5. Government policy[3]	1. Yield variability[3] 2. Commodity price[3] 3. Government policy[3] 4. Capital return[3] 5. Soil fertility[3]
4	1. Gain higher profit 2. Attain higher yield 3. Avoid commodity price fluctuation	Economic Economic Economic	1. Risk-Averse 2. Risk-neutral	1. Yield variability[3] 2. Pests and diseases[3] 3. Commodity price[3] 4. Water scarcity[3] 5. Capital return[3]	1. Yield variability[3] 2. Pests and diseases[3] 3. Commodity price[3] 4. Water scarcity[3] 5. Soil fertility[3]

Source: Field survey data.
Note: [1] = Likert scale score is below 2.0; [2] = Likert scale score ranged from 2.0-2.5; [3] = Likert scale score was higher than 2.5; Likert scale: 1 = very low; 2 = low; 3 = high; 4 = very high.

of risk of farmers who practiced single cropping pattern (Likert score 2.0-2.5) were lower than those farmers who practiced two cropping patterns (Likert score >2.5).

(2) Motivation for farming, risk behavior, and risk perception might influence farmers' decision to practice single cropping pattern or three cropping patterns. Farmers who practiced single cropping pattern were driven by cultural and economic motivations, and the majority of them were risk-neutral and risk-averse, while farmers who practiced three cropping patterns were driven by economic and technical motivations, and the majority of them were risk-averse. They were different in risk impact perception and risk probability perception. Farmers who practiced single cropping pattern argued that "Water scarcity" and "Farmers' skills" had impacts on income from farming, and the probability of "Pests and diseases", "Water scarcity", and "Farmers' skills" risks to occur was high, while farmers who practiced three cropping patterns argued that "Capital return" and "Government policy" had impacts on

income from farming, and the probability of "Government policy", "Capital return", and "Soil fertility" risk to occur was high.

(3) There were two variables that might influence farmers' decision on practicing single cropping pattern or four cropping patterns, namely farmers' motivation for farming and risk perception. Though they had similar risk behavior (risk-averse and risk-neutral), they differed in motivations for farming. As mentioned above, farmers who practiced single cropping pattern were driven by both cultural and economic motivations, while farmers who practiced four cropping patterns were driven by economic motivations. Regarding risk perception, farmers who practiced four cropping patterns argued that "Capital return" risk impacted on income from farming, and the probability of "Soil fertility" risk to occur was high. Those risks were not considered to be in the top five risks of farmers who practiced single cropping pattern.

(4) The variable that might determine farmers' decision to select two or three cropping patterns was motivation. Farmers who practiced two or three cropping patterns had similar risk behavior (risk-averse) and similar risk impact and risk probability perception, though different in the number of cropping patterns. This might be due to a difference in their motivations. Farmers who practiced two cropping patterns had cultural and economic motivations, while farmers who practiced three cropping patterns had economic and technical motivations.

(5) Farmers' motivation for farming, risk behavior, and risk perception might influence farmers' decision to practice two cropping patterns or four cropping patterns. Farmers who practiced two cropping patterns were driven by cultural and economic motivations, and the majority of them were risk-averse, while farmers who practiced four cropping patterns were only driven by economic motivations, and the majority of them were risk-neutral and risk-averse. Regarding risk perception, there were risks that were considered by farmers who practiced two cropping patterns as in the top five risks, but they were not considered so for farmers

who practiced four cropping patterns, namely risk impact perception of "Government policy" and risk probability perception of "Government policy", "Capital return", and "Asset". Conversely, there were risks that were considered by farmers who practiced four cropping patterns to be in the top five risks, but they were not considered so by farmers who practiced two cropping patterns, namely risk impact perception of "Capital return" and risk probability perception of "Commodity price", "Water scarcity", and "Soil fertility".

(6) Farmers' motivation for farming and risk behavior might influence farmers' decision to practice three or four cropping patterns. The majority of farmers who practiced three or four cropping patterns had a similar risk perception (impact and probability). However, because they differed in motivation and risk behavior, they selected different cropping patterns. Economic motivations encouraged farmers to practice four cropping patterns, while technical and economic motivations encouraged farmers to practice three cropping patterns. Regarding risk behavior, the majority of farmers who practiced three cropping patterns were risk-averse, while those who practiced four cropping patterns were risk-neutral and risk-averse.

To identify the farmer groups that had similar characteristics in motivation for farming, risk behavior, risk perception, and CEI, cluster analysis (CA) was conducted. Before conducting the CA, the PCA was applied to determine the common factors of farmers' motivation for farming and risk perception. The result of varimax-rotated factor analysis (Table 5.10) shows that there were four common factors of farmers' motivation for farming. These factors explained 73.48 percent of the variance. The factors were given a label based on the main motivations loaded on each factor: economic factor (F1), technical factor (F2), environmental factor (F3), and cultural factor (F4). Table 5.11 presents the result of varimax-rotated factor analysis of risk perception. The farmers' 11 perceptions of risk impact on income could be integrated into two factors, which accounted for 82.9 percent of the variance. The first factor was production and price (F_1), while the second was farmers' skill and government policy (F_2). Similarly, the farmers' 11 perceptions

of risk probabilities could be integrated into two factors, which covered 83.2 percent of the variance: the production factor (F_1), and the farmers' capacity and government policy factor (F_2).

Table 5.10 Rotated factor matrix of motivation for farming

Motivation	Factors		
	Factor Loading	Variance Explained (%)	Eigenvalues
Economic (F1)		33.59	3.69
Gain higher profit	0.518		
Attain higher yield	0.470		
Avoid commodity price fluctuation	0.518		
Get higher cash flow	0.312		
Technical (F2)		17.06	1.88
Reduce the occurrence of pests and diseases	0.651		
Improve soil fertility	0.667		
Environmental (F3)		13.31	1.47
Reduce the adverse impacts of the environmental factor change	0.662		
Follow market demand	0.660		
Cultural (F4)		9.52	1.05
Never change the crop grown	-0.540		
Avoid higher input cost	0.443		
Have knowledge and skill	0.699		
Total variance explained		73.48	

Source: Field survey data.
Note: Factor loading taken is over 0.3, and eigenvalues is over 1. Kaiser-Meyer-Olkin of sampling adequacy (KMO) = 0.73.

Table 5.11 Rotated factor matrix of risk impact and risk probability

Risk Impact Perception	Factor			Risk Probability Perception	Factor		
	Factor Loading	Variance Explained (%)	Eigenvalues		Factor Loading	Variance Explained (%)	Eigenvalues
Production and price (F1)		71.96	7.92	Production (F1)		67.60	7.44
Yield variability	0.347			Yield variability	0.449		
Pests and diseases	0.327			Pests and diseases	0.435		
Water scarcity	0.324			Water scarcity	0.417		
Soil fertility	0.357			Soil fertility	0.382		
Pollination failure	0.337			Pollination failure	0.434		
Commodity Price	0.331			Farmers' capacity and government policy (F2)		15.64	1.72
Input price	0.356						
Capital return	0.367			Farmers' skill	0.550		
Farmers' capacity and government policy (F2)		10.94	1.20	Asset	0.418		
				Government policy	0.362		
Farmers' skill	0.779			Capital return	0.351		
Asset	0.458			Commodity Price	0.358		
Government policy	0.387			Input price	0.362		
Total variance explained		82.90		Total variance explained		83.24	

Source: Field survey data.
Note: Factor loading is over 0.3 and eigenvalues is over 1. KMO risk impact perception = 0.93, KMO risk probability perception = 0.89.

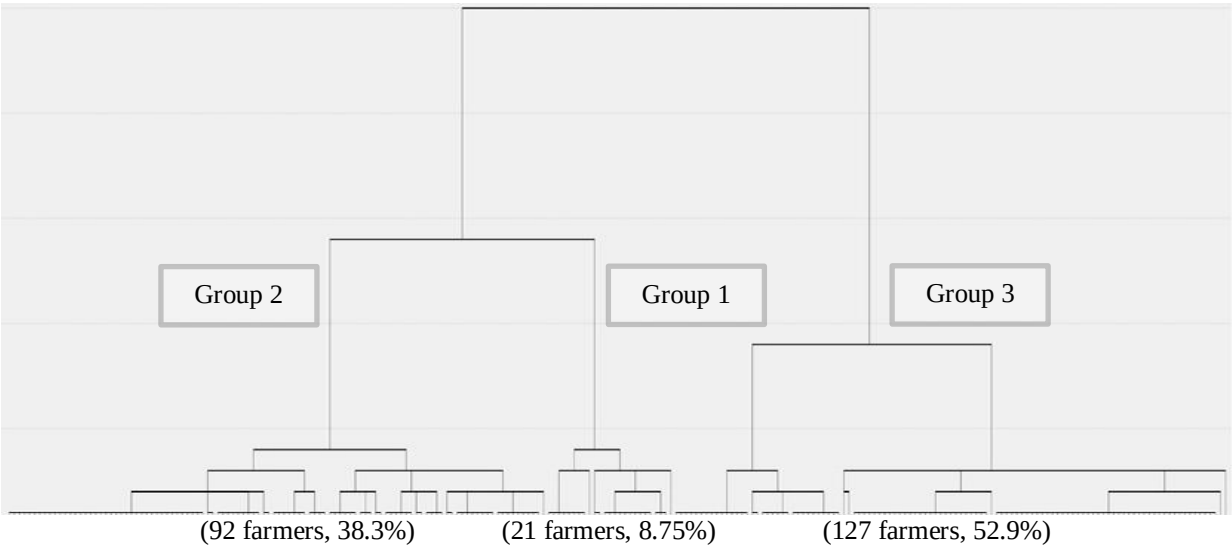
Using the common factors of motivation for farming and risk perception (impact and probability) from the PCA, risk behavior, and the CEI, the farmers that had similar characteristics were grouped by the CA (Table 5.12 and Figure 5.9). Group 1 was farmers (8.75 percent of the total farmers) who had higher mean values for the cultural and economic motivations but lower technical and environmental motivations. In addition, they had low mean values of risk perception on both risk impact and risk probability (lower than 2.5). The mean value of the CEI and risk behavior of this group was 0.04 and Rp22,857, respectively, suggesting that they were risk-taker and practiced single cropping pattern.

Group 2 was farmers (38.3 percent of the total farmers) who had a higher mean value for the economic and cultural motivations but lower technical and environmental motivations. The mean values of the economic motivation (0.38) and the cultural motivation (0.4) were slightly higher than those of Group 1. They had low mean values of risk perception, both risk impact and risk probability (lower than 2.5). Regarding risk behavior, they were risk-neutral, as their mean value of risk behavior was Rp11,304. The mean value of CEI (0.13) was higher than that of the CEI of Group 1, suggesting that Group 2 more diversified its cropping pattern than Group 1.

Table 5.12 Cluster analysis based on risk behavior, CEI, risk perception, and motivation

Cluster	Mean Values										Number of Farmers		
	CEI	RB	MF				RPF				CP	No (%)	Total
							RI		RP				
			E	T	EV	CT	P	FCG	P	FCG			
1	0.04	22,857	0.33	0.14	0.16	0.38	1.59	1.17	1.12	0.99	1 2 3 4	19 (90.5%) 1 (4.8%) 1 (4.8%) 0 (0%)	21 (8.75%)
2	0.13	11,304	0.38	0.12	0.13	0.40	1.97	1.46	1.65	1.05	1 2 3 4	65 (70.7%) 5 (5.4%) 13 (14.1%) 9 (9.8%)	92 (38.3%)
3	0.28	4,370	0.49	0.18	0.17	0.44	3.05	2.25	2.79	1.48	1 2 3 4	25 (19.7%) 36 (28.35) 51 (40.2) 15 (11.8%)	127 (52.9%)

Source: Author.
Note: Cluster analysis uses K-means method; CEI = Composite Entropy Index; RB = Risk behavior; MF = Motivation factor; E = Economic; T = Technical; EV = Environmental; CT = Cultural; RPF = Risk perception factor; RI = Risk impact; RP = Risk probability; P = Production and price; FCG = Farmers' capacity and government policy; CP = cropping pattern.



Source: Author.

Figure 5.9 The dendrogram of CA

Group 3 was farmers (52.9 percent of the total farmers) who had a higher mean value for the economic and cultural motivations but lower technical and environmental motivations. The mean values of the economic motivation (0.49) and the cultural motivation (0.44) were slightly higher than those of Group 1 and Group 2. They had higher mean values of risk perception on both impact and probability perception (higher than 2.5) of production and price risk. They were risk-averse as they had a mean value of risk behavior around Rp4,370. The mean value of CEI (0.28) was higher than those in Group 1 and 2, suggesting that Group 3 more diversified its cropping pattern than Group 1 and 2.

It can be found that the majority of farmers (77.1 percent, 84 out of 109 farmers) who practiced single cropping pattern had low economic motivation as well as risk perception (impact and probability). The risk-neutral farmers dominated this group (59.6 percent, 65 out of 109 farmers). Meanwhile, the majority of farmers (77.9 percent, 102 out of 131 farmers) who practiced cropping pattern diversification had high economic motivation and risk perception (impact and probability), and they were risk-averse farmers (80.3 percent, 102 out of 127 farmers).

5.4 Conclusions

Economic motivations were the major reasons for farmers practicing cropping pattern diversification, particularly for farmers who practiced three or four cropping patterns. “Knowledge and skills” was a key factor in practicing cropping pattern diversification. There was a tendency, when farmers were risk-averse, they diversified the cropping pattern. Meanwhile, the majority of risk-neutral and risk-taker farmers practiced single cropping pattern. Moreover, this study revealed a relationship between the number of cropping patterns practiced by farmers and their risk perception. Farmers who practiced cropping pattern diversification had a higher risk impact and probability perception than those practicing single cropping pattern (paddy-paddy-paddy).

As a whole, the characteristics of farmers who practiced cropping pattern diversification are as follows: (1) high-risk perception (impact and probability); (2) risk-averse; (3) economic motivations. This implies that to adopt a risk coping strategy, farmers should aware that there are risks that may impact on farming income and be motivated to increase their prosperity (economic motivations). In this study, around one-third of farmers had risk-neutral characteristics (92 farmers, 38.3 percent) and low-risk perception (impact and probability), of whom around 70.7 percent practiced single cropping pattern. They may not adopt any risk coping strategies unless they are aware of the risks that they face. Improving awareness about the negative impacts of risks on income from farming might encourage them to adopt risk coping strategies for both on-farm risk coping (such as cropping pattern diversification) and off-farm risk coping (such as agricultural insurance).

CHAPTER 6. DETERMINANTS OF FARMERS' DECISION ON RISK COPING STRATEGIES IN RURAL WEST JAVA[19]

6.1 Introduction

Farmers adopt strategies to cope with risks to sustain their livelihood. Under a given condition, farmers select ex-ante or ex-post strategies to cope with farming risks. According to Cooper et al. (2008), farmers tend to adopt ex-post strategies to minimize the impacts of disasters. World Bank (2001) note that, in principle, the best approach to reduce risks is to take actions that anticipate the adverse impacts of disasters or to adopt ex-ante strategies because the function of ex-post strategies is to address the failures of ex-ante strategies.

One government policy categorized as an ex-ante coping strategy that enhances farmers' risk coping capacity is agricultural insurance. The Indonesian government decided to implement agricultural insurance in 2015. However, its participation rate in 2016 was still low, at around 23.3 percent of the target farmers (Jasindo, 2017). For the Indonesian government to motivate farmers to purchase agricultural insurance as a risk coping strategy, as the first step toward the amendment of agricultural insurance policies, it is important to understand farmers' risk coping behaviors and their constraints, especially for farmers who have not yet purchased agricultural insurance.

The present study had two objectives: (1) to identify determinants of decisions on ex-ante coping strategies; and (2) to identify determinants of decisions on ex-post coping strategies. For the analysis, the choice to adopt strategies, number of strategies, and types of strategies are considered as aspects of decisions. In reality, not all farmers adopt ex-ante coping strategies, whereas almost all farmers who have experience with disasters adopt ex-post coping strategies. When adopting ex-post coping strategies after a certain disaster has occurred, the stress level of

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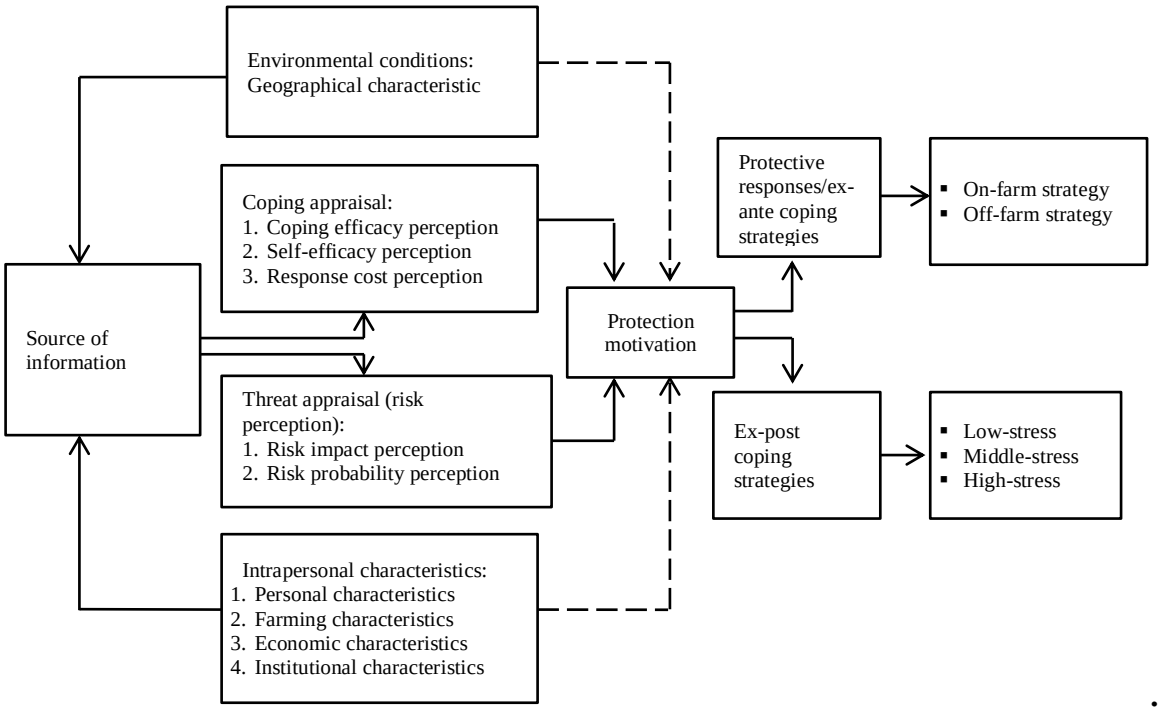
the ex-post coping strategy influences farmers' capacities for choosing ex-ante coping strategies in the future (adaptive capacity). Hence, the above-mentioned aspects are significant to ex-post strategy analysis.

6.2 Methodology

6.2.1 Framework

PMT explains decisions on taking protective responses based on socio-psychological factors. According to the PMT presented in Figure 6.1, two processes are involved in risk evaluation. The first is a threat appraisal known as risk perception, which involves two assessments: risk impact perception and risk probability perception. The second is a coping appraisal, which involves three evaluations: coping efficacy, self-efficacy, and cost-efficacy (Rogers & Prentice-Dunn, 1997).



Source: Modified from Rogers & Prentice-Dunn (1997) (Figure 1, p. 114).
Note: → = the process of PMT; - > = predicted to directly influence protection motivation.

Figure 6.1 The framework used in the study

Based on the PMT, the key mediator of the relationship among threat appraisal, coping appraisal, and behavior is protection motivation (Milne et al., 2000; Paxson, 1992; Rogers & Prentice-Dunn, 1997), which is a combination of threat and coping appraisal assessments. The processes of the two assessments are sequential (Gebrehiwot & van der Ven, 2015). Before conducting coping appraisal (assessment of adaptive options), farmers must first believe that a threat is present (Gebrehiwot & van der Ven, 2015; Rogers & Prentice-Dunn, 1997). Threat appraisal evaluates the perceived probability and impact of harm. This process occurs before coping appraisal because to evaluate the adaptive options farmers have to perceive a threat (Grothmann & Reusswig, 2006). The combination of threat and coping appraisal assessments determines the protection motivation. If the protection motivation is high, this motivation should be converted into taking ex-ante coping strategies; otherwise, it will result in taking ex-post coping strategies. Taking ex-post coping strategies, furthermore, influences the adaptive capacity of farmers to anticipate expected future risks, which depends on the resource value and its degree of reversibility allocated for taking ex-post coping strategies. In this study, ex-ante coping strategies were grouped into on-farm and off-farm strategies. Ex-post coping strategies were grouped into three types of stress levels: low, middle, and high (Cohen & Sebstad, 2005; Montgomery, 1996).

6.2.2 Data Collection

Face-to-face interviews were conducted to collect data on farmers' ex-ante and ex-post coping strategies. First, farmers were asked whether they knew of agricultural insurance. If they did not, the interview was continued; if so, they were excluded. The farmers were asked whether they had performed ex-ante risk coping strategies in the last five years (January 2012–December 2016) to reduce the impacts of disasters. If they had, they were asked what types of coping strategies they had adopted. As for ex-post coping strategies, farmers were asked what types of ex-post coping strategies they had adopted after disasters had occurred. Farmers' characteristics (personal, economic, financial, institutional, and farming) were collected. At the end of the

interview, to measure risk behavior, trust, and discount rate, a game was played following procedures used by Schechter (2007) and Kirby et al. (2002). Variables for the analysis in the study are presented in Table 6.1.

Table 6.1 Variables used in the study

Variable	Description	Symbol	Expected Sign
Personal characteristics			
Age	Age of farmer (year)	AGE	Positive
Education	Farmer's formal education years (year)	EDU	Positive
Sex	1 = male, 0 = otherwise	SEX	Positive
Risk behavior	Value of money taken by a farmer in the risk game (Rp)	RISK	Positive
Discount rate	Farmer's preference in discount rate games	DISC	Negative
Trust	Value of money given by a farmer in the trust game (Rp)	TRUST	Positive
Disaster experience	Average disaster experience (disaster number/season)	DISEXP	Positive
Percentage of damage	The highest percentage of damage (percentage)	PDM	Positive
Risk perception			
Risk impact perception	Very low = 1, low = 2, high = 3, very high = 4	RIP	Positive
Risk probability perception	Very low = 1, low = 2, high = 3, very high = 4	RPP	Positive
Coping appraisal perception			
Coping efficacy perception	Very low = 1, low = 2, high = 3, very high = 4	CEA	Positive
Self-efficacy perception	Very low = 1, low = 2, high = 3, very high = 4	SEA	Positive
Cost perception	Very low = 1, low = 2, high = 3, very high = 4	CA	Negative
Economic characteristics			
Per capita living expenditure	Per capita living expenditure of food and non-food (Rp/year/person)	EXPD	Positive
Asset value	Total physical (non-land) and financial asset values (Rp)	ASST	Positive
Farming characteristics			
Farmland size	Farmland size managed by a farmer (ha)	LAND	Positive
Type of farmland	1 = irrigated, 0 = rain-fed	TF	Positive
Landholding			
Sharecropping	1 = sharecropping, 0 = otherwise	SHARE	Positive
Rent in cash	1 = rent in cash, 0 = otherwise (privately-owned land as the base case)	RIC	Positive
Access to financial institutions			
Bank account	1 = own bank account, 0 = otherwise	BANK	Positive
Geographical location			
Downstream	1 = living in the downstream area, 0 = otherwise	DSTR	Positive
Midstream	1 = living in the midstream area, 0 = otherwise (Upstream as the base case)	MSTR	Positive

Source: Author.
Note: Accumulative frequency is used to convert ordinal to cardinal data.

6.2.3 Data Analysis

6.2.3.1 Binary Data Estimation: Adopt or Not Adopt

The decision on adopting ex-ante coping strategies was recorded as yes or no (a binary response). The model for analysis is the binomial logit model.

$$y\begin{cases}1 = \text{if farmer adopts an ex} - \text{ante coping strategy} \\ 0 = \text{if farmer does not adopt an ex} - \text{ante coping strategy}\end{cases}$$

The decision is influenced by the expected utility of wealth from adopting coping strategies. If the utility level after disasters without ex-ante coping strategies is $U(\omega^a)$ and the utility level after disasters with ex-ante coping strategies is $U(\omega^b)$, farmers adopt ex-ante coping strategies when they believe that coping strategies will stabilize the utility level compared to without coping strategies. This occurs when $U(\omega^b) > U(\omega^a)$. When farmers decide to adopt ex-ante coping strategies, the value is called a latent variable, being unobservable. The latent variable $(U^*(\omega_i))$ can be determined by factors that are predicted to influence the decision. Therefore, the utility level of wealth can be written as:

$$U^*(\omega_i) = \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i \qquad i = 1,2,3,\dots,n \tag{6.1}$$

where x_k $(k = 1,2,\dots,K)$ represents determinants (independent variables) of a decision such as personal characteristics, β_k is the coefficient of independent variable k, and ε is the error term. The decision to adopt ex-ante coping strategies can be rewritten as follows:

$$y_i^* \begin{cases}1 \; if \; U^*(\omega^{\mathrm{b}}) \; > \; U^*(\omega^{\mathrm{a}}) \\ 0 \; if \; U^*(\omega^{\mathrm{b}}) \; < \; U^*(\omega^{\mathrm{a}})\end{cases}$$

According to Wooldridge (2013), supposing that the probability of farmer i adopting ex-ante coping strategies is represented by P_i, the equation for the logit model can be written as:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \ln e^{\sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i} = \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i \tag{6.2}$$

where e is the base of the natural logarithm, and $\sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i$ is the function of farmers' characteristics. The equation of the logit model can be rewritten as follows:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 SEX_i + \beta_4 RISK_i + \beta_5 DISC_i + \beta_6 TRUST_i + \beta_7 DISEXP_i + \beta_8 PDM_i + \beta_9 RIP_i + \beta_{10} RPP_i + \beta_{11} CEA_i + \beta_{12} SEA_i + \beta_{13} CA_i + \beta_{14} EXPD_i + \beta_{15} ASST_i + \beta_{16} LAND_i + \beta_{17} TF_i + \beta_{18} SHARE_i + \beta_{19} RIC_i + \beta_{20} BANK_i + \beta_{21} DSTR_i + \beta_{22} MSTR_i + \varepsilon_i \quad (6.3)$$

One important statistical feature in the logit model is the marginal effect that shows the change of probability on adopting ex-ante coping strategies when there is a unit change in an independent variable, and the other independent variables are constant. The marginal effect ($\frac{\partial y_i}{\partial x_k}$) of independent variable k with a coefficient β_k can be written as follows:

$$\frac{\partial y_i}{\partial x_k} = \frac{e^{\sum_{k=1}^{K} \beta_k x_{ki}}}{(1 + e^{\sum_{k=1}^{K} \beta_k x_{ki}})^2} \beta_k \quad (6.4)$$

6.2.3.2 Count Data Estimation: Number of Ex-Ante Coping Strategies Adopted

There is a possibility that there are different behaviors among farmers who adopt ex-ante coping strategies. Due to different determinants, some farmers adopt one strategy, whereas others adopt more than one. When analyzing the number of ex-ante coping strategies adopted by farmers, the data are count data. One appropriate model to analyze count data with positive responses ($y > 0$) is the zero truncated Poisson regression model (ZTPRM).

The econometric equation in the ZTPRM is based on Green (2003). Suppose that the number of ex-ante coping strategies chosen by a farmer in a given period is y. To identify the effects of independent variables (x) on y, the Poisson distribution of independent variables (x) is analyzed. The Poisson distribution is specified by the mean value. If e is the base of the natural logarithm, the expected value (E) of the mean parameter (γ) is an exponential function as follows:

$$E(y_i|\mathbf{x}_i) = \gamma_i = e^{\sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i} \quad (6.5)$$

when y is a Poisson random variable conditional on x, the probability of the density function can be written as:

$$P(y_i = j|\mathbf{x}_i) = \frac{e^{-\gamma_i}\gamma_i^j}{j!}, \qquad j = 0, 1, 2, 3, \dots, n \tag{6.6}$$

where j is the number of ex-ante coping strategies adopted, which is dependent on the value of γ_i.

In the ZTPRM, positive values ($y > 0$) are used. If the probability of farmers without adopting ex-ante coping strategies is equal to $e^{-\theta}$, Equation (6.6) can be expressed as follows:

$$\begin{gathered} if\ P(y_i = 0|\mathbf{x}_i) = e^{-\theta} \\ P(y_i = j|\mathbf{x}_i) = \frac{(1 - e^{-\theta})e^{-\gamma_i}{\gamma_i}^j}{j!\ (1 - e^{-\gamma_i})}, \qquad j = 1, 2, 3, \dots, n \end{gathered} \tag{6.7}$$

Supposing that EXP represents an exponential function, the equation of γ_i is as follows:

$$\begin{aligned} E(y_i|\mathbf{x}_i) = \gamma_i = EXP\ (&\beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 SEX_i + \beta_4 RISK_i + \beta_5 DISC_i \\ &+ \beta_6 TRUST_i + \beta_7 DISEXP_i + \beta_8 PDM_i + \beta_9 RIP_i + \beta_{10} RPP_i \\ &+ \beta_{11} CEA_i + \beta_{12} SEA_i + \beta_{13} CA_i + \beta_{14} EXPD_i + \beta_{15} ASST_i \\ &+ \beta_{16} LAND_i + \beta_{17} TF_i + \beta_{18} SHARE_i + \beta_{19} RIC_i + \beta_{20} BANK_i \\ &+ \beta_{21} DSTR_i + \beta_{22} MSTR_i + \varepsilon_i) \end{aligned} \tag{6.8}$$

In ZTPRM, the marginal effect ($\frac{\partial y_i}{\partial x_k}$) of independent variable k with the coefficient β_k can be written as follows:

$$\frac{\partial y_i}{\partial x_k} = \beta_k e^{\sum_{k=1}^{K} \beta_k x_{ki}} \tag{6.9}$$

The proportion, by which the dependent variable changes for a unit change in independent variable k with the coefficient β_k, is called the Incidence Rate Ratio (IRR). Its equation can be expressed as:

$$IRR_{x_k} = e^{\beta_k} \tag{6.10}$$

There is a restriction on the ZTPRM: the variance of the model has to be equal to the mean, $Var(y|x) = E(y|x) = \gamma$. This assumption can sometimes be violated because the variance in the model (y_i) can be either higher or lower than the mean. To avoid this problem, the standard error has to be adjusted. The zero truncated negative binomial model (ZTNBM) is one of the alternative models after the variance is adjusted. Based on Hilbe (2011), after the standard error is

adjusted, the variance equation can be written as $Var(y|x) = \gamma_i + \alpha\gamma_i{}^2$. When the standard error is equal to 0 ($\alpha = 0$), the model fulfills the assumption (restricted model). Under this condition, the ZTPRM is used. If the standard error is higher than 0 ($\alpha > 0$), called overdispersion, the ZTNBM is used. When the standard error is lower than 0 ($\alpha < 0$), this is called underdispersion. To select either restricted model or unrestricted model, the likelihood statistic test (φ) is applied by examining the null hypothesis with an equation as follows:

$$\varphi = -2\ \left[\ln(\mathrm{l}_{\mathrm{ztnbm}}) - \ln(\mathrm{l}_{\mathrm{ztprm}})\right] \tag{6.11}$$

6.2.3.3 Categorical Data Estimation: Types of Adopted Ex-Post Coping Strategies

When a disaster occurs, farmers have to adopt ex-post coping strategies. These can be categorized based on stress levels: low, middle, and high (Cohen & Sebstad, 2005; Montgomery, 1996). The multinomial logit model (MLM) can be applied in the analysis. When farmer i adopts type j ex-post coping strategy, based on Green (2003), the equation can be written as:

$$y_{ij} = \begin{cases} 1 = if\ farmer\ i\ takes\ ex - post\ coping\ strategy\ j \\ 0 = otherwise \end{cases}$$

Supposing that x represents a variable that influences the decision on adopting a certain type of ex-post coping strategy, β represents the coefficient of each variable, and e is the base of the natural logarithm, the MLM can be written as:

$$P(y_i = j|\mathbf{x}_i) = P_{ij} = \frac{e^{\boldsymbol{\beta}_j \mathbf{X}_i'}}{1\ + \sum_{k=1}^{3} e^{\boldsymbol{\beta}_k \mathbf{X}_i'}}, \qquad j = 1,2,3 \tag{6.12}$$

The response variable (j) has three possible outcomes: low-stress (1); middle-stress (2); and high-stress (3). In addition, middle-stress (2) is considered as a base case in this study. Therefore, there are two non-redundant sub-models as follows:

$$Model\ 1 = \ln\left(\frac{y_i = low - stress}{y_i = middle - stress}\right) = \beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 SEX_i + \beta_4 RISK_i + \beta_5 DISC_i + \beta_6 TRUST_i + \beta_7 DISEXP_i + \beta_8 PDM_i + \beta_9 EXPD_i + \beta_{10} ASST_i + \beta_{11} LAND_i + \beta_{12} TF_i + \beta_{13} SHARE_i + \beta_{14} RIC_i + \beta_{15} BANK_i + \beta_{16} DSTR_i + \beta_{17} MSTR_i + \varepsilon_i \quad (6.13)$$

$$Model\ 2 = \ln\left(\frac{y_i = high - stress}{y_i = middle - stress}\right) = \beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 SEX_i + \beta_4 RISK_i + \beta_5 DISC_i + \beta_6 TRUST_i + \beta_7 DISEXP_i + \beta_8 PDM_i + \beta_9 EXPD_i + \beta_{10} ASST_i + \beta_{11} LAND_i + \beta_{12} TF_i + \beta_{13} SHARE_i + \beta_{14} RIC_i + \beta_{15} BANK_i + \beta_{16} DSTR_i + \beta_{17} MSTR_i + \varepsilon_i \quad (6.14)$$

The marginal effect $\left(\frac{\partial P_{ij}}{\partial \mathbf{x}_i}\right)$ of an independent variable with a coefficient β_k on the probability of adopting ex-post coping strategy j can be expressed as:

$$\frac{\partial P_{ij}}{\partial \mathbf{x}_i} = P_{ij}(\boldsymbol{\beta}_j - \overline{\boldsymbol{\beta}}) \quad (6.15)$$

Diagnostic procedures are conducted adequately for reliability analysis as follows: First, variance inflation factors (VIF) are calculated to check for multicollinearity problems. Second, the link test is conducted to determine the right model to use. Third, for the ZTPRM, an adjustment of standard error followed by the likelihood statistic test is undertaken to check whether the model has overdispersion or underdispersion problem.

6.3 Results and Discussions

6.3.1 Farmers' Characteristics

As shown in Table 6.2, most of the interviewed farmers were male (92.2 percent). The average age of the farmers was 51.8 years, and their education level was 7.3 years. On average, farmland size managed by farmers was 0.43 ha, of which around three-quarters were irrigated. The largest share of farmers was sharecroppers (49.4 percent).

Table 6.2 Summary of farmers' characteristics

Independent Variable	Number of Farmers = 180	
	Mean	SD
Personal characteristics		
Age (year)	51.8	8.766
Education (year)	7.3	2.866
Sex (percentage of men)	92.2	0.883
Risk behavior (Rp)	21,638	5280
Discount rate (%)	36.9	23.73
Trust (Rp)	8833	6233
Disaster experience (times/season)	1.5	0.350
Percentage of damage	74.6	25.78
Risk perception		
Risk impact perception	0.66	0.325
Risk probability perception	0.83	0.341
Coping appraisal		
Coping efficacy perception	0.79	0.314
Self-efficacy perception	0.68	0.278
Cost perception	0.71	0.252
Economic characteristics		
Per capita living expenditure (Rp mil/year/person)	9.7	2.127
Asset value (Rp mil)	91.9	98.487
Farming characteristics		
Farmland size (ha)	0.43	0.295
Type of farmland (% irrigated land)	77.2	0.421
Landholding		
Sharecropping (%)	49.4	5.013
Rent in cash (%)	5	2.186
Access to financial institutions		
Bank account (% ownership)	28.33	4.518
Geographical location		
Downstream (%)	33%	47.27
Midstream (%)	33%	47.27

Source: Field survey data.

6.3.2 Farmers' Experience of Disasters

There were five types of risks experienced by farmers: droughts, floods, pests and diseases, deficit rainfall, and excessive rainfall. Table 6.3 presents the average number of disasters experienced by farmers during 2012–2016. The most frequent disaster in each crop season was pests and diseases. The least frequent disaster was floods, which occurred in crop Season 1 and 2 in downstream and midstream areas. Therefore, the major risk in the area was pests and diseases, which all farmers experienced in almost every crop season and occurred in downstream, midstream, and upstream areas.

Table 6.3 Average number of disasters

Type of Disaster	Average Number of Disasters per Season per Farmer								
	Downstream			Midstream			Upstream		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
Droughts	0.00	0.00	0.24	0.00	0.00	0.01	0.00	0.00	0.14
Floods	0.07	0.08	0.00	0.05	0.07	0.00	0.00	0.00	0.00
Pests and diseases	0.30	0.32	0.29	0.32	0.35	0.27	0.33	0.34	0.31
Rainfall deficit	0.01	0.01	0.08	0.05	0.04	0.36	0.00	0.00	0.02
Excessive rainfall	0.12	0.13	0.01	0.05	0.06	0.004	0.05	0.04	0.02

Source: Field survey data.
Note: S = crop season. S1 and S2 belong to the wet seasons, while S3 to the dry season.

6.3.3 Farmers' Risk Coping Strategies

6.3.3.1 Ex-Ante Coping Strategies

There are two types of ex-ante coping strategies adopted by the farmers: on-farm and off-farm. On-farm coping strategy is to reduce negative impacts on agricultural production by farming practices, including water management, planting in different plots, and crop diversification. There are three off-farm coping strategies: income diversification, saving, and rotating savings and credit association (ROSCA). According to the survey data, 134 out of 180 farmers (74.4 percent) adopted ex-ante coping strategies. As shown in Table 6.4, 60 percent of farmers used income diversification as a coping strategy, while around one-third used saving (31.7 percent) as a coping strategy. The highest number of ex-ante coping strategies adopted by a farmer was four (eight farmers). Coping strategies were a mix of on-farm and off-farm types.

Table 6.4 Farmers' adoption of ex-ante coping strategies by type (on-farm and off-farm)

Type	Number of Farmers (%)
On-farm strategy	
Water management	6 (3.3%)
Planting in different plots	30 (16.7%)
Crop diversification	35 (19.4%)
Off-farm strategy	
ROSCA	7 (3.8%)
Income diversification	108 (60%)
Saving	57 (31.7%)

Source: Field survey data.
Note: Percentages were calculated by dividing the number of farmers adopting an ex-ante coping strategy by the total number of farmers (180 farmers).
ROSCA = rotating savings and credit association.

Overall, the number of farmers who adopted more than one ex-ante coping strategy was higher than that of farmers who adopted only one ex-ante coping strategy.

6.3.3.2 Ex-Post Coping Strategies

All the farmers in the study area experienced disasters and adopted ex-post coping strategies. There were 10 ex-post coping strategies adopted by the farmers (Table 6.5). Overall, most farmers chose middle-stress level of ex-post coping strategies, among which the frequency of receiving help from relatives was the highest (122 farmers, 67.7 percent). The lowest frequency was taking children out of school adopted by four farmers (2.2 percent).

Table 6.5 Farmers' adoption of ex-post coping strategies by stress type

Type	Number of Farmers (%)
Low-stress	
Modify consumption pattern	7 (3.9%)
Increase household budget	45 (25%)
Middle-stress	
Utilize savings	37 (20.6%)
Borrow from formal and informal sources	34 (18.9%)
Get help from relatives	122 (67.7%)
Migrate to find jobs	22 (12.2%)
High-stress	
Sell consumption assets	13 (7.2%)
Sell production assets	25 (13.9%)
Default on loan(s)	32 (17.8%)
Take children out of school	4 (2.2%)

Source: Field survey data.
Note: Percentages were calculated by dividing the number of farmers taking an ex-post coping strategy by the total number of farmers (180 farmers).

A farmer might adopt more than one ex-post coping strategy. At most, four ex-ante coping strategies were adopted (three farmers, 1.7 percent). The majority of farmers adopted two ex-post coping strategies, which accounted for 39.4 percent of the total farmers. Farmers who adopted more than one type of ex-post coping strategy were more common than farmers who adopted one type of ex-post coping strategy.

6.3.4 Farmers' Behavior to Risk Coping Strategies

When farmers adopt ex-ante coping strategies, they might adopt a combination of ex-ante coping strategies. According to Table 6.6, when selecting one ex-ante coping strategy (59 out of 134 farmers), off-farm strategies were preferred to on-farm strategies, but it is mostly limited to income diversification (47 farmers, 79.7 percent).

Table 6.6 Combination of ex-ante coping strategies adopted by farmers

Number of Coping Strategies	On-Farm Strategy			Off-Farm Strategy			Number of Farmers (%)
	Water Management	Planting in Different Plot	Crop Diversification	ROSCA	Income Diversification	Saving	
1			√				8 (13.6%)
					√		47 (79.7%
						√	4 (6.8%)
2		√	√				2 (4.2%)
			√		√		8 (17%)
		√		√			3 (6.4%)
		√				√	2 (4.2%)
		√			√		4 (8.5%)
	√				√		2 (4.2%)
					√	√	26 (55.3%)
3	√		√			√	1 (5%)
		√	√		√		2 (10%)
		√	√			√	3 (15%)
	√				√	√	2 (10%)
			√		√	√	6 (30%)
		√			√	√	5 (25%)
		√		√		√	1 (5%)
4		√	√		√	√	4 (50%)
		√	√	√		√	1(12.5%)
	√	√		√		√	1 (12.5%)
		√		√	√	√	2 (25%)

Source: Field survey data.

In the case of selecting multiple ex-ante coping strategies, a combination of two ex-ante coping strategies was the most popular. Although at first glance, the combination was varied, the major combination was limited to selecting off-farm strategies rather than combining on-farm and off-farm strategies. Although being minor, when selecting three or four ex-ante coping strategies, both on-farm and off-farm strategies were combined. However, the "Water management" on-farm strategy and "ROSCA" off-farm strategy were not highly preferred. In other words, cropping practices, such as "Planting in different plots" and "Crop diversification",

and own capital, such as “Income diversification” and “Saving”, were the major means.

When ex-ante coping strategies fail to address risks, farmers rely on ex-post coping strategies to cope with loss caused by those risks. Even with ex-post coping strategies, farmers can select many ex-post coping strategies depending on conditions. As shown in Table 6.7, in terms of the number of ex-post coping strategies, there were 29 combinations of ex-post coping strategies. Although two ex-post coping strategies were preferred by 71 out of 180 farmers, only one ex-post

Table 6.7 Combination of ex-post coping strategies adopted by farmers

Number of Coping Strategies	Low-Stress		Middle-Stress				High-Stress				Number of Farmers (%)
	MCN	IHB	USV	BRW	GHR	MFJ	SCA	SPA	DOL	TCS	
1		√									24 (36.9%)
					√						32 (49.2%)
			√								7 (10.8%)
								√			2 (3.1%)
2	√	√									4 (5.6%)
		√			√						8 (11.3%)
			√	√							15 (21.1%)
			√		√						7 (9.9%)
				√	√						6 (8.4%)
				√		√					1 (1.4%)
					√	√					8 (11.3%)
					√			√			5 (7%)
					√				√		14 (19.7%)
							√	√			2 (2.8%)
							√			√	1 (1.4%)
3	√	√			√						2 (4.9%)
		√		√	√						5 (12.2%)
	√						√	√			1 (2.4%)
			√	√	√						1 (2.4%)
			√		√	√					7 (17.1%)
				√	√		√				1 (2.44%)
				√	√	√					2 (4.9%)
					√	√	√				1 (2.4%)
					√	√		√			1 (2.4%)
					√		√	√			3 (7.3%)
					√	√			√		1 (2.4%)
					√			√	√		11 (26.8%)
					√		√		√		1 (2.4%)
					√				√	√	3 (7.3%)
								√	√	√	1 (2.4%)
4		√		√	√		√				1 (33.3%)
			√		√	√	√				1 (33.3%)
		√	√		√	√					1 (33.3%)

Source: Field survey data.

Note: MCP = Modification consumption pattern; IHB = Increase household budget; USV = Utilize savings; BRW = Borrow from formal and informal resources; GHR = Get help from relative; MFJ = Migrate to find jobs; SCA = Sell consumption assets; SPA = Sell production assets; DOL = Default on loan(s); TCS = Take children out from school.

coping strategy (65 farmers out of 180 farmers) was equally high. Adopting three ex-post coping strategies (31 out of 180 farmers) was less common but represented a significant selection. In terms of combinations from the viewpoint of stress level, ex-post coping strategies at the low-stress level were less frequently selected. Even when selecting three ex-post coping strategies, middle-stress and high-stress coping strategies were preferred. Selecting only one ex-post coping strategy, either "Increase in the household budget" or "Get help from relatives", was comparatively preferred. For selecting two or three ex-post coping strategies, although the combination was diverse, the top three combinations were as follows in terms of mode: "Use savings" (middle-stress) and "Borrow from formal and informal resources" (middle-stress) (15 farmers, 21.1 percent), "Get help from relatives" and "Default on loans" (14 farmers, 19.7 percent), and "Get help from relatives", "Sell production assets", and "Default on loans" (11 farmers, 26.8 percent).

6.3.5 Determinants of Adopting Risk Coping Strategies

6.3.5.1 Determinants of Adopting Ex-Ante Coping Strategies

Table 6.8 shows estimated coefficients, marginal effects, and odds ratios of parameters from the binomial logit model. According to the Chi-squared test, the joint determinants of adopting ex-ante coping strategies are significant at the 1 percent level. The result of the link test indicates that the model is precisely specified. Moreover, as the highest value of the variance inflation factor (VIF) is 3.77, there is no multicollinearity in the model.

The result of the logit model shows that risk behavior, disaster experience, coping efficacy, self-efficacy, and per capita living expenditure positively and significantly determine the decision on ex-ante coping strategies. Meanwhile, discount rate, percentage of damage, cost perception, and farmland size significantly negatively influence the decision on ex-ante coping. Farmers in the downstream and midstream areas significantly adopt fewer ex-ante coping strategies compared to those in the upstream area.

Table 6.8 Estimated coefficients, marginal effects, and odds ratios of the binomial logit model

Variable	Estimated Coefficient		Marginal Effect [a]		Odds Ratio	SE
	Coef.	SE	Coef.	SE		
Dependent variable: 1 if a farmer has adopted ex-ante coping strategies, 0 otherwise						
Constant	−11.3906	5.2333			0.0001^{-1}	0.0006^{-1}
Personal characteristics						
Age^2 (x_1)	0.0003	0.0006	0.0001^{-1}	0.0003^{-1}	1.0003	0.0006
Education (x_2)	0.4627	0.3404	0.0261	0.0187	1.5883	0.5407
Sex (x_3)	0.4967	1.4267	0.0279	0.0802	1.6433	2.3445
Risk behavior (x_4)	0.0002 **	0.0001	0.0001^{-1} **	0.0046^{-4}	1.0002 **	0.0001
Discount rate (x_5)	−4.7439 *	2.7574	−0.2673 *	0.1496	0.0087 *	0.0240
Trust (x_6)	0.0351^{-4}	0.0001	0.0198^{-5}	0.0636^{-4}	1.0000	0.0001
Disaster experience (x_7)	4.3489 *	2.3680	0.2451 *	0.1278	77.392 *	183.267
Percentage of damage (x_8)	−0.0601 *	0.0312	−0.0034 *	0.0017	0.9416 *	0.0294
Risk perception						
Risk impact perception (x_9)	1.4829	1.9243	0.0836	0.1070	4.4057	8.4779
Risk probability perception (x_{10})	0.8031	1.4172	0.0453	0.0795	2.2325	3.1639
Coping appraisal perception						
Coping efficacy perception (x_{11})	2.0901 *	1.2316	0.1178 *	0.0666	8.0861 *	9.9586
Self-efficacy perception (x_{12})	3.3186 *	1.8304	0.1870 *	0.0989	27.6231 *	50.5619
Cost perception (x_{13})	−7.0087 ***	2.2025	−0.3949 ***	0.1044	0.0009 ***	0.0019
Economic characteristics						
Per capita living expenditure (x_{14})	1.0496 ***	0.3959	0.0592 ***	0.0208	2.8566 ***	1.1308
Asset value (x_{15})	0.0066	0.0117	0.0004	0.0006	1.0066	0.0117
Farming characteristics						
Farmland size^2 (ha) (x_{16})	−4.1249 *	2.2867	−0.2325 *	0.1243	0.0162 *	0.0369
Type of farmland (x_{17})	−0.1900	1.3056	−0.0107	0.0737	0.8269	1.0796
Landholding						
Sharecropping (x_{18})	−0.6043	0.9038	−0.0340	0.0508	0.5464	0.4939
Rent in cash (x_{19})	0.3559	2.0748	0.0201	0.1168	1.4275	2.9619
Access to financial institutions						
Bank account (x_{20})	−0.6749	2.0881	−0.0380	0.1173	0.5092	1.0632
Geographical locations						
Downstream (x_{21})	−5.3564 ***	2.2804	−0.3019 **	0.1199	0.0047 ***	0.0108
Midstream (x_{22})	−5.6373 **	1.7401	−0.3177 ***	0.0824	0.0036 ***	0.0062
Predicted 1s that were actual 1s (%)	96.3	Log-likelihood function			−32.9992	
Predicted 0s that were actual 0s (%)	91.1	Prob (Chi^2 > value)			0.0000	
Power of Prediction	95.0	Pseudo R^2			0.6774	
Linktest: _hat	0.000	Varian Inflation Factor (VIF)			3.77	
_hatsq	0.207					

Source: Author.
Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level. [a] Marginal effects were computed at the average of marginal effects.

The result shows that risk-averse farmers significantly adopt ex-ante coping strategies to anticipate the negative impacts of future risks. Risk-averse farmers tend to diversify income, even though the total income might be lower (Ellis, 2000). This result confirms the finding of previous studies that risk-averse farmers tend to use crop diversification as one of the ex-ante coping strategies to reduce failures in production (Bezabih & Sarr, 2012; Cohen & Sebstad, 2005;

DiFalco & Chavas, 2009; Montgomery, 1996). Farmers who have a higher discount rate significantly do not adopt ex-ante coping strategies. This finding is similar to that of Reardon & Vosti (1995), who state that farmers may have a high discount rate and may sacrifice long-term objectives (reducing the adverse impacts of risks). A higher discount rate means that farmers value current resources higher than those in the future. This means that farmers prefer to present benefits from their current resources over those in the future. This condition reduces farmers' investments allocated for ex-ante coping strategies such as saving, from which the benefit will be enjoyed by farmers in the future.

Disaster experience significantly determines the decision to adopt ex-ante coping strategies. The influence of disaster experience on adopting ex-ante coping strategies is consistent with Alam & Collins (2010) and Freedy et al. (1992). Disaster experience delivers knowledge of the adverse impacts of disasters on farmers' wealth. As a result, their motivation to adopt ex-ante coping strategies increases. The percentage of damage has a negative impact on adopting ex-ante coping strategies. This is because a higher percentage of damage means that farmers' income is lower. Therefore, farmers have a lower capacity to invest in ex-ante coping strategies. As reported by Warner et al. (2012), the percentage of damage influences the capacity of individuals to cope with risks.

In terms of prediction, each of the coping appraisal perception variables (coping efficacy, self-efficacy, and cost) were important determinants of adopting ex-ante coping strategies. Farmers who have higher coping efficacy and self-efficacy perceptions significantly adopt ex-ante coping strategies to minimize the impacts of risks. Conversely, farmers who have higher cost perception significantly do not adopt ex-ante coping strategies, in line with previous findings (Bubeck et al., 2018; Gebrehiwot & van der Ven, 2015; Grothmann & Patt, 2005; Grothmann & Reusswig, 2006). In contrast with the prediction, risk perception variables (risk probability and risk impact) were not significant for adopting ex-ante coping strategies. According to the survey data, most farmers reported that the probability of disaster occurrence was high, particularly with

respect to pests and diseases. Therefore, there was almost no difference in terms of risk probability perception between farmers who adopted on and those who did not adopt on ex-ante coping strategies. This condition might have occurred because the objective of ex-ante coping strategies is to minimize the adverse impacts of various risks (five risks in the present study) (Burnham & Ma, 2018; Feola et al., 2015; Osbahr et al., 2008). The insignificant risk perception of adopting ex-ante coping strategies is similar with previous findings (Kreibich et al., 2005; Miceli et al., 2008; Takao, 2003; Thieken et al., 2007), which analyze the effect of risk perception on adopting protective responses to minimize the impacts of the floods.

Regarding economic characteristics, per capita living expenditure was a determinant of adopting ex-ante coping strategies. Farmers with higher per capita living expenditure significantly adopt ex-ante coping strategies, because farmers with high per capita living expenditure have more capacity to do so (Dorward, 1999; Morduch, 1995; Reardon et al., 1992; Rosenzweig & Wolpin, 1993).

Farming characteristics are expected to be essential to the decision on adopting ex-ante coping strategies. Farmland size had a negative impact on the decision. This finding is similar to those of previous studies (Reardon et al., 2000; Shand, 1987). According to the survey, because of small farmland size, farmers had enough time to undertake non-farm income-generating activities as sources of ex-ante coping. Farmers who managed middle-sized farmland tended to concentrate on farming as the main income source and allocated all their time to farming. However, because of small incomes, they could not save part of their incomes as an ex-ante coping strategy. In contrast, farmers who managed larger farmland size could adopt ex-ante coping strategies, such as saving, because they could earn higher incomes with larger farmland size. Therefore, farmers who had larger farmland size significantly adopted ex-ante coping strategies. This condition fitted in the model when the farmland size variable was converted into a squared variable, it increased the prediction power.

Regarding geographical location, the result indicates that farmers in the downstream and

midstream areas adopted fewer ex-ante coping strategies compared to those in the upstream area. This is because in the upstream area, there are many options for cropping due to favorable agro-climatic conditions, resulting in their crop diversification as an ex-ante coping strategy.

6.3.5.2 Determinants of Number of Ex-Ante Coping Strategies Adopted

Farmers adopt different strategies to minimize the total income risk (Walker & Ryan, 1990). The number of ex-ante coping strategies adopted reflects the intensity of the desire to reduce the negative impacts of disasters. An increase in the number of coping strategies strengthens the capacity of farmers to reduce the impacts of disasters, but this reduces valuable resources, in terms of not only money but also time.

The number of ex-ante coping strategies adopted by a farmer was predicted to be influenced by many factors. The model selected is ZTPRM. The choice of the model is strengthened by the values of the log-likelihood of the ZTPRM and ZTNBM, which are identical. The result of overdispersion test shows that the value of α (3.19^{-8}) in the ZTNBM is nearly equal to 0. This low value suggests that the variable response is not overdispersed, and that the model needs to follow the restricted model of the ZTPRM instead of the ZTNBM.

According to the result of the ZTPRM in Table 6.9, among independent variables, there were four determinants of the number of ex-ante coping strategies adopted: per capita living expenditure, farmland size, disaster experience, and access to financial institutions. Access to financial institutions might increase the capacity of farmers to adopt ex-ante coping strategies. For instance, farmers use a financial institution to save some parts of their income and to borrow money to invest in non-farm income-generating activities (Barret et al., 2001; Dercon, 1998; Jacob, 1994; McPeak & Barret, 2001). It is likely that economic affordability (deriving from income, large farmland size, and access to financial institutions) enables farmers to invest in several coping strategies.

Table 6.9 Estimated coefficients and marginal effects of the ZTPRM

Variable	Coefficient Estimates			Marginal Effect [a]	
	Coefficient	IRR	SE	Coef.	SE
Dependent variable: number of ex-ante coping strategies adopted					
Constant	−2.9969	0.0499	0.0801		
Personal characteristics					
Age^2 (x_1)	-0.0002^{-1}	0.9999	0.0002	-0.0002^{-1}	0.0002
Education (x_2)	0.0002	0.0002	0.0533	0.0002	0.0671
Sex (x_3)	−0.1833	0.8325	0.3229	−0.2307	0.4884
Risk behavior (x_4)	-0.0002^{-1}	0.9999	0.0002^{-1}	-0.0001^{-1}	0.0003^{-1}
Discount rate (x_5)	0.4458	1.5618	0.8076	0.5612	0.6521
Trust (x_6)	-0.0001^{-1}	0.9999	0.0002^{-1}	-0.0001^{-1}	0.0002^{-1}
Disaster experience (x_7)	0.6864 *	1.9865	0.7946	0.8641 *	0.5066
Percentage of damage (x_8)	0.0023	1.0023	0.0056	0.0029	0.0071
Risk perception					
Risk impact perception (x_9)	0.7693	2.1583	1.2420	0.9685	0.7271
Risk probability perception (x_{10})	0.2754	1.3170	0.7529	0.3466	0.7202
Coping appraisal perception					
Coping efficacy perception (x_{11})	−0.0166	0.9835	0.5130	−0.0209	0.6567
Self-efficacy perception (x_{12})	0.5159	1.6751	0.9070	0.6495	0.6827
Cost perception (x_{13})	−0.4076	0.6653	0.3656	−0.5131	0.6927
Economic characteristics					
Per capita living expenditure (x_{14})	0.0695 *	1.0719	0.0439	0.0875 *	0.0519
Asset value (x_{15})	0.0006	1.0006	0.0011	0.0008	0.0014
Farming characteristics					
Farmland size (ha) (x_{16})	0.8689 **	2.3845	0.8827	1.0939 **	0.4716
Type of farmland (x_{17})	0.4210	1.5235	0.6157	0.5300	0.5099
Landholding					
Sharecropping (x_{18})	−0.1904	0.8266	0.2418	−0.2397	0.3686
Rent in cash (x_{19})	−0.2164	0.8054	0.5271	−0.2725	0.8241
Access to financial institutions					
Bank account (x_{20})	0.7149 **	2.0439	0.7362	0.8999 **	0.4568
Geographical locations					
Downstream (x_{21})	−0.4738	0.6226	0.2404	−0.5965	0.4877
Midstream (x_{22})	−0.3568	0.6999	0.2445	−0.4492	0.4408
Log-likelihood	−122.0770		Prob (Chi^2> value)		0.0000
McFadden Pseudo R^2	0.2713				

Source: Author.

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level, IRR is Incidence Rate Ratio. [a] Marginal effects are computed at the average of marginal effect.

6.3.5.3 Determinants of Adopting Ex-Post Coping Strategies

Results of the multinomial logit model (MLM) analysis are presented in Table 6.10. In the model, the middle-stress coping strategy was set as a base case. The first analysis identified determinants of selecting ex-post coping strategies between the low- and middle-stress coping strategies. The second analysis identified the determinants of decisions on adopting ex-post coping strategies between the middle- and high-stress coping strategies.

Table 6.10 Estimated coefficients and marginal effects of the multinomial logit model

Variable	Low-Stress (Model 1)	High-Stress (Model 2)	M. Effect of Low-Stress [a]	M. Effect of Middle-Stress [a]	M. Effect of High-Stress [a]
Dependent variable: type of ex-post coping strategy adopted, with the middle-stress as the base case					
Constant	5.4772	8.4523			
Personal characteristics					
Age (x_1)	0.0348	0.0026	0.0026	−0.0016	−0.0010
Education (x_2)	−0.6664 *	−0.5363	−0.0334	0.0486	−0.0152
Sex (x_3)	−2.0622	−1.0128	−0.1259	0.1267	−0.0007
Risk behavior (x_4)	0.0001	0.0005^{-1}	0.0632^{-4}	-0.0630^{-4}	-0.0126^{-6}
Discount rate (x_5)	−2.2111	2.6766	−0.2654 **	−0.0022	0.2676 *
Trust (x_6)	0.0001	0.0001	0.0408^{-4}	-0.0899^{-4}	0.0491^{-4}
Disaster experience (x_7)	−1.2994	−6.2242 **	0.1142	0.2848	−0.3991 **
Percentage of damage (x_8)	0.0641 ***	0.0669 ***	0.0027	−0.0052	0.0026
Economic characteristics					
Per capita living expenditure (x_9)	−0.8548 ***	−0.2225	−0.0590 ***	0.0453 ***	0.0138
Asset value (x_{10})	−0.0074	−0.0446 ***	0.0009	0.0019 *	−0.0029 **
Farming characteristics					
Farmland size (ha) (x_{11})	−3.2919	−3.558	−0.1337	0.2735 *	−0.1398
Type of farmland (x_{12})	0.2117	−2.2375	0.0941	0.0729	−0.1669 **
Landholding					
Sharecropping (x_{13})	4.5743 ***	2.0257 **	0.2869 ***	−0.2729 ***	−0.0139
Rent in cash (x_{14})	3.1849 *	−0.3417	0.2605 **	−0.1258	−0.1348
Access to financial institutions					
Bank account (x_{15})	−0.2832	−15.1517	0.5030	0.5683	−1.0713
Geographic locations					
Downstream (x_{16})	0.7632	4.2844 *	−0.0889	−0.1904 *	0.2792 *
Midstream (x_{17})	−2.1524 **	1.3892	−0.2162 ***	0.0425	0.1737 *
Log-likelihood	−70.8098	Prob > chi^2	0.0000		
Pseudo R^2	0.6002				

Source: Author.
Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level. [a] M. Effect, marginal effect is computed at the average of marginal effect.

The result of the MLM to identify determinants of decisions on adopting ex-post coping strategies between the low-stress and the middle-stress shows that, among personal characteristics, education, and percentage of damage were significant determinants of selecting the low- and middle-stress coping strategies. Farmers with higher education level significantly adopt middle-stress coping strategy rather than low-stress coping strategy. This might be because farmers with higher education level have a better ability to process information (Norris & Batie, 1987). For instance, migrating to find jobs should be easier for farmers with higher education level because it requires the processing of complicated information to find a suitable job. Maddison (2007) states that farmers with higher education level are more likely to employ coping strategies to minimize the adverse impacts of risks. Farmers who have experienced a higher percentage of damage significantly adopt low-stress coping strategy rather than middle-stress

coping strategy. This is likely because the higher percentage of damage results in lower incomes. Accordingly, instead of high investments, such as migrating to find jobs, farmers increase their household budget to fulfill their basic needs by minimizing unnecessary expenditure and modifying consumption patterns as ex-post coping strategies.

Among economic characteristics, per capita living expenditure was significant for selecting the low- and middle-stress coping strategies. Farmers with higher per capita living expenditure significantly selected the middle-stress coping strategy. In terms of farming characteristics, sharecropping and rent in cash farmers were determinants of adopting ex-post coping strategies. Farmers who practiced sharecropping and rent in cash farmers significantly selected the low-stress coping strategy compared to owner farmers. This is because they have lower incomes due to paying a share of products and rent to land owners. According to the survey data, farmers who practiced sharecropping or rent in cash had lower per capita incomes by 46.6 percent and 10.9 percent, respectively, compared to owner farmers.

Regarding the geographical factor, farmers in the midstream area significantly adopted the middle-stress coping strategy rather than the low-stress coping strategy. According to the survey data, farmers in the midstream area had higher per capita incomes by 24.5 percent, and almost three times higher savings values, but were 13.3 percent less taking credit compared to those in the upstream area.

The result of the MLM in identifying the determinants of decisions on adopting ex-post coping strategies between the middle-stress and the high-stress type shows that disaster experience and percentage of damage significantly influenced the selection of ex-post coping categories. Farmers who experienced several disasters chose middle-stress rather than high-stress coping strategies. Conversely, farmers who experienced a higher percentage of damage adopted the high-stress rather than the middle-stress coping strategies. Sharecroppers significantly adopted the high-stress rather than the middle-stress coping strategies. Asset value is a significant determinant of selecting between the high-stress and the middle-stress coping strategies. Farmers

with a higher asset value tend to select the middle-stress coping strategy because they could easily pay the cost of coping strategies. Farmers in the downstream area significantly adopted the high-stress coping strategy compared to farmers in the upstream area.

The result of the analysis on the type of ex-post coping strategy adopted shows that the more prosperous farmers (higher per capita living expenditure and asset value) selected the middle-stress coping strategy and, after that, the low-stress and the high-stress coping strategies. This means that as long as farmers can use their savings, borrow from formal or informal sources, migrate to find jobs, and obtain help from relatives, they avoid reducing consumption and expenditure, selling production and consumption assets, defaulting on loans, and taking children out from school as ex-post coping strategies.

Implications of governmental policy, in particular, should focus on increasing farmers' risk coping capacities. According to the results of this study, access to financial institutions reflected by bank account ownership positively influenced farmers' decisions on the number of ex-ante coping strategies adopted. Increasing access to financial institutions provides opportunities for farmers to increase incomes. For instance, farmers might borrow money to provide capital for crop diversification and invest in non-farm income-generating activities. When farmers' incomes rise, farmers can increase their risk coping capacity by adopting more than one ex-ante coping strategy. This study reveals that a psychological factor (coping appraisal perception) is a significant determinant of adopting ex-ante coping strategies. Therefore, the government should improve farmers' awareness of ex-ante coping strategies. Increasing awareness of ex-ante coping strategies will influence coping appraisal perception. As a result, farmers' willingness to adopt ex-ante coping strategies or adaptive capacity would be expected to increase.

6.4 Conclusions

Most farmers (74.4 percent) adopted ex-ante coping strategies. They had certain characteristics: higher risk aversion, higher per capita living expenditure, and greater experience of disasters, but lower discount rate and percentage of damage, and location in downstream and

midstream areas. It was found that coping appraisal perception determined the decision on adopting coping strategies. This confirms that socio-psychological aspects are essential to choosing coping strategies.

The majority of farmers adopt more than one coping strategy. They combine strategies either within the same type of ex-ante coping strategies (on-farm or off-farm) or different type of ex-ante coping strategies (across on-farm and off-farm). The main is the combination of two off-farm strategies (income diversification and saving). Four significant determinants of the number of ex-ante coping strategies adopted are as follows: per capita living expenditure, farmland size, disaster experience, and access to financial institutions.

All farmers adopt ex-post coping strategies. The most common coping strategy is the middle-stress type. When adopting more than one coping strategy, farmers prefer combinations within the same stress level (low, middle, or high) or across types of stress level. Prosperous farmers tend to select the middle-stress ex-post coping strategy, followed by the low- and high-stress ex-post coping strategy.

The government should increase farmers' access to financial institutions to increase their adaptive capacity, which would provide opportunities for farmers to increase income. As income increases, the capacity of farmers to adopt ex-ante strategies increases. Moreover, the government should improve farmers' awareness of ex-ante strategies because the psychological factor (coping appraisal) is essential to adopt risk coping strategies.

CHAPTER 7. SMALLHOLDER FARMERS' WILLINGNESS TO PAY FOR AGRICULTURAL PRODUCTION COST INSURANCE IN RURAL WEST JAVA: A CONTINGENT VALUATION METHOD (CVM) APPROACH[20]

7.1 Introduction

Climate change impacts have already hampered the land-based sector performance in Indonesia, particularly agriculture. To minimize the adverse impacts of risks on smallholder farmers, the Indonesian government has implemented agricultural insurance program for rice production since 2015. The type of agricultural insurance is the production cost insurance, in which the indemnity is equal to the cost of production (MoA, 2017b).

Currently, the premium of agricultural production cost insurance in Indonesia is directly determined by the government (producer value) based on a cost approach (MoA, 2015), like estimating administration costs, indemnity, and profit. Although the government has highly subsidized the premium, farmers' participation in the agricultural production cost insurance has still been low, and farmlands covered by the insurance equaled only around 23.3 percent of the 2016 target (1 million ha/year) (Jasindo, 2017). There are various reasons why farmers' participation in the insurance is low. One of the reasons is that the premium is not affordable for farmers. As a result, they are not willing to join and pay (Goodwin, 2001; Haab & McConnell, 2002; Barnett & Mahul, 2007). When the premium (after the government subsidizes) is higher than the willingness to pay (WTP) of farmers, the participation rate might be lower. On the other hand, if the premium is lower than the WTP of farmers, it leads to inefficiency in government expenditure because the proportion of subsidy allocated to the premium is too high. When the premium can be set at the level of farmers' WTP, it enhances the effectiveness of the government expenditure as a subsidy allocated to the premium and increases the rate of farmers' participation

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in the insurance.

Thus, in order to improve the agricultural production cost insurance program, the present study aims to identify farmers' WTP and its mean values for agricultural production cost insurance[21] by applying the contingent valuation method (CVM). Before proceeding to this objective, the agricultural production cost insurance scheme is explained, including indemnity, guaranteed yield, premium, and how the government estimates these components.

7.2 Methodology

7.2.1 Framework

Valuation of the agricultural insurance based on consumer value can be investigated through CVM (Zhang & Li, 2005), though this method is originally applied to estimate the value of non-marketed goods, particularly environmental resources (Haab & McConnell, 2002; Smith, 2006). For example, Gulseven (2014) estimates farmers' WTP for crop, fruit, and livestock insurance in Turkey, while Danso-Abbeam et al. (2014) measure farmers' WTP for crop insurance in Ghana.

In CVM, as explained later, in order to estimate WTP (that is, Equation (7.8)), a set of coefficients of parameters (variables) and bids are required. Those coefficients can be estimated through an analysis of the probability of willingness to pay of a farmer for the agricultural insurance at a certain level of bid. Alongside this, the present study can identify the determinants of participation in agricultural insurance.

7.2.2 Data Collection

A face-to-face interview survey was conducted in August-October 2017 and February 2018. Items of data include: (i) personal characteristics; (ii) economic characteristics; (iii) farming

[21] It is only in Indonesia that the production cost insurance is fully implemented without being mixed with other types of insurance. Meanwhile, in other countries, such as India and the Philippines, the agricultural production cost insurance is mixed with yield insurance.

characteristics; (iv) institutional characteristics; (v) access to financial institutions; and (vi) WTP for agricultural production cost insurance. Variables in the study are summarized in Table 7.1.

Table 7.1 Variables used in the model

Variable	Description	Symbol	Expected Sign
Bid/premium	Bid offered to a farmer (Rp)	BID	Negative
Personal characteristics			
Age	Age of farmer (year)	AGE	Negative
Education	Farmer's formal education (year)	EDU	Positive
Sex	1 = male, 0 = otherwise	SEX	Positive/negative
Risk behavior	Money allocated for a bet in the risk game (Rp)	RISK	Positive
Discount rate	Farmer's preference in the discount rate game	DISC	Negative
Trust	Value of Money given by farmer in the trust game (Rp)	TRUST	Positive/negative
Disaster experience	Average disaster experience (disaster number/season)	DISEXP	Positive
Percentage of damage	The highest percentage of damage (percentage)	PDM	Positive
Expected next season production	1 = high, if expected next season production > average, 0 = otherwise	ENP	Negative
Previous purchase agricultural production cost insurance	1 = purchase agricultural production cost insurance, 0 = otherwise	PPA	Positive
Economic characteristics			
Per capita living expenditure	Per capita living expenditure (Rp/year/person)	EXPD	Positive
Asset value	Total physical (non-land) and financial asset values (Rp)	ASST	Positive
Farming characteristics			
Farmland size	Farmland size managed by farm household (ha)	LAND	Positive
Type of farmland	1 = rain-fed, 0 = irrigated	TF	Positive
Landholding			
Sharecropping	1 = sharecropping, 0 = otherwise	SHARE	Positive
Rent in cash	1 = rent in cash, 0 = otherwise, (privately owned land as a base case)	RIC	Positive
Rice production cost	Rice production cost including in-kind (Rp mil/ha/season)	PC	Positive
Institutional characteristics			
Contact with extension service	1 = contact with extension service, 0 = otherwise	CES	Positive
Access to financial institutions			
Bank account	1 = own bank account, 0 = otherwise	BANK	Positive/negative
Locations			
Downstream	1 = living in the downstream area, 0 = otherwise	DSTR	Positive/negative
Midstream	1 = living in the midstream area, 0 = otherwise, (Upstream as a base case)	MSTR	Positive/negative

Source: Author.
Note: Games to measure trust, risk behavior, and discount rates follow Schechter (2007) and Kirby et al. (2002).

In the interview on (vi), farmers were proposed the hypothetical agricultural production cost insurance as follows:

"*The government has a program called 'agricultural production cost insurance' for smallholder farmers. Farmers with the insurance will receive the indemnity equal to production cost, Rp6 mil/ha/cropping season ($444/ha/cropping season) if 75 percent of the farmland under the insurance is destroyed by disasters*".

After the hypothetical agricultural production cost insurance was introduced, farmers were asked two questions: (i) whether they are willing to pay "in principle" (willing to join) for agricultural production cost insurance in the next cropping season; and (ii) if farmers say "yes" to (i), whether they are willing to pay for the agricultural production cost insurance at a specific level of bid. Question (ii) is in the form of a dichotomous choice. Based on the result of preliminary interviews with around 50 farmers, the survey used six bids ranging from Rp10,000/ha/cropping season ($0.74/ha/cropping season) to Rp60,000/ha/cropping season ($4.4/ha/cropping season). The bid amount was picked and randomly offered to each respondent. To avoid starting point bias, the maximum number of respondents asked about each bid was around 40.

7.2.3 Data Analysis

When a farmer is asked whether or not he/she will pay for the agricultural production cost insurance at a certain level of a bid, the answer is recorded as 1 or 0 (binary data). Since the present study applies the binomial logit model for analysis, the answer (1 or 0) is used as a dependent variable, while the other variables as independent variables. The probability of a farmer's willingness to pay for a certain level of a bid (P_1) can be written as follows:

$$P_{1i} = \frac{e^{C+\lambda BID+\sum_{k=1}^{K}\beta_k x_{ki}}}{1+\ e^{C+\lambda BID+\sum_{k=1}^{K}\beta_k x_{ki}}} \tag{7.1}$$

where BID is level of the bid, C is constant, λ is coefficient of BID, K is the number of variables, and β is the coefficient of farmers' characteristics (x).

WTP measurement follows Haab & McConnell (2002). WTP is the amount of money

allocated by the farmer to purchase agricultural production cost insurance that makes them indifferent between with and without the insurance or status quo. Supposing that M_i is the income of farmer i; x is the farmer's characteristics with coefficient β; and ε is the error term, the utility function of income of farmer i without the insurance (U_{i0}) can be written as follows:

$$U_{i0}(M_i) = \lambda M_i + \sum_{k=1}^{K} \beta_{k0} x_{ki} + \varepsilon_{i0} \tag{7.2}$$

Meanwhile, when farmer i purchases agricultural production cost insurance, which the value is equal to the WTP, the utility function of income of farmer i (U_{i1}) can be written as follows:

$$U_{i1}(M_i) = \lambda(M_i - WTP_i) + \sum_{k=1}^{K} \beta_{k1} x_{ki} + \varepsilon_{i1}. \tag{7.3}$$

When farmer i is indifferent about purchasing agricultural production cost insurance, the utility functions before and after purchasing the insurance are equal. This can be written as follows:

$$U_{i0}(M_i) = U_{i1}(M_i)$$

$$\lambda M_i + \sum_{k=1}^{K} \beta_{k0} x_{ki} + \varepsilon_{i0} = \lambda(M_i - WTP_i) + \sum_{k=1}^{K} \beta_{k1} x_{ki} + \varepsilon_{i1} \tag{7.4}$$

WTP value can be estimated using the equation:

$$WTP_i = \frac{\sum_{k=1}^{K} \beta_k x_{ki}}{-\lambda} + \frac{\varepsilon_i}{-\lambda} \tag{7.5}$$

where λ is the coefficient of BID, and β is the coefficient of each variable x. For the present study, the model uses an assumption of willingness to pay expectation with respect to preference uncertainties (ε) (Haab & McConnell, 2002). Thus, WTP can be written as follows:

$$WTP_i = \frac{\sum_{k=1}^{K} \beta_k x_{ki}}{-\lambda} \tag{7.6}$$

Using the average value of each variable ($\bar{x}$), the mean WTP ($\overline{WTP}$) of the sample population can be estimated by the following equation:

$$\overline{WTP_i} = \frac{\sum_{k=1}^{K} \beta_k \bar{x}_{ki}}{-\lambda} \tag{7.7}$$

Using variables in the logit model (Equation (7.1)), Equation (7.7) can be rewritten as follows:

$$\begin{aligned}\overline{WTP} = (&C + \beta_1\overline{AGE} + \beta_2\overline{EDU} + \beta_3\overline{SEX} + \beta_4\overline{RISK} + \beta_5\overline{DISC} + \beta_6\overline{TRUST} + \\ &\beta_7\overline{DISEXP} + \beta_8\overline{PDM} + \beta_9\overline{ENP} + \beta_{10}\overline{PPA} + \beta_{11}\overline{EXPD} + \beta_{12}\overline{ASST} + \\ &\beta_{13}\overline{LAND} + \beta_{14}\overline{TF} + \beta_{15}\overline{SHARE} + \beta_{16}\overline{RIC} + \beta_{17}\overline{PC} + \beta_{18}\overline{CES} + \\ &\beta_{19}\overline{BANK} + \beta_{20}\overline{DSTR} + \beta_{21}\overline{MSTR})/(-\lambda)\end{aligned} \tag{7.8}$$

7.3 Results and Discussions

7.3.1 Agricultural Production Cost Insurance in Indonesia

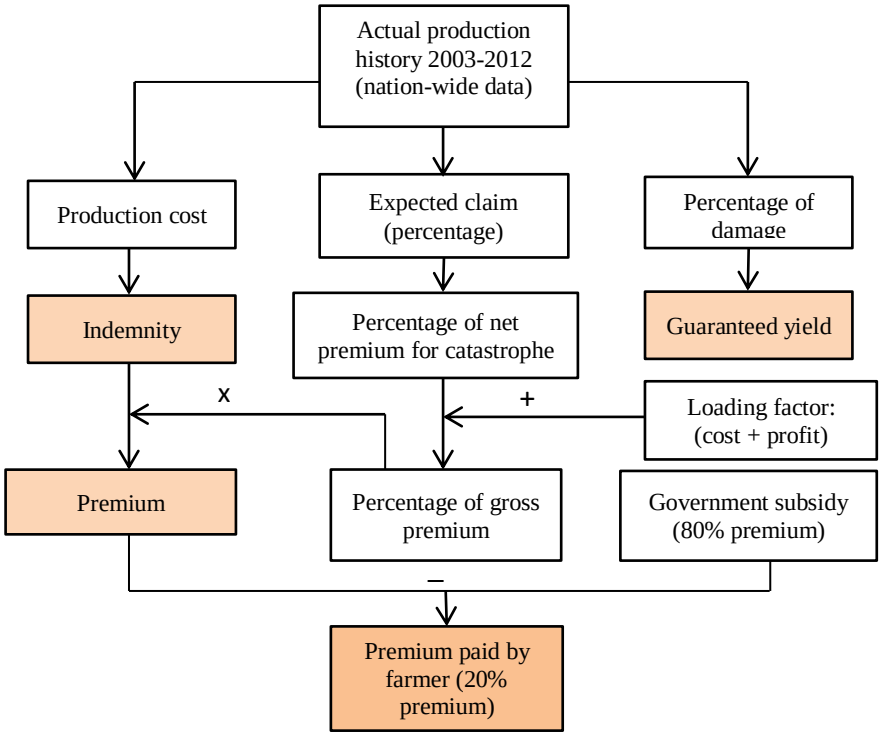
Agricultural production cost insurance is one of the priority programs for the Indonesian government in the agriculture sector. It has been implemented since 2015. The Ministry of Agriculture is the regulator of the insurance scheme, while a central government-owned enterprise, PT Jasindo, has been appointed to sell the insurance to farmers. At the district level, the Agriculture District Office plays the role of channeling the program. The office has a responsibility to collect the data of farmers and farmlands that could be covered by the insurance and to endorse farmers who are eligible to receive a subsidy[22] of the insurance premium.

Agricultural production cost insurance is limited only to rice production. The insurance scheme (indemnity, guaranteed yield, and premium) is equally applied to all provinces. A flow chart of determination of indemnity, guaranteed yield, and premium is presented in Figure 7.1. According to MoA (2015), indemnity and guaranteed yield are estimated based on an average of production cost and percentage of damage during rice production in the period 2003-2012 across all Indonesian regions (on a nation-wide basis). Based on this calculation, the indemnity of the

[22] Premium subsidy is financial assistance provided by the government that helps farmers to pay for the premium of agricultural production cost insurance. The current premium subsidy of agricultural production cost insurance is 80 percent of the premium.

insurance is equal to Rp6 mil/ha/cropping season ($444/ha/cropping season). Guaranteed yield is 25 percent of the yield, which means that the indemnity will be paid to farmers from the insurer if 75 percent of the farmland covered by the insurance is destroyed by disasters.

As shown in Figure 7.1, the premium is calculated based on the expected claim during the period 2003-2012. It is calculated by taking the average value of production failures in rice production during the same period, 2003-2012 (10 years). Its value is around 1.11 percent of the total farmland per cropping season, with a standard deviation of 0.33 percent. Assuming a 95 percent confidence level, the value of the maximum expected claim (P) is equal to 1.32 percent ($P = 1.11\% + 1.96\frac{0.33\%}{\sqrt{10}}$). To determine the net premium (P'), the value of the maximum expected claim is added to the catastrophe premium (λ), which is equal to 10 percent of the



Source: MoA (2015).
Note: + = added, - = substracted, x = times.

Figure 7.1 Indemnity, guaranteed yield, and premium determination

expected claim. Therefore, the value of the net premium is equal to 1.45 percent ($P' = (P + \lambda) = (1 + 10\%)P = (1 + 10\%)1.32\%$). Gross premium ($G$) is calculated by adding the loading factor (β), which consists of administration and marketing costs and profit, to the net premium. Cost and profit are set at 55 percent of the gross premium, which is equal to 3.22 percent $\left(G = \frac{P'}{1-\beta} = \frac{1.45\%}{1-55\%}\right)$ of the indemnity[23]. Thus, the premium is determined by multiplying gross premium with indemnity (production cost), which is equal to Rp193,200/ha/cropping season ($premium = 3.22\% \times Rp6\ mil$). In 2017, the government decided to set the premium at Rp180,000/ha/cropping season and subsidized 80 percent of the premium (MoA, 2017b). As a result, farmers paid around Rp36,000/ha/cropping season for the premium.

The government has not applied any different method to determine the expected claim, compared to what has happened in other countries (Zhang et al., 2015). However, regarding the type of data, there are differences among countries. The majority of countries do not use data based on a nation-wide basis to determine indemnity, guaranteed yield, and premium. In India, data are collected from cross-cutting experiments (CCEs) at village, *mandal*, *taluka*, and district levels.[24] The minimum number of CCEs at each level is 4, 10, 16, and 24, respectively (LARRDIS, 2015). In the United States, data are based on 4 to 10 years of actual historical production (AHP) at farm level and 20 years of loss history in a given county (Goodwin, 1994). In the Philippines, data are historical data on the production of each region, and then the premium is differentiated based on the season (Reyes et al., 2015).

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[23] The relation of catastrophe premium (λ), expected claim (P), net premium (P'), gross premium (G), and loading factor (β) are as follows: $P' = P + \lambda$; $G = P' + \beta \leftrightarrow G = (P + \lambda) + \beta$. Because λ is set at 10 percent of the expected claim, and β is set at 55 percent of the gross premium (G), the equation can be rewritten as follows: $G = (P + 10\%P) + 55\%G \leftrightarrow (G - 55\%G) = (P + 10\%P) \leftrightarrow G = (P + 10\%P)/(1 - 55\%)$.

[24] *Taluka and mandal* are subdivisions of a district which consist of several villages (Collins English Dictionary, 2012). *Taluka* is used in certain states such as Gujarat, Goa, and Karnataka, while *mandal* appears in Andhra Pradesh and Telanggana. *Taluka* and *mandal* are equal to sub-district in Indonesia.

Smith & Baquet (1996) point out that using nation-wide data might generate asymmetric information, leading to the occurrence of market failure, especially adverse selection. Using such data, indemnity, guaranteed yield, and premium cannot be properly estimated as they cannot reflect the level of individual risk (Goodwin & Smith, 1995). In the case of agricultural production cost insurance, there are two impacts of adverse selection on farmers' participation. First, when farmers' production cost is higher than the indemnity, this leads to less willingness to pay for the insurance. On the other hand, when their production cost is less than the indemnity, they will purchase the insurance because of the higher expected benefit. Second, when farmers' yield seldom falls below 75 percent of average production, this leads to no participation in the insurance.

7.3.2 Farmers' WTP

7.3.2.1 Farmers' Characteristics

Respondent farmers' characteristics are summarized in Table 7.2. The majority of farmers were male (90.4 percent). Their average age was 52 years old, and the average length of their formal education was around 6.8 years. Moreover, the average size of farmland managed by the farmers was 0.47 ha, of which around 79 percent was irrigated. The majority (51 percent) of farmers were sharecroppers, followed by owner farmers (39 percent) and farmers paying rent in cash (10 percent). Average per capita living expenditure was Rp10.1 mil/year, and around two-thirds of income was from farming.

Since the indemnity of agricultural production cost insurance is equal to the average production cost and the guaranteed yield is estimated based on the average percentage of damage, the decision on purchasing the insurance might be influenced by farmer's own production costs as well as his/her percentage of damage. Table 7.3 presents the production costs of rice in the study area. As a whole, the rice production cost of small farms was higher than that of large farms. The production cost of rice in the midstream area was higher than those in the downstream and upstream areas. It was likely to be attributed to higher labor wage and machinery rent in the

Table 7.2 Summary of farmers' characteristics

Independent Variable	All Farmers (n=240)	
	Mean	Std. Dev
Personal characteristics		
Age (year)	52	9.4
Education (year)	6.8	2.6
Sex (% male)	90.4	29.5
Risk behavior (Rp)	20,125	6,101
Discount rate	0.44	0.20
Trust (Rp)	9,020	5,312
Expected next season production	0.48	0.50
Disaster experience (times/season)	1.7	0.38
Percentage of damage (%)	73.9	25.6
Previous purchase agricultural production cost insurance (%)	50	50
Economic characteristics		
Per capita living expenditure (Rp mil/year/person)	10.1	2.482
Asset value (Rp mil)	80.9	88.06
Farming characteristics		
Farmland size (ha)	0.47	0.32
Type of farmland (% rain-fed)	21	41
Landholding		
Sharecropping (%)	51	5.01
Rent in cash (%)	10	3.06
(Privately owned land as the base case)		
Production cost (Rp mil/ha/season)	10.6	2.09
Institutional characteristics		
Contact with extension service (% farmers)	51	50
Access to financial institutions		
Bank account (% ownership)	25	43.39
Geographical characteristics		
Downstream	0.33	0.47
Midstream	0.33	0.47
(Upstream as the base case)		

Source: Field survey data.

Table 7.3 Cost of rice production without and with in-kind

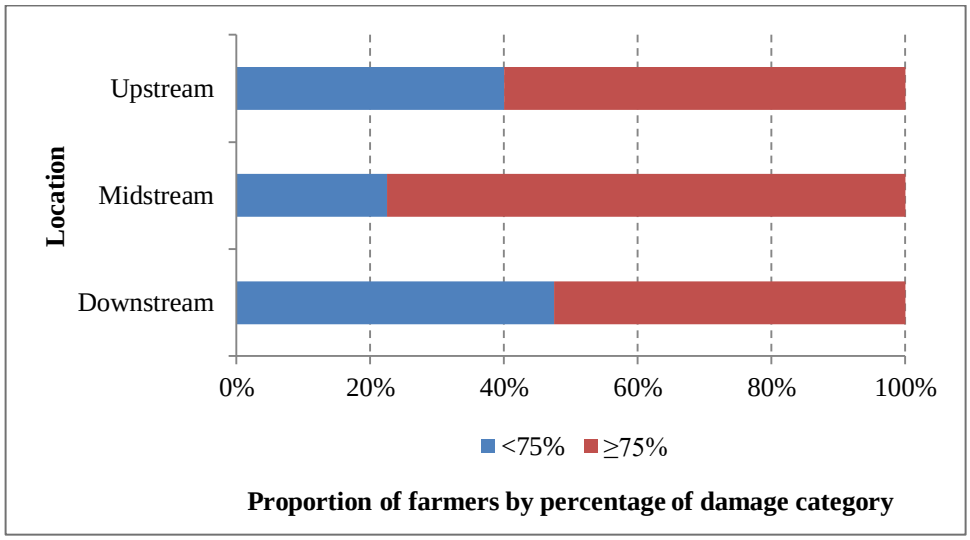
Location	Farmland Size (ha)		Production Cost (Rp mil/ha)			
	Class	Average	Without In-Kind	With In-Kind	Average without In-Kind	Average with In-Kind
Downstream	≤ 0.5	0.28	5.86	10.84	5.93	10.25
	0.5 <	0.79	6.09	8.85		
Midstream	≤ 0.5	0.29	7.87	12.88	7.61	11.61
	0.5 <	0.79	7.36	10.46		
Upstream	≤ 0.5	0.29	6.10	10.52	5.84	10.01
	0.5 <	0.72	5.22	7.96		
Total		0.47			6.45	10.62

Source: Field survey data.

midstream area (as it is closer to the capital city of the district), compared to the other areas.

Average rice production costs with and without in-kind were around Rp10.62 mil/ha and Rp6.45 mil/ha, respectively. This finding showed that the indemnity (Rp6 mil/ha) of agricultural production cost insurance was lower than the average rice production cost both with in-kind and without in-kind.

The average percentage of damage in the study area was around 73.9 percent. As shown in Figure 7.2, the majority (152 farmers, 63.3 percent) of 240 farmers had experienced a higher percentage of damage (percentage of damage ≥ 75 percent) than the guaranteed yield of the agricultural production cost insurance (percentage of damage = 75 percent). From the viewpoint of location, the proportion of farmers who had experienced a percentage of damage above 75 percent was higher in the midstream area than those in the downstream and upstream areas. Although the majority (63.3 percent) of farmers in the study area had experienced a higher percentage of damage (percentage of damage ≥ 75 percent), its average was lower than the guaranteed yield of agricultural production cost insurance (percentage of damage = 75 percent).



Source: Field survey data.

Figure 7.2 The proportion of farmers by the percentage of damage

7.3.2.2 Farmers' Willingness to Join

The pattern of farmers' willingness to join in the insurance is presented in Figure 7.3. Some findings are explained as follows:

(1) The majority (194 farmers, 80.8 percent) of 240 farmers were willing to pay "in principal join" for agricultural production cost insurance.

(2) Farmers who had not yet purchased agricultural production cost insurance:

   (a) Out of 120 farmers who had not yet purchased agricultural production cost insurance, 43 farmers (35.8 percent) had no ex-ante risk coping strategies, of whom 22 farmers (51 percent) were willing to join in the insurance. Therefore, farmers who had the willingness to join but did not have the willingness to join were almost equal.

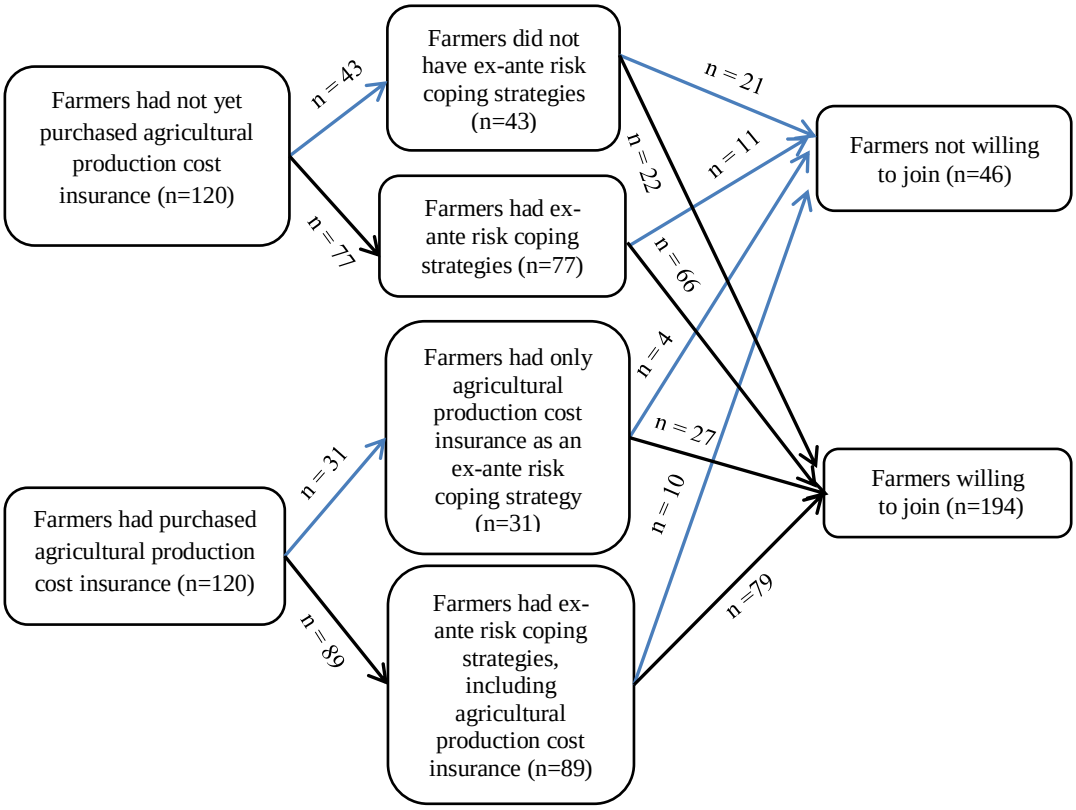
   (b) Those who had not yet utilized agricultural production cost insurance but had other ex-ante risk coping strategies numbered 77 farmers (64 percent), of whom 66 farmers were willing to join in the insurance. Thus, in this group, farmers who were willing to join in the insurance were higher than those who were not.

(3) Farmers who had already purchased agricultural production cost insurance:

   (a) Out of 120 farmers who had already purchased the agricultural production cost insurance, 31 farmers (25 percent) had adopted only agricultural production cost insurance as an ex-ante coping strategy. Of these 31 farmers, 27 farmers (87 percent) were willing to continue to join in the insurance.

   (b) The remaining 89 farmers had more ex-ante coping strategies, including the insurance. Seventy-nine farmers (89 percent) of these 89 farmers were willing to join in the insurance.

As a whole, the major pattern was that farmers who had already adopted ex-ante coping strategies were likely to join in the agricultural production cost insurance. It might be because farmers who had ex-ante risk coping strategies had a higher capacity to purchase the insurance.



Source: Field survey data.
Note: Ex-ante coping strategies include water management, planting in different plots, crop diversification, income diversification, saving, rotating savings and credit association (ROSCA).

Figure 7.3 The pattern of farmers' willingness to join

There were changes in the behavior of farmers when they were offered agricultural production cost insurance as follows:

(1) For farmers who had not yet purchased agricultural production cost insurance, 22 out of 43 farmers (51.2 percent) who had not adopted any ex-ante risk coping strategies, and 66 farmers out of 77 farmers (85.7 percent) who had already adopted ex-ante risk coping strategy were willing to join in the insurance.

(2) Among farmers who had already purchased agricultural production cost insurance, 4 out of 31 farmers (12.9 percent) who had only agricultural production cost insurance as an ex-ante risk coping strategy, and 10 out of 89 farmers (11.2 percent) who had ex-ante risk coping strategies, including agricultural production cost insurance, were not willing to join in the

insurance, despite having purchased the insurance in the previous cropping season.

This shows that as a whole, the majority of farmers (51 percent) who had not adopted an ex-ante risk coping strategy demonstrated the willingness to join in the insurance as one strategy of risk management. However, there were farmers having purchased the insurance who decided not to join in the insurance in the next cropping season, but their number was quite low.

Several reasons were found for why farmers were not willing to join in agricultural production cost insurance (Table 7.4). Most farmers argued firstly that the indemnity of the insurance was low, and it could not compensate for their rice production cost. The second reason was that the percentage of damage as a claim requirement was high. Lack of information about the insurance was the third reason. Farmers ranked "low level of risk", "don't have any additional budget to purchase the agricultural production cost insurance", and "already implementing other risk coping strategies" as the fourth, fifth, and sixth reason, respectively. The least popular reason was that "they had already purchased the insurance, but there were no disasters". However, these four reasons had a Likert scale range of 1-2, suggesting that these reasons were not considered as obstacles to purchasing the insurance. As a whole, the reasons that farmers gave for refusing to join in the insurance could be grouped into four: scheme ("indemnity and percentage of damage"), risk condition of farmland ("the risk was low in farmland", "purchased insurance but no disasters"), farmers' capacity ("do not have any additional budget to purchase the insurance", "have other risk coping strategies"), and institutional condition ("need more information").

Table 7.4 Reasons for not willing to join in agricultural production cost insurance

Reason	Rank
Indemnity cannot compensate for the production cost	3.08
Percentage of damage is too high as the claim requirement	2.98
Need more information	2.83
Risk is low in farmland	1.91
Don't have any additional budget to purchase insurance	1.82
No need insurance because of having other coping strategies	1.67
I have already purchased the insurance but no disasters	1.30

Source: Field survey data.
Note: Rank is based on a Likert scale (1=strongly disagree, 4= strongly agree). The number of sample farmers = 46 farmers (who had not willing to join in the insurance).

7.3.2.3 Determinants of Farmers' WTP

Among the 194 farmers who were willing to join in agricultural production cost insurance, 126 farmers (52 percent of the total 240 sample farmers) were willing to pay for the insurance. As shown in Table 7.5, among farmers who had not yet purchased the insurance, the percentage of farmers with WTP was nearly the same as that of farmers without WTP. However, looking into these percentages, it is seen that there are slightly more farmers with WTP than farmers without WTP in the downstream and midstream areas, while the converse is true in the upstream area. On the other hand, for farmers who had purchased the insurance, without any exemption due to locality, the majority (72 percent - 75 percent) of them had WTP.

Table 7.5 Farmers' WTP by location and the previous purchase of the insurance

Farmers' Group	Willingness to Pay	Downstream	Midstream	Upstream	Total
Farmers had not yet purchased	No	12	13	18	43
	Yes	16	17	12	45
Farmers had purchased	No	8	8	9	25
	Yes	28	27	26	81
Total		64	65	65	194

Source: Field survey data.

Coefficients, marginal effects, and odds ratios of the logit model of WTP analysis are summarized in Table 7.6. The chi-square test is significant at the 1 percent level. The model can predict 83.5 percent of the data (power of prediction is 83.5 percent). As the highest variance inflation factor (VIF) is 2.35, there is no multicollinearity among independent variables in the model. The link test shows that the model is properly specified. Moreover, the logit model analysis found 10 variables as determinants of WTP: bid, education, risk behavior, expected next production, percentage of damage, asset value, farmland size, production cost, contact with extension service, and the dummy of the downstream area.

Table 7.6 Estimated coefficients, marginal effects, and odds ratios of the logit model

Variable	Estimated Coefficient		Marginal Effect[a]		Odds Ratio	SE
	Coef.	SE	Coef.	SE		
Dependent variable: 1 if a farmer is willing to pay a bid at a certain level, 0 otherwise						
Constant	-13.7198***	4.5838			0.0011^{-4}***	0.0005^{-2}
Bid (x_1)	-0.0001***	0.0001^{-1}	-0.0001^{-1}***	0.0037^{-4}	0.9998***	0.0039^{-2}
Personal characteristics						
Age^2 (x_2)	-0.0004	0.0003	-0.0004^{-1}	0.0003^{-1}	0.9996	0.0003
Education (x_3)	0.3176**	0.1556	0.0331**	0.0155	1.3738**	0.2137
Sex (x_4)	0.2949	0.7175	0.0307	0.0745	1.3430	0.9637
Risk behavior (x_5)	0.0001***	0.0001^{-1}	0.0001^{-1}***	0.0053^{-3}	1.0001***	0.0053^{-2}
Discount rate (x_6)	0.3579	1.5148	0.0373	0.1575	1.4304	2.1668
Trust (x_7)	0.0001	0.0001^{-1}	-0.0017^{-3}	0.0057^{-3}	0.9999	0.0055^{-2}
Expected next season production (x_8)	-1.2339**	0.5840	-0.1285**	0.0578	0.2912**	0.1700
Disaster experience (x_9)	0.0773	0.7227	0.0081	0.0752	1.0804	0.7808
Percentage of damage (x_{10})	0.0293**	0.0146	0.0031**	0.0015	1.0297**	0.0151
Previous purchase agricultural production cost insurance (x_{11})	1.0622	0.7026	0.1106	0.0719	2.8928	2.0326
Economic characteristics						
Per capita living expenditure (x_{12})	0.0461	0.1297	0.0048	0.0135	1.0472	0.1359
Asset value (x_{13})	0.0304***	0.0099	0.0032***	0.0009	1.0309***	0.0103
Farming characteristics						
Farmland size (x_{14})	2.6706*	1.6139	0.2781*	0.1644	14.4482*	23.3180
Type of farmland (x_{15})	-0.5200	0.7779	-0.0541	0.0806	0.5945	0.4625
Landholding						
Sharecropping (x_{16})	-0.4910	0.6616	-0.0511	0.0684	0.6120	0.4049
Rent in cash (x_{17})	-0.8564	1.0015	-0.0892	0.1035	0.4247	0.4253
(Privately owned land as a base case)						
Production cost (x_{18})	0.4912**	0.2201	0.0511**	0.0219	1.6342**	0.3597
Institutional characteristics						
Contact with extension service (x_{19})	2.4748***	0.7276	0.2577***	0.0658	11.8792***	8.6435
Access to financial institutions						
Bank account (x_{20})	-0.7421	0.6525	-0.0773	0.0674	0.4761	0.3106
Locations						
Downstream (x_{21})	1.7994**	0.7115	0.1874**	0.0689	6.0461**	4.3016
Midstream (x_{22})	0.2047	0.8019	0.0213	0.0834	1.2272	0.9839
(Upstream as the base case)						
Predicted 1s that were actual 1s (%)	86.72		Log-likelihood function		-63.6722	
Predicted 0s that were actual 0s (%)	77.27		Prob (Chi^2> value)		0.0000	
Power of Prediction	0.8351		Pseudo R^2		0.4933	
Link test:			Variance Inflation Factor (VIF)		2.35	
_hat	0.000					
_hatsq	0.762					

Source: Author.
Note: ***significant at 1% level, **significant at 5% level, *significant at 10% level. [a] Marginal effects are computed at the average of marginal effects. SE = Standard Error.

By considering the value of marginal effects that show the change of probability of WTP at a certain level of bid when there is a unit change in an independent variable, as well as the odds ratios that present the proportion between the probability of "willing to pay" and that of "not

willing to pay", among 10 variables, there were four key variables that were essential determinants of farmers' WTP for the agricultural production cost insurance: expected next production (marginal effect = -0.1285, odds ratio = 0.2912), farmland size (marginal effect = 0.2781, odds ratio = 14.4482), contact with extension service (marginal effect = 0.2577, odds ratio = 11.8792), and location in the downstream area (marginal effect = 0.1874, odds ratio = 6.0461). Therefore, according to these four variables, farmers with certain characteristics, especially small farmland size, low contact with extension service, and farmers in the midstream and upstream areas, should be the target of the insurance program to improve farmers' participation in the insurance.

7.3.2.4 Mean Value of WTP

The mean value of WTP is estimated by using coefficients of independent variables in Table 7.6 and their mean values. The equation is as follows:

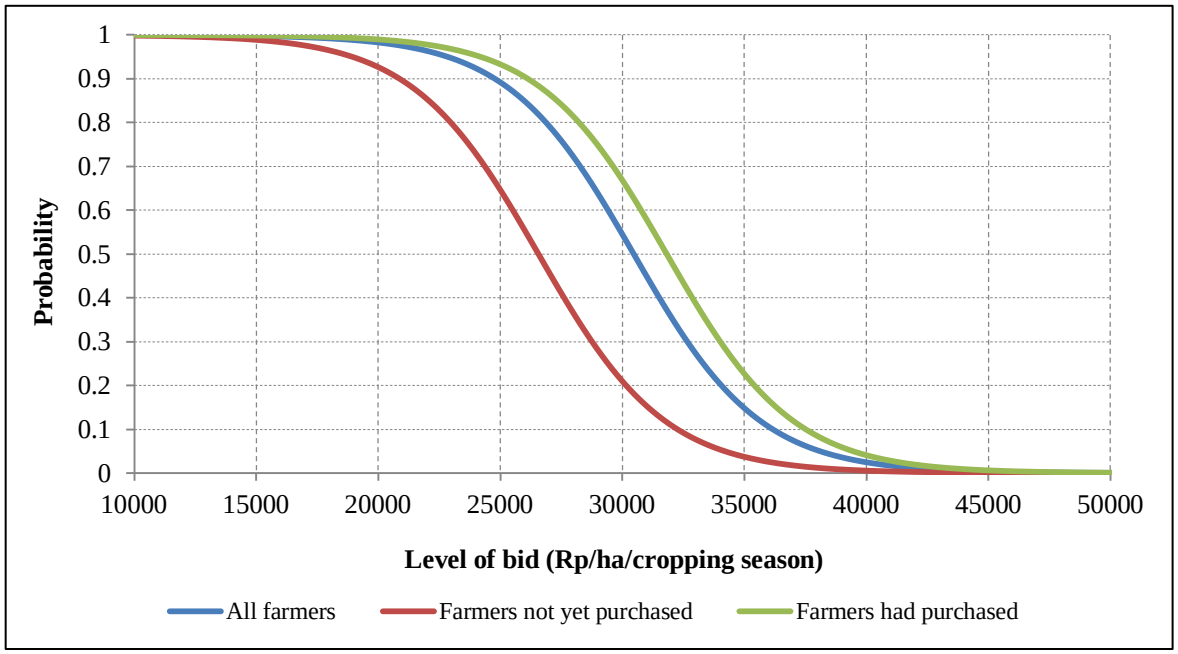
$$\begin{aligned}\overline{WTP} = [&-13.7198 - 0.0004\overline{AGE} + 0.3176\overline{EDU} + 0.2949\overline{SEX} + 0.0001\overline{RISK} + 0.3579\overline{DISC} \\ &- 0.0001\overline{TRUST} - 1.2339\overline{DISEXP} + 0.0773\overline{PDM} + 0.0293\overline{ENP} + 1.0622\overline{PPA} \\ &+ 0.0461\overline{EXPD} + 0.0304\overline{ASST} + 2.6706\overline{LAND} - 0.5200\overline{TF} - 0.4910\overline{SHARE} \\ &- 0.8564\overline{RIC} + 0.4912\overline{PC} + 2.4748\overline{CES} - 0.7421\overline{BANK} + 1.7994\overline{DSTR} \\ &+ 0.2047\overline{MSTR}]/-0.0001\end{aligned}$$

As shown in Table 7.7 and Figure 7.4, the mean value of WTP for farmers was Rp30,358/ha/cropping season ($2.25/ha/cropping season), being lower by 16 percent than the current premium of Rp36,000/ha/cropping season ($2.67/ha/cropping season). Using a similar equation, the mean value of WTP was estimated at Rp26,369/ha/cropping season ($1.95/ha/cropping season) for farmers who had not yet purchased agricultural production cost

Table 7.7 Mean value of WTP

Indicator	All Farmers	Farmers not yet purchased	Farmers had purchased
WTP (Rp/ha/cropping season)	30,358	26,369	31,853
Standard error	12,475	9,403	9,769
n	240	120	120

Source: Author.



Source: Author.

Figure 7.4 WTP of farmers (had purchased and not yet purchased)

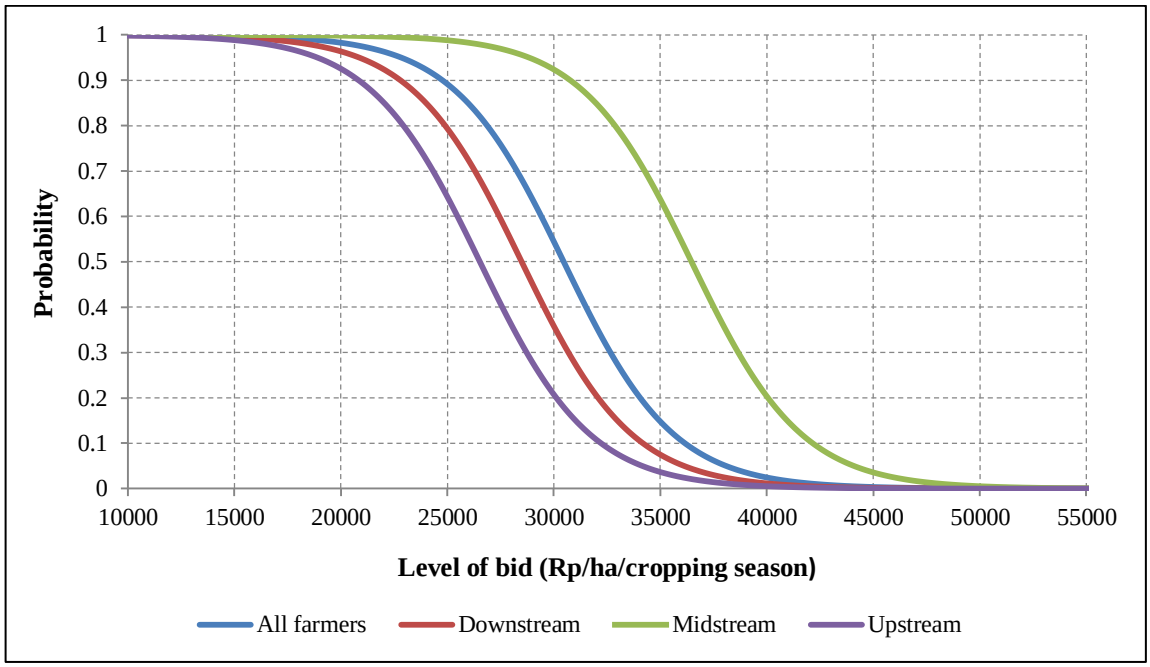
insurance but at Rp31,853/ha/cropping season ($2.36/ha/cropping season) for farmers who had already purchased the insurance, which were lower by 27 percent and 11.5 percent than the current premium, respectively.

Moreover, as shown in Table 7.8 and Figure 7.5, there were differences in the mean value of WTP of farmers among the downstream, midstream, and upstream areas. The mean value of WTP of farmers in the midstream area (Rp36,318/ha/cropping season = $2.69/ha/cropping season) was higher than that in the downstream area (Rp28,794/ha/cropping season = $2.13/ha/cropping season) and that in the upstream area (Rp26,267/ha/cropping season = $1.94/ha/cropping season).

Table 7.8 Mean value of WTP by location

Indicator	All Farmers	Farmers in Downstream	Farmers in Midstream	Farmers in Upstream
WTP (Rp/ha/cropping season)	30,358	28,794	36,318	26,267
Standard error	12,475	8,881	10,046	9,680
n	240	80	80	80

Source: Author.



Source: Author.

Figure 7.5 WTP of farmers in the downstream, midstream and upstream areas

7.4 Conclusions

The present study confirms that, as a whole, the majority of respondent farmers were willing to join in the insurance (194 farmers, 80.8 percent). It is of interest that 27 percent of farmers (33 farmers out of 120) who had not purchased agricultural production cost insurance remained unwilling to join, and that 11.7 percent of farmers (14 farmers out of 120) who had purchased agricultural production cost insurance turned to be unwilling to join as well. It means that those farmers hold the key to a greater level of participation in the insurance.

By applying CVM, the present study reveals that farmers' WTP (consumer value) for the agricultural production cost insurance was 16 percent lower than the current premium. This might be one of the reasons why farmer participation in agricultural production cost insurance was low. Moreover, there were four variables that were considered as the main factors of farmers' WTP for the agricultural production cost insurance: expected next production, farmland size, contact with extension service, and location in the downstream area. Results indicate that the government

should give more attention to farmers with small farmland size and low contact with the extension service, and to farmers in the midstream and upstream areas, as the target of the government program to improve farmers' participation in the insurance.

In order to make the premium of the insurance more affordable to farmers, there are two approaches: reducing the premium (supply side) and increasing farmers' WTP (demand side). The former requires the allocation of more government budget to the premium subsidy. However, due to the financial constraints on the government, further subsidy for the premium cannot be relied upon. Therefore, the practical strategy is to increase farmers' WTP.

Farmers' WTP for agricultural production cost insurance can be increased through a few amendments. The first is to change the data used for premium determination from nation-wide basis to regional-wide basis (for example, district level). Therefore, each region (district) might have different premiums that would reflect its level of risk. A district with lower risk will have a lower premium, and farmers in this region might be more interested in purchasing agricultural production cost insurance. The second is to improve farmers' access to information. According to the result of the logit model, farmers' WTP had a strong positive correlation with contact with the extension service. The extension service provides farmers with information concerning the benefit of insurance and removes their doubts about insurance as an ex-ante risk coping strategy. The third is to educate farmers concerning agricultural production cost insurance. This includes what agricultural production cost insurance is, what they get, and what the cost is. When farmers are understood and aware of agricultural production cost insurance, they might participate in it.

CHAPTER 8. SMALLHOLDER FARMERS' SATISFACTION WITH AGRICULTURAL PRODUCTION COST INSURANCE IN INDONESIA

8.1 Introduction

The Indonesian government has decided to implement agricultural production cost insurance program to minimize the negative impacts of risks in farming since 2015. However, after three years of the implementation, farmers' participation in the insurance remains low. This has raised a concern about its sustainability. To sustain the business of agricultural production cost insurance, stable and more participation are indispensable.

One important aspect of sustainability is farmers' satisfaction (Flores & Sarandon, 2004). The evaluation of farmers' satisfaction with the insurance is essential because of two reasons. Firstly, satisfied farmers are more likely to continue to purchase the insurance. Secondly, farmers' personal experience of insurance purchase (satisfied/unsatisfied) might be influential information for other farmers who have not yet purchased the insurance when making their decision on purchasing the insurance. According to Hekkert et al. (2009) and Rubin et al. (1993), customer satisfaction is a major instrument in the evaluation of goods and service quality, enabling providers to increase the quality of goods and services to meet customer expectation.

Therefore, the objective of the present study is to clarify the determinants of farmers' satisfaction with the agricultural production cost insurance.

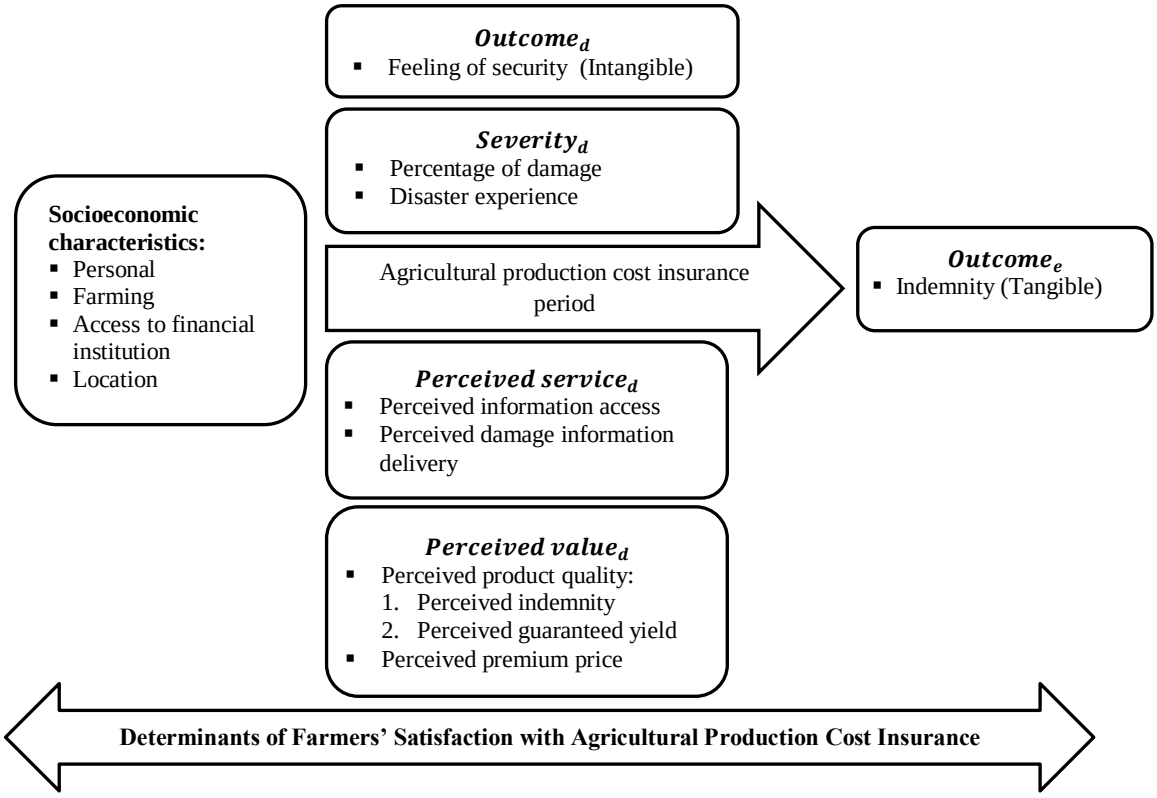
8.2 Methodology

8.2.1 Framework

The present study will use the "service quality versus satisfaction" approach to investigate overall satisfaction with the insurance, including satisfaction with the quality of the product (value), services, and outcomes. The study will adopt the model (Equation (2.1), page 39)

developed by Kane et al. (1997) on health care service with some modifications in terms of variables.

In the present study, five variables are predicted to influence farmers' satisfaction with agricultural production cost insurance: socioeconomic characteristics, perceived service, perceived value, severity, and outcomes. Regarding the characteristics of insurance (services and goods), the variable "procedure" in Kane's model (1997) can be replaced by perceived service and perceived value because the content of the procedure explains services as well as the value (what the customers get and what they give). Variables used to estimate farmers' satisfaction with agricultural production cost insurance are presented in Figure 8.1 and Table 8.1.



Source: Author.
Note: d = during the insurance period; e = the end of the insurance period.

Figure 8.1 Determinants of farmer's satisfaction with agricultural production cost insurance

Table 8.1 Variables used in the study

Variable	Description	Symbol	Expected Sign
Personal characteristics			
Age	Age of a farmer (years)	AGE	Positive/Negative
Education	Farmer's formal education year (years)	EDU	Positive
Sex	1 = male, 0 = otherwise	SEX	Positive/Negative
Risk behavior	Value of money taken in the risk games (Rp)	RISK	Positive/Negative
Discount rate	Farmer's preference in the discount rate games	DISC	Positive/Negative
Number of enrollment	Cropping season with the insurance (times)	NOE	Positive/Negative
Economic characteristics			
Per capita living expenditure	Total per capita living expenditure (Rp/year/person)	EXPD	Positive
Asset value	Total physical (non-land) and financial asset values (Rp)	ASST	Positive
Farming characteristics			
Farmland size	Farmland size managed by a farmer (ha)	LAND	Positive
Landholding			
Sharecropping	1 = sharecropping, 0 = otherwise	SHARE	Positive
Rent in cash	1 = rent in cash, 0 = otherwise	RIC	Positive
(Private land as the base case)			
Production cost	Production cost including in-kind (Rp mil/ha/cropping season)	PC	Positive
Access to financial institutions			
Bank account	1 = own bank account, 0 = otherwise	BANK	Positive/Negative
Location			
Downstream	1 = living in the downstream area, 0 = otherwise	DSTR	Positive/negative
Midstream	1 = living in the midstream area, 0 = otherwise	MSTR	Positive/negative
(Upstream as the base case)			
Severity			
Disaster experience	The average number of disasters (times/cropping season)	DISEXP	Positive
Percentage of damage	The highest percentage of damage (percent)	PDM	Positive
Perceived value			
Indemnity	Perception on indemnity of insurance (categorical data)	IDM	Positive
Guaranteed yield	Perception on guaranteed yield (categorical data)	GY	Positive
Premium price	Perception on premium price (categorical data)	PP	Positive
Perceived service			
Information access	Perception on information access (categorical data)	AIM	Positive
Damage information delivery	Perception on damage information delivery (categorical data)	DID	Positive
Outcome			
Gain indemnity	1 = received indemnity; 0 = otherwise	GIDM	Positive
Feeling of security	Perception on feeling of security (categorical data)	SF	Positive

Source: Author.
Note: Rp = Rupiah, Indonesian currency. Games to measure trust, risk behavior, and discount rate follow Schechter (2007) and Kirby et al. (2002).

In the present study, socioeconomic characteristics consist of personality, farming, access to financial institutions, and location. Personal characteristics explain age, education, sex, and the number of enrollment (Lange et al., 2012). Other personal characteristics that are not yet considered as determinants in the previous studies are risk behavior and discount rate (time

preference). Risk behavior is of interest as a variable because the insurance is a risk management strategy that involves the expenditure in cash. Supposing that the benefit of the insurance is similar among farmers and it does not meet their expectations, risk-averse farmers might be more unsatisfied with the insurance than others (risk-neutral and risk-taker farmers) due to their characteristics which avoid risks. With regard to the discount rate, even though the outcomes are the same, they value current resources higher than those in the future.

Farming characteristics (farmland size, landholding arrangement, production cost) might influence farmers' satisfaction with the agricultural production cost insurance. When outcomes are equal, farmers who have larger farmland size, higher production cost, rent in cash, and sharecropping might have lower satisfaction than those who have smaller farmland size, lower production cost, and own farmland, because the negative impacts of risks that can be reduced will be much lower. Economic characteristics consist of per capita living expenditure and assets. Higher these variables are associated with a higher capacity to adopt various risk coping strategies. If the agricultural insurance cannot reduce the risks, they might be unsatisfied. Regarding access to financial institutions (banks), it is influential because they might have more experience in using other risk coping strategies associated with access to financial institutions, for example, saving. The location of farmers is influential to their satisfaction with agricultural insurance because of two reasons. Firstly, the quality of services for customers in dispersed areas is difficult to be maintained by the insurance provider (Mittal et al., 2004). Secondly, farmers in different locations have different wellbeing (Brereton et al., 2008; Jokela et al., 2015). Location is divided into three geographical areas: downstream, midstream, and upstream.

Based on the preliminary interview with farmers (around 50 farmers) and the insurance provider, there are two variables to estimate perceived service of the insurance: perceived information access and perceived damage information delivery. Farmers' perception on indemnity, guaranteed yield, and price of insurance are used as variables of perceived value. There are two variables that might reflect the severity: disaster experience and percentage of

damage. There are two variables to measure outcomes of agricultural insurance: indemnity received by farmers (tangible outcome) and a feeling of security during the insurance period (intangible outcome).

Using variables presented in Figure 8.1, the model of Kane et al. (1997), Equation (2.1), could be modified as follows:

$$\begin{aligned} &Satisfaction \\ &= Outcome + Severity + \ Perceived\ value + Perceived\ service \\ &+ Socioeconomic\ characteristics \end{aligned} \tag{8.1}$$

By considering the insurance period, Equation (8.1) can be rewritten as follows:

$$\begin{aligned} &Satisfaction \\ &= (Outcome_d + Outcome_e) + Severity_d + Perceived\ value_d \\ &+ Perceived\ service_d + Socioeconomic\ characteristics \end{aligned} \tag{8.2}$$

8.2.2 Data Collection

Face-to-face interviews were conducted for data collection. The questioner used in the interview was divided into eight parts: (i) personal characteristics (age, education, sex, risk behavior, discount rate, and number of enrollment); (ii) economic characteristics (per capita living expenditure and asset value); (iii) farming characteristics (farmland size, landholding, and production cost); (iv) access to financial institution (bank account); (v) outcomes (receiving indemnity and secure feeling); (vi) severity (disaster experience and percentage of damage); (vii) perceived value (coverage, guaranteed yield, and premium price); (viii) perceived service (access information and damage information delivery).

8.2.3 Data Analysis

The dependent variable (satisfaction) is ordered categorical data, in which there are two possible methods for estimation: order logit model and order probit model. However, because there are four categories of the dependent variable in the present study, there are difficulties in interpreting the results with the use of these methods. Therefore, as suggested by Van Praag &

Ferrer-I-Carbonell (2008), to estimate the Equation (8.2) the present study applies the probit-adapted ordinary least square (POLS). In general, this method is similar to the multiple linear regression, but the dependent variable has to be converted from ordinal data to cardinal data. The cardinalisation uses the latent variable approach, in which the latent variable Y^* has a normal distribution. The cardinal variable Y_m^C is constructed by replacing all dependent variable categories (in this case m categories) with the conditional expectation of $Y^{*.}$ Thus, the values are located in the interval (i_{m-1}, i_m). If N is Y*'s distribution function and n is the density function based on Van Praag & Ferrer-I-Carbonell (2008) and Lange et al. (2012), the equation of the conditional expectation can be written as follows:

$$Y_m^C = E(Y^*|i_{m-1} < Y^* \leq i_m) = \frac{n(i_{m-1}) - n(i_m)}{N(i_m) - N(i_{m-1})}, \qquad m = 1,2,3,4 \tag{8.3}$$

The specific value of the cutoff point (i_m) is constructed by observing all sample distribution of ordinal data $(N(i_m))$. Based on a sample distribution, the accumulative probability of category i_m is as follows:

$$N(i_m) = F(m) \tag{8.4}$$

where $F(m)$ represents the accumulative probability of respondents selecting category m. The cutoff point (i_m) can be estimated by rewriting Equation (8.4) as follows:

$$i_m = N^{-1}F(m) \tag{8.5}$$

Using the calculated cutoff point (i_m) in Equation (8.3), the cardinalized variable (Y_m^C) for each m is estimated. This variable is used as the dependent variable (y_i) replacing each categorical data in the multiple regressions linear. Its equation can be written as follows:

$$\begin{aligned} y_i = c &+ \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 SEX_i + \beta_4 RISK_i + \beta_5 DISC_i \\ &+ \beta_6 NOE_i + \beta_7 EXPD_i + \beta_8 ASST_i + \beta_9 LAND_i + \beta_{10} SHARE_i \\ &+ \beta_{11} RIC_i + \beta_{12} PC_i + \beta_{13} BANK_i + \beta_{14} DSTR_i + \beta_{15} MSTR_i \\ &+ \beta_{16} GIDM_i + \beta_{17} SF_i + \beta_{18} DISEXP_i + \beta_{19} PDM_i + \beta_{20} IDM_i \\ &+ \beta_{21} GY_i + \beta_{22} PP_i + \beta_{23} AIM_i + \beta_{24} DID_i + \varepsilon_i \end{aligned} \tag{8.6}$$

where y_i is the cardinalised variable (Y_m^C) for each m, c is the constant, and $\beta_1 - \beta_{24}$ are

coefficients of the independent variables.

8.3 Results and Discussions

8.3.1 Farmers' Characteristics

Characteristics of both farmers who were satisfied and unsatisfied with agricultural production cost insurance are presented in Table 8.2. The average age of farmers was 53.1 years, and the majority was male (94 percent). The mean of farmland size managed by farmers was 0.53 ha. The proportion of sharecroppers and rent in cash farmers was 46 percent and 8 percent, respectively. Around 27 percent of farmers had a bank account for many purposes, such as savings and credit.

Table 8.2 Summary of farmers' characteristics

Variable	All Farmers		Satisfaction				Location					
			Satisfied		Unsatisfied		Downstream		Midstream		Upstream	
	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
Personal characteristics												
Age (years)	53.1	8.9	51.4	7.8	53.7	9.2	52.7	4.8	53.1	9.3	53.7	11.3
Education (years)	7.4	3.01	6.7	2.3	7.6	3.2	7.0	2.6	7.7	3.2	7.5	3.2
Sex (% male)	94	24	91.1	22.2	94.8	28.8	90	28	95	22	95	22
Risk behavior (Rp)	18,722	7,171	20,001	6,904	18,370	7,249	21,750	6,232	18,583	5,681	15,833	8,190
Discount rate	0.42	0.23	0.39	0.23	0.43	0.23	0.44	0.21	0.32	0.25	0.49	0.19
Number of enrollment (times)	1.92	0.76	2.57	0.58	1.70	0.68	1.97	0.97	2.25	0.47	1.55	0.56
Economic characteristics												
Per capita living expenditure (Rp mil/year/person)	11.5	2.6	11.5	2.3	11.5	2.7	10.8	2.3	11.9	2.1	11.60	3.2
Asset value (Rp mil)	128.8	133.2	76.1	65.7	146.4	145	75.0	41.6	147.2	170	164.3	135.7
Farming characteristics												
Farmland size (ha)	0.53	0.34	0.19	0.32	0.50	0,34	0.51	0.29	0.58	0.41	0.49	0.30
Type of landholding:												
Sharecropping (%)	46	50	3.9	37	42	49	50	50	52	51	40	49
Rent in cash (%)	8	28	1.7	29	6.7	28	0	0	5	22	20	40
(Privately owned land as the base case)												
Production cost (Rp mil/ ha/cropping season)	10.4	2.3	11.1	2.1	10.3	2.4	9.3	1.9	11.8	2.2	10.1	2.2
Access to financial institutions												
Bank account (% ownership)	27%	44%	4.8	38.7	22.2	45.8	13	34	41	49	25	44

Source: Field survey data.

Although both farmers who were satisfied and unsatisfied with the agricultural production cost insurance had the same level of per capita living expenditure (economic characteristics), their personal characteristics were different. Farmers who were satisfied with the insurance had lower discount rates than those who were unsatisfied. The majority of them were owner farmers, and they had smaller farmland size (0.19 ha) than those of unsatisfied farmers (0.5 ha). Moreover, farmers who were satisfied with the insurance had lower access to financial institutions (bank account ownership) (4.8 percent) than those of unsatisfied (22.2 percent).

In general, farmers in the downstream, midstream, and upstream areas have different socioeconomic characteristics. Farmers in the downstream area were more risk-averse than those in the midstream and upstream areas. They had lower discount rates than those in the upstream area, but higher than those in the midstream area. Moreover, farmers in the downstream area had the lowest per capita living expenditure, assets, and access to financial institutions. The rent in cash farmers were only located in the midstream and upstream areas.

The value of rice production cost is important because the indemnity of agricultural production cost insurance ($Outcome_e$) is equal to the average rice production cost. This might influence farmers' satisfaction with the insurance. As shown in Table 8.3, the average production cost of rice was around Rp10.41 mil/ha/cropping season with in-kind and around Rp6.78 mil/ha/cropping season without in-kind. The midstream area had the highest rice production cost (Rp11.83 mil/ha/cropping season). It might be because its location is closer to the capital city of

Table 8.3 The production cost of rice

Location	Farmland Size (ha)		Production Cost (Rp mil/ha)			
	Farmland Size Range	Average	Without In-Kind	With In-Kind	Average without In-Kind	Average with In-Kind
Downstream	≤ 0.5	0.33	6.80	9.59	6.74	9.32
	0.5 <	0.87	6.63	8.74		
Midstream	≤ 0.5	0.29	8.1	12.64	7.87	11.83
	0.5 <	0.85	7.6	11.01		
Upstream	≤ 0.5	0.32	5.96	10.88	5.73	10.10
	0.5 <	0.84	5.21	8.38		
Average		0.53			6.78	10.41

Source: Field survey data.

the district where machine rent and hired labor wages are higher than those in the downstream area (Rp9.32 mil/ha/cropping season) and the upstream areas (Rp10.10 mil/ha/cropping season). As a whole, the average rice production cost of smallholder farmers ($\leq$ 0.5 ha) was higher than that of largeholder farmers (0.5 ha $<$).

8.3.2 Farmers' Perception on Service, Value, Outcome, and Satisfaction

Table 8.4 shows farmers' perceived service, perceived value, perceived outcome, and satisfaction. Some findings are as follows:

(1) Perceived service

(a) The majority of farmers (133 farmers, 74 percent) argued that information about agricultural production cost insurance was difficult to access when they were willing to purchase the insurance (Likert scale range 1-2). Meanwhile, there were only around 47 farmers (26 percent) who stated that the insurance information was easy to access (Likert scale = 3-4).

(b) Farmers argued that they faced difficulties when they wanted to inform the insurance provider about the damage that occurred on their farmland due to disasters (Likert scale = 1.61). Among farmers, only 52 farmers (29 percent) claimed that there was no problem in informing the insurance provider of damage information.

(2) Perceived value

(a) The majority of farmers (134 farmers, 74 percent) insisted that the indemnity of agricultural production cost insurance could not cover the production cost of rice (the average score of the Likert scale = 1.77).

(b) The majority of farmers (130 farmers, 72 percent) argued that the guaranteed yield was too low, being 25 percent of the average production. This meant that even though farmers experienced disasters, they could not claim the indemnity (the average score of the Likert scale = 1.82) because the percentage of damage was lower than 75 percent.

(c) Farmers stated that the premium price was not affordable for farmers (the average score

Table 8.4 Farmers' perception on insurance service, value, outcome, and satisfaction

Perception and Satisfaction		All Farmers		Downstream		Midstream		Upstream	
		AVG	SD	AVG	SD	AVG	SD	AVG	SD
Perceived service									
Information access	A farmer has easy access to information about insurance when he/she is willing to purchase.	1.82	1.04	2.35	1.22	1.82	0.99	1.30	0.46
Damage information delivery	A farmer can quickly contact the insurance provider and agriculture district office to inform them of damage due to disasters.	1.61	0.94	2.17	1.14	1.47	0.83	1.18	0.39
Perceived value									
Indemnity	Indemnity can cover production costs.	1.77	1.06	2.48	1.27	1.60	0.91	1.25	0.431
Guaranteed yield	Guaranteed yield (75 percent) reflects the average percentage of damage of the area.	1.82	1.04	2.47	1.24	1.77	0.91	1.23	0.43
Premium	The premium is affordable by the farmer.	1.90	1.03	2.38	1.22	1.88	0.98	1.43	0.49
Perceived outcome									
Feeling of security	The purchase of agricultural production cost insurance provides a feeling of security.	2.14	1.07	2.75	1.00	2.40	0.99	1.28	0.55
Satisfaction	Overall, the farmer is satisfied with agricultural production cost insurance.	1.94	1.20	2.68	1.32	1.95	1.14	1.20	0.48

Source: Field survey data.
Note: AVG = average; SD = standard deviation; 1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree.

of the Likert scale = 1.90). There were only 48 farmers (27 percent) who argued that the premium price was still reasonable.

(3) Perceived outcome

According to the average score of the Likert scale, there were around 62 farmers (34 percent) who stated that the insurance purchase provided a feeling of security during the insurance period (the average score of Likert scale = 2.14).

(4) Satisfaction

(a) There were 45 farmers (25 percent) who stated that they were satisfied with agricultural

production cost insurance (Likert scale = 3-4). This meant that only one-fourth of farmers stated that adopting agricultural insurance as a risk coping could meet their expectations.

(b) The perceived outcome had the biggest contribution to farmers' satisfaction compared with perceived service and perceived value, since it had the highest average score of the Likert scale.

(5) Location

As a whole, farmers' perception on service, value, and outcome in the downstream area were higher than those in the midstream and upstream area.

In brief, farmers had lower perception on service (information access, damage information delivery), value (indemnity, guaranteed yield, premium price), and outcome (feeling of security) as the majority of farmers (66 percent - 74 percent) had a range of 1-2 Likert scale. This implies that there is a problem of insurance quality, that is, both service and value. In particular, a low feeling of security could be interpreted that the insurance fails to make farmers believe that the insurance can reduce the negative impacts of natural hazards such as the impact on their income.

8.3.3 Determinants of Farmers' Satisfaction

According to the link test (Table 8.5), the model is well specified. The highest value of VIF (3.65) shows that there is no multicollinearity. The model can explain 79 percent of the variance. The result of POLS shows that there are 12 variables influencing farmers' satisfaction: risk behavior, discount rate, the number of enrollment, per capita living expenditure, rent in cash farmers, midstream area, percentage of damage, indemnity (value), premium price, information access, gain indemnity (outcome), and feeling of security.

Among personal characteristics, risk behavior, discount rate, and the number of enrollment were determinants of farmers' satisfaction with the agricultural production cost insurance. Risk-averse farmers were significantly unsatisfied with the insurance. It might be because they have higher expectations of the insurance benefits, and when the results of insurance do not meet their

Table 8.5 Result of POLS

Variable	Estimated Coefficient	
	Coefficient	Std. Error
Dependent variable: farmers' satisfaction		
Constant	0.1047***	0.216108
Personal Characteristics		
Age (x_1)	-0.0012	0.0013
Education (x_2)	-0.0046	0.0040
Sex (x_3)	0.0467	0.0406
Risk behavior (x_4)	0.0005^{-1}***	0.0000
Discount rate (x_5)	-0.0903*	0.0512
Number of enrollment (x_6)	-0.0614***	0.0223
Economic Characteristics		
Per capita living expenditure (x_7)	-0.0090**	0.0043
Asset value (x_8)	0.0002	0.0001
Farming Characteristics		
Farmland size (x_9)	-0.0075	0.0359
Landholding		
Sharecropping (x_{10})	0.0246	0.0258
Rent in cash (x_{11})	0.0841*	0.0491
Production cost (x_{12})	-0.0034	0.0057
Access to financial institutions		
Bank account (x_{13})	-0.0003	0.0289
Location		
Downstream (x_{14})	0.0053	0.0440
Midstream (x_{15})	0.0745*	0.0415
Severity		
Disaster experience (x_{16})	-0.0187	0.0419
Percentage of damage (x_{17})	-0.0012**	0.0006
Perceived value		
Indemnity (x_{18})	0.2217*	0.1355
Guaranteed yield (x_{19})	0.1559	0.1500
Premium price (x_{20})	0.2053**	0.0954
Perceived service		
Information access (x_{21})	0.2999**	0.1178
Damage information delivery (x_{22})	0.0669	0.2177
Outcome		
Gain indemnity (x_{23})	0.1586**	0.0799
Feeling of security (x_{24})	0.3437***	0.0638
Number of observation	180	
Adj R^2	0.79	
Highest VIF	3.65	
Linktest: _hat	0.000	
_hatsq	0.121	

Source: Author.
Note: ***significant at 1% level, **significant at 5% level, *significant at 10% level.

expectations, risk-averse farmers are likely to be more unsatisfied than those of risk-taker and risk-neutral.

The discount rate negatively influenced farmers' satisfaction with agricultural production

cost insurance. Farmers with a higher discount rate had a lower level of satisfaction with the insurance. The low return of the insurance might be the reason why farmers with higher discount rates were unsatisfied with it because they valued current resources (money) higher than those in the future. The number of enrollment (purchase) is predicted to positively influence farmers' satisfaction since the repetition of insurance purchases might be a lucrative benefit. However, the result shows that farmers' satisfaction decreased as the number of enrollment increased.

Among economic characteristics, per capita living expenditure influenced farmers' satisfaction with agricultural production cost insurance. Farmers who had higher per capita living expenditure had lower satisfaction. It might be because farmers with higher per capita living expenditure had a higher capacity to adopt many types of risk coping strategies. When the agricultural production cost insurance did not meet their expectations in comparison to other risk coping strategies, farmers' satisfaction with the insurance might be low.

Rent in cash landholding significantly influenced farmers' satisfaction with agricultural production cost insurance, being the only determinant among farming characteristics. Since the rent in cash have higher production cost of rice than others (sharecropping and owner), the insurance could reduce their loss due to disasters and provides a feeling of security.

There was one determinant found related to severity: percentage of damage. Farmers who experienced a higher percentage of damage had lower satisfaction with agricultural production cost insurance. A higher percentage of damage means that farmers have a higher production loss due to disasters. When the insurance purchased could not significantly reduce the loss of production, farmers with a higher percentage of damage were more unsatisfied than those with a lower percentage of damage because the proportion of the production loss that could be compensated by the insurance was much lower.

Among three variables of perceived value, there were only two variables that positively determined farmers' satisfaction with agricultural production cost insurance: perceived indemnity and perceived premium price. When farmers perceived that the indemnity could cover the

production cost and the premium price were reasonable, they might be satisfied with the insurance.

Among two variables of perceived service, information access was the only positive determinant of farmers' satisfaction with agricultural production cost insurance. This is because access to information might broaden farmers' knowledge of the benefit of insurance.

Outcomes of agricultural production cost insurance, namely receiving indemnity (tangible) and feeling of security (intangible), were significant determinants of farmers' satisfaction with the insurance. Intangible outcome (feeling of security) had a higher contribution to farmers' satisfaction with the insurance than tangible outcome (indemnity).

Even though there are 12 determinants of farmers' satisfaction with agricultural production cost insurance, as far as the value of coefficient is concerned, the comparatively significant determinants are limited to two perceived values (indemnity, premium), one perceived service (information access), and two outcomes (indemnity, feeling of security). It means that the largest contribution to the satisfaction with agricultural production cost insurance could be attributed to quality, services, and outcomes of the insurance rather than socioeconomic characteristics of farmers.

8.4 Conclusions

The majority of farmers (75 percent) were unsatisfied with agricultural production cost insurance. Farmers' satisfaction was determined by risk behavior, discount rate (time preference), number of enrollment, per capita living expenditure, rent in cash farmers, location (that is the midstream area), percentage of damage, and perception of indemnity (value), premium price, information access, indemnity (outcome), and feeling of security.

Among independent variables, perceived value, perceived service, and outcomes were major determinants of farmers' satisfaction with agricultural production cost insurance. Current unsatisfied farmers will influence other farmers who have not yet participated in the insurance. To increase farmers' satisfaction with the insurance, improving the quality of insurance (goods

and services) and convincing farmers that the insurance might reduce the negative impacts of risks (feeling of security) should be prioritized.

The present study suggests that the sustainability of agricultural production cost insurance program can be achieved by using three strategies. Firstly, the improvement of information access (service) to the agricultural production cost insurance should be a priority. This improvement includes information about the mechanism of purchasing insurance and its scheme. This can be conducted by increasing the number of extension services to provide information directly to farmers (farmer groups) and providing insurance information on social media (websites) followed by the dissemination of information to the farmers. Because the ability of the government to increase extension services might be limited, the former will be not reliable. Therefore, the latter will be an appropriate solution since insurance information on social media can be easily accessed without using an extension service.

Secondly, the government should reduce premium and revise the indemnity of the insurance to increase the insurance value. The former is difficult to be implemented because it increases the government subsidy allocated for the premium. The latter is more possible. According to the present study, farmers argued that the indemnity could not cover the production cost. In order to get the indemnity reflecting the production cost of rice, the government should revise the determination of indemnity, for example, utilizing data at regional level (such as district) instead of nation-wide (currently the government uses nation-wide data of production cost to determine the indemnity applied for all districts).

Thirdly, improving farmers' feeling of security can be conducted by educating farmers about agricultural production cost insurance. Education on the insurance might broaden farmers' knowledge about the insurance. This includes what the benefits and costs of the agricultural insurance are. Farmers cannot feel secure when purchasing the insurance, unless they understand what benefits of the insurance can deliver to them.

CHAPTER 9. CONCLUSIONS

It is driven by various reasons that farmers' participation rate in agricultural production cost insurance is low. These include the design of insurance (scheme and institutional arrangements), farmers' characteristics, farmers' economic affordability, and quality of insurance (value, services, and outcomes).

Comparing with agricultural insurance implementation in India and the Philippines, weaknesses of the agricultural production cost insurance scheme in Indonesia are found in coverage, basic data estimation, indemnity, guaranteed yield, and premium. Agricultural production cost insurance covers only the production cost. Even though it has the potential to avoid moral hazards, limiting coverage to the production cost reduces the attractiveness of the insurance, which leads to farmers' low participation. It is also triggered by low guaranteed yield and indemnity. Inaccurate determination of premium, indemnity, and guaranteed yield was induced by the use of nation-wide data as a basis of estimation.

The central government (MoA) dominates activities in agricultural production cost insurance implementation. Although the decision-making process can be accelerated, not all activities can be properly executed by the central government. For example, research and development should be more properly conducted by the implementing agencies at the district level. Therefore, by utilizing data in each district, the implementing agencies can precisely determine premium, indemnity, and guaranteed yield. Currently, the central government provides 100 percent of the premium subsidy. Not only will this burden the central government, but also it will lead to a lack of awareness about the insurance program for the local governments (particularly district). As a result, they make little effort to encourage farmers to participate in the insurance. The restriction of private companies from providing agricultural insurance for smallholder farmers reduces the competitiveness of the insurance market and decreases the insurance quality.

The first effort adopted by farmers to reduce the adverse impacts of risks is to modify

farming practices (on-farm strategies) by cropping pattern diversification. The decision on cropping pattern diversification is influenced by three factors: motivation for farming, risk behavior, and risk perception. On the whole, farmers who adopt cropping pattern diversification are motivated by economic objectives. They have risk-averse behavior and have risk perception on the impact and probability of production and price. This confirms that cropping pattern diversification is a strategy to minimize the adverse impacts of risks (risk management). Around one-third of farmers had risk-neutral behavior and low-risk perception (impact and probability). Because of these characteristics, they might not adopt any risk coping strategies (including cropping pattern diversification) unless they are aware of the risks that they face. Improving awareness about the negative impacts of risks to income from farming might encourage them to adopt risk coping strategies, both on-farm and off-farm risk coping.

Farmers combine their risk coping strategies between on-farm and off-farm to increase their resilience to risks, rather than concentrating on one type of ex-ante strategy. Failure in on-farm risk coping strategies will be compensated by off-farm risk coping strategies. When ex-ante risk coping strategies (on-farm and off-farm) fail to cope with risks, they rely on ex-post coping strategies to minimize loss. In general, farmers will avoid reducing consumption and expenditure (low-stress) as ex-post risk coping strategy. To maintain the level of consumption and expenditure, they prefer to adopt middle-stress ex-post coping strategies (borrow from formal and informal resources, migrate to find jobs, get help from relatives, and utilize savings). In addition, socio-psychological characteristics (perceived coping appraisal) are essential factors in determining farmers' decisions relating to risk coping strategies.

Economic affordability determines farmers' decisions on the number of ex-ante coping strategies adopted. The economic affordability, which derives from income, farmland size, and access to financial institutions, enables farmers to invest in various types of ex-ante risk coping strategies. Thus, it will increase farmers' resilience to risks.

The Indonesian government has determined the insurance scheme (premium, indemnity, and

guaranteed yield) based on the average production cost and percentage of damage of rice production during the period 2003-2012 in all regions (a nation-wide basis). This approach leads to market failure, especially adverse selection, because indemnity, guaranteed yield, and premium cannot be estimated properly, and cannot reflect the level of individual risk. Especially, due to the cost approach, the premium cannot reflect social exchange value (market value). CVM shows that farmers' WTP (consumer value) is lower by 16 percent than the current premium (the producer value).

The majority of farmers were unsatisfied with the insurance. Rather than personal characteristics, the insurance's value, services, and outcomes are the largest contribution to being satisfied with agricultural production cost insurance. Farmers who had already participated in the insurance but were unsatisfied with agricultural production cost insurance might not participate in the insurance in the next cropping season. This will influence the decision of farmers who have not yet participated in the insurance.

By integrating all analyses, farmers' low participation in agricultural insurance could be explained: 1) outcomes do not meet farmers' expectations, though the design of the insurance scheme (insurance value) is well formulated, and the insurance service is good; 2) the insurance service is not good, although outcomes meet farmers' expectations and the insurance scheme is well designed; 3) the insurance is not well designed, although the insurance service is good; and 4) due to personal characteristics, farmers cannot participate in the insurance, even though the insurance is well designed and the insurance service is good. Thus, this study suggests four main policy implications to increase farmers' participation in agricultural production cost insurance as follows:

(1) Revising the insurance design

(a) Insurance scheme

- Insurance scheme (premium, indemnity, guaranteed yield) should reflect risks faced by farmers in a specific region (for example, district). It can be achieved if insurance

scheme determination for a district uses the data of historical production of the district. Instead of nation-wide data, region-wide data (district) could provide more accurate data to determine the insurance scheme for a district. Therefore, premium, indemnity, and guaranteed yield could be differentiated by the district. Farmers in a district with lower risks will have a lower premium and guaranteed yield. They will also have different indemnity because they have different production costs.

(b) Institutional arrangements

- Determination of premium, guaranteed yield, and indemnity should be conducted by implementing agencies at the region level (such as agriculture district office and the insurance provider at the district level) because they have more capacity to collect data at the region level and have more knowledge about its risks.
- The premium subsidy should be divided between the central and local government so that it is not burdening the central government, and the local government will have more awareness of the agricultural insurance program.
- Allowing private insurance providers to enter the agricultural insurance market might improve its competitiveness, and consequently improve services and delivery.

(2) Improving farmers' capacity to adopt risk coping strategies

- Improving access to financial institutions may improve farmers' capacity to cope with risks by adopting several risk coping strategies, including agricultural insurance. It provides opportunities for farmers to increase incomes by investing money in on-farm income such as cropping pattern diversification and non-farm income generating activities. When farmers' incomes rise, farmers can increase their adaptive capacity by adopting more than one ex-ante risk coping strategy.
- Improvement of access to information might remove farmers' doubts about insurance as an ex-ante risk coping strategy. This can be conducted by increasing extension services to provide information directly to farmers (farmer groups) and providing

insurance information on social media (websites), followed by dissemination of information to farmers.

- Educating farmers about agricultural production cost insurance is essential to farmers' awareness and understanding of the insurance.

(3) Focusing on farmers with certain characteristics

- Farmers who implement cropping pattern diversification have high-risk perception and risk-averse characteristics. It implies that farmers who are more likely to purchase insurance are farmers who have already practiced cropping pattern diversification. Thus, farmers who implement single cropping pattern (with lower risk perception and risk-neutral characteristics) should be as a target for the agricultural production cost insurance program.
- Farmers' WTP for the agricultural production cost insurance indicates that the government should pay more attention to farmers with small farmland and low contact with extension services as the target for improving farmers' participation in the insurance.

(4) Sustaining the participation of farmers who have already purchased the insurance

- Improving the insurance value by revising the determination of indemnity, guaranteed yield, and premium might enhance farmers' satisfaction with purchasing insurance. When premium, indemnity, and guaranteed yield reflect the risks and historical production of farmers, it will improve the insurance value, and consequently, farmers' satisfaction with agricultural production cost insurance. This strategy is parallel with improving the insurance design (policy implication point 1).
- Farmers' feelings of security can be improved by educating farmers who have already purchased the insurance about the benefits of the insurance. It might broaden farmers' knowledge about insurance and strengthen their belief that the insurance can reduce the negative impacts of risks.

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Appendix A: Research Questionnaire

Questionnaire
Agricultural Production Cost Insurance in West Java, Indonesia:
A Case of Garut District

Date of Interview : Name of Interviewer :

Sub-district : Village :

1. Personal Information

1.1 Name of Respondent :…….

1.2 Address :……..

1.3 Gender : ① Male ② Female

1.4 Age :……years old

1.5 Education :……years

No	Education	Years
1	No Schooling	
2	Elementary School	
3	Junior High School	
4	Senior High School	
5	Under Graduate	
6	Post Graduate	

1.6 Marital Status : ① Single ② Married

1.7 Household's Members :……...people

Name	Gender M = ① F = ②	Age	Relation 1. Household head 2. Parent 3. Spouse 4. Children 5. Grand Parents 6. Grand Children	Education 1. No schooling 2. Elementary school 3. Junior High School 4. Senior High school 5. Under Graduate 6. Post Graduate	Household member's income No = ① Yes = ②
1.	① ②		① ② ③ ④ ⑤ ⑥	① ② ③ ④ ⑤ ⑥	① ②
2.	① ②		① ② ③ ④ ⑤ ⑥	① ② ③ ④ ⑤ ⑥	① ②
3.	① ②		① ② ③ ④ ⑤ ⑥	① ② ③ ④ ⑤ ⑥	① ②
4.	① ②		① ② ③ ④ ⑤ ⑥	① ② ③ ④ ⑤ ⑥	① ②

2. Economic Characteristics

2.1 Household Income

2.1.1 How much gross income did you and your household member get from farming activities in 2016?

No	Type of Job	No (1) or Yes (2)	Income respondent (Rp/season)			Income other household members (Rp/season)		
			S1	S2	S3	S1	S2	S3
1.	Rice production	① ②						
2.	Livestock	① ②						
3.	Other crops and vegetable	① ②						
4.	Fishery	① ②						
5.	Agricultural labor	① ②						
6.	Others:……..	① ②						
Total								

2.1.2 How much gross income di you and your household members get from non-farm activities in 2016?

No	Type of Job	① No ② Yes	Average income respondent (Rp/year)	Average income other household members (Rp/year)
1.	Wage Employment			
	a. Permanent Job	① ②		
	b. Temporal Job	① ②		
2.	Self-employment			
	a. Own permanent business (trade etc)	① ②		
	b. Own temporal business (trade etc.)	① ②		
3.	Other sources			
	a. Remittance	① ②		
	b. Pension	① ②		
	c. Land rent (in cash or in-kind)	① ②		
	d. Machinery rent	① ②		
	e. Others…….	① ②		
Total				

2.2 Household Expenditure

2.2.1 How much was your household's living expenditure in 2016?

Category	Type	In kind (kg etc./year)	In cash (Rp/year)
Food	Rice		
	Vegetable		
	Fruit		
	Oil		
	Spice		
	Sugar		
	Salt		
	Drinking water		
	Others:……		
Non-food	Transportation		
	Electricity		
	Children education		
	Healthcare		
	Loan repayment		
	House rent		
	Gas		
	Firewood		
	Water		
	Others:……		

2.3 Financial Characteristics

2.3.1 Asset

2.3.1.1 What assets do you own now?

No.	Type of asset	No=1, yes = 2	Current value (Rp)
1.	Permanent house	① ②	
2.	Color TV	① ②	
3.	Radio	① ②	
4.	Gas Cooker	① ②	
5.	Refrigerator	① ②	
6.	Bicycle	① ②	
7.	Motor Cycle	① ②	
8.	Car	① ②	
9.	Livestock	① ②	
10.	Other…….	① ②	

2.3.2 Saving

2.3.2.1 Do you and your household members save money (income) or rice for the future expenses?

① No ② Yes

If no go to question 3.1.1, If yes go to question 2.3.2.2

2.3.2.2 What is the type of saving you and your household member use?

① Money ② Rice ③ Gold ④ Others:….

2.3.2.3 How often do you save your income?

Money	Rice	Gold	Others:….
① Every day ② Every month ③ Every three month ④ Every six month ⑤ Every year	① Every day ② Every month ③ Every three month ④ Every six month ⑤ Every year	① Every day ② Every month ③ Every three month ④ Every six month ⑤ Every year	① Every day ② Every month ③ Every three month ④ Every six month ⑤ Every year

2.3.2.4 How much the average total of savings you and your household members every year (Rp/year)?

① Money = Rp…… ② Rice =…..kg ③ Gold = ……gr. ④ Others:……

3. Access to Financial Institutions

3.1 Formal Institutions: Bank and Cooperative

3.1.1 Have your household (you and other members) used bank and cooperative for saving?

① No ② Yes

If no go *to question 3.2.1, If yes go to question 3.1.2*

3.1.2 Now, do you or your household members have a bank account?

① No ② Yes

3.1.3 Did your household (you and other members) use credit/loan from bank or cooperative in the past five years?

Bank ① No ② Yes Others:……. ① No ② Yes

Cooperatives ① No ②Yes

3.1.4 Why do/did you choose this type of financial institution for the loan (borrowing money)?

① Easy to access ② No collateral ③ No limitation on borrowing

④ Flexibility on paying the loan ⑤ Others:…….

3.1.5 Is your household (you or other household members) currently paying back credit/loan?

Bank ① No ② Yes

Cooperatives ① No ②Yes

Others…… . ① No ② Yes

3.1.6 How much is your and other members' current loans remained (have to be paid back)?

Bank	Cooperative	Others:…
Consumption Rp……..	Consumption Rp…….	Consumption Rp…….
Production Rp……..	Production Rp…….	Production Rp…….

3.2 Informal Institution: Money Lenders, Relatives or Social Groups

3.2.1 Have your household (you and other members) used social groups for saving?

① No ② Yes

3.2.2 Did your household (you or other members) use credit from money lenders, relatives or social groups in the past five years?

Moneylenders ① No ② Yes Rp…….

Relatives ① No ② Yes Rp…….

Social groups ① No ② Yes Rp…….

3.2.3 Why do you choose these informal institutions for a loan (borrowing money)?

① Easy to access ② No collateral ③ No limitation on borrowing

④ Flexibility on paying the loan ⑤ Others……

3.2.4 Is your household (you or other members) currently paying back loan from financial institutions?

Moneylender ① No ② Yes Social groups ① No ② Yes

Relatives ① No ② Yes Others:……. ① No ② Yes

3.2.5 How much is your household's (you and other members) current loans remained (have to be paid back)?

Money Lender	Relatives	Social Groups	Others:…
Consumption: Rp… Production : Rp…	Consumption: Rp… Production : Rp…	Consumption: Rp… Production : Rp…	Consumption: Rp… Production : Rp…

4. Farming Characteristics

4.1 Farmland Size, Land Holding, and Production

4.1.1 What type of landholding did you use for agriculture production in 2016?

① Own land ……..ha ② Rent-in (kind)…… ...ha

③ Rent-in (cash)……ha ④ Sharecropping……...ha

4.1.2 Type of farmland did you use in 2016?

① Irrigated ② Rain-fed ③ Irrigated and Rain-fed

4.1.3 How many ha of farmland did you cultivate rice in each season in 2016?

① Season 1 ……...ha

② Season 2……ha

③ Season 3……ha

4.1.4 How many ha of farmland did you cultivate for other crops (vegetable) production in each season in 2016?

① Season 1 ……...ha

② Season 2……ha

③ Season 3……ha

4.1.5 How many tons of rice per ha is average productivity in the past five years? (under normal condition)? ……..ton/ha.

4.1.6 How many tons of rice per ha could you produce when disasters occurred in the past five years?

Low =……..ton/ha

Middle =……..ton/ha

Worst =……..ton/ha

4.1.7 How many ha of farmland were destroyed when disasters occurred in the past five years?

Low =……..ha (…….%)

Middle =……..ha (…….%)

Worst =……..ha (…….%)

4.1.8 What type of crops and how many productions did you cultivate in the last five years?

Year	Farmland	Plot	Area (ha)	Reason	Type of crop	Season 1 (ton)	Season 2 (ton)	Season 3 (ton)	Payment of rent (- by rent /lease /sharecrop-in, + by rent/lease/sharecrop-out)	Total production (home consumption)
2012	Own (used)									
	Rent/lease/ sharecrop-in									
	Rent/lease/ sharecrop-out									
	Total									
2013	Own (used)									
	Rent/lease/ sharecrop-in									
	Rent/lease/ sharecrop-out									
	Total									
2014	Own (used)									
	Rent/lease/ sharecrop-in									
	Rent/lease/ sharecrop-out									
	Total									
2015	Own (used)									
	Rent/lease/ sharecrop-in									
	Rent/lease/ sharecrop-out									
	Total									
2016	Own (used)									
	Rent/lease/ sharecrop-in									
	Rent/lease/ sharecrop-out									
	Total									

Note: Price in 2016 = Rp 4000/kg.

4.1.9 How many tons of rice per ha did you produce in the last season? …….ton/ha

4.1.10 How do you predict the rice production in the next season, compare to the average yield production in normal condition?

① Lower ② The same ③ Higher

4.1.11 How much the cost of rice production?

Component	Without in-kind (Rp)	In-kind (Rp)	Total (Rp)
a. Seed			
b. Labor			
c. Fertilizer			
d. Pesticide			
e. Land rent			
f. Machine rent			
g. Self-employment			
h. Fuel			
i. Others:			

4.2 Farmer's Motivation for Farming

4.2.1 What is your motivation for farming?

Type	Motivation
Economic	① Gain higher profit
	② Attain higher yield
	③ Avoid commodity price fluctuation
	④ Avoid higher input cost
	⑤ Get higher cash flow
	⑥ Follow market demand
Cultural	⑦ Never change the crop grown
Technical	⑧ Have knowledge and skill
	⑨ Reduce the occurrence of pests and diseases
	⑩ Reduce the impacts of environmental factor change
	⑪ Improve soil fertility

Note: A farmer can select more than one motivation.

5. Institutional Characteristics

5.1 Is there any agriculture advisor who visits you and give advice concerning rice production?

① No ② Yes

If no go to question 6.1.1, If yes go to question 5.2

5.2 How often does the agriculture adviser come to you?

① At least once a week ② At least once a mount ③ At least once in three months

④ At least once in six months ⑤ At least once a year

5.3 Is there any farmer groups in your village?

① No ② Yes

If no go to question 6.1.1, If yes go to question 5.4.

5.4 What is the type of farmer groups? Please mention the name of the farmer groups?

① Farming group, Name:…..

② Irrigation group, Name:……

③ Others……., Name:……

5.5 Are you members of those farmer groups?

① No ② Yes

If no go to question 6.1.1, If yes go to question 5.6

5.6 What are your positions in farmer groups?

① Leader (name of the group:)

② Member (name of the group:)

6. Personal Characteristics Related to Risks

6.1 Risk Perception on Natural Hazard

Type of Disaster	6.1.1 What types of natural hazards occurred in the last five years? ① No ② Yes		6.1.2 Categorize the impacts of natural hazards on income from farming in the past five years based on your experience ① Very low ② Low ③ High ④ Very high				6.1.3 How is the probability of the occurrence of natural hazards in the next one year planting season? ① Very low ② Low ③ High ④Very high			
Droughts	①	②	①	②	③	④	①	②	③	④
Floods	①	②	①	②	③	④	①	②	③	④
Pests and diseases	①	②	①	②	③	④	①	②	③	④
Landslides	①	②	①	②	③	④	①	②	③	④
Fires	①	②	①	②	③	④	①	②	③	④
Windstorms	①	②	①	②	③	④	①	②	③	④
Rainfall deficit	①	②	①	②	③	④	①	②	③	④
Excess rainfall	①	②	①	②	③	④	①	②	③	④
Others ……	①	②	①	②	③	④	①	②	③	④

Type of disasters	6.1.4 How many times did the disaster occur in the past five years?				
	2012	2013	2014	2015	2016
Droughts					
Floods					
Pests and diseases					
Landslides					
Fires					
Windstorms					
Rainfall deficit					
Excess rainfall					
Others ……					

6.2 Risk in Farming

Type of risk	6.2.1 What type of risks did you experience in the past five years? ① No ② Yes		6.2.2 How are the impacts of risks on your income from farming? ① Very low ② Low ③ High ④ Very high				6.2.3 How is the probability of the existence of the risk? ① Very low ② Low ③ High ④ Very high			
Yield variability	①	②	①	②	③	④	①	②	③	④
Pests and diseases	①	②	①	②	③	④	①	②	③	④
Water scarcity	①	②	①	②	③	④	①	②	③	④
Land fertility	①	②	①	②	③	④	①	②	③	④
Pollination failure	①	②	①	②	③	④	①	②	③	④
Price commodity	①	②	①	②	③	④	①	②	③	④
Price input	①	②	①	②	③	④	①	②	③	④
Human skill	①	②	①	②	③	④	①	②	③	④
Asset	①	②	①	②	③	④	①	②	③	④
Government policy	①	②	①	②	③	④	①	②	③	④
Capital return	①	②	①	②	③	④	①	②	③	④

6.3 Ex-Ante Risk Coping Strategy

6.3.1 Do you have any activities to minimize the impacts of natural disasters that will occur in the future (risk coping strategies)?

① No ② Yes

If No go to question No.6.4.1, If Yes go to question No.6.3.2

6.3.2 What types of risk coping strategies do you adopt? (farmers can select more than one risk coping strategy).

① Crop diversification

② Planting rice in different locations

③ Rotating savings and credit association (ROCAS)

④ Income diversification

⑤ Saving

⑥ Others……

6.3.3 Reasons to select such coping activities? 1……., 2……., 3…….

6.3.4 From whom/which have you come to know such coping activities?

① Self-experience ② From farmer colleague ③ Agricultural advisors ④ Other: …..

6.4 Coping Appraisal

Type of risk coping strategy	6.4.1 How do you evaluate the effectiveness of risk coping strategies to minimize the impacts of disasters? ① Very low ② Low ③ High ④ Very high				6.4.2 How do you think about your ability to implement risk coping strategies? ① Very low ② Low ③ High ④ Very high				6.4.3 How do you think the cost to implement risk coping strategies? ① Very low ② Low ③ High ④ Very high			
a. Crop diversification	①	②	③	④	①	②	③	④	①	②	③	④
b. Planting rice in different locations	①	②	③	④	①	②	③	④	①	②	③	④
c. Water management	①	②	③	④	①	②	③	④	①	②	③	④
d. ROCAS	①	②	③	④	①	②	③	④	①	②	③	④
e. Income diversification	①	②	③	④	①	②	③	④	①	②	③	④
f. Saving	①	②	③	④	①	②	③	④	①	②	③	④
g. Others:	①	②	③	④	①	②	③	④	①	②	③	④

Note: If farmers implemented more than one coping strategy, the average perception was used to reflect farmers' perception value.

6.4.4 In the past five years, how many times do you use risk coping strategies?

Type of risk coping	Frequency (times)				
	2012	2013	2014	2015	2016
a. Crop diversification					
b. Planting rice in different locations					
c. Rotating savings and credit association (ROCAS)					
d. Income diversification					
e. Saving					
f. Others:….					

6.5 Ex-Post Risk Coping Strategy

Type of ex-post risk coping strategy	6.5.1 What type of risk coping strategies after disasters did you adopt in the past five years? ① No ② Yes					6.5.2 Mention the reasons to implement such risk coping strategies?
	2012	2013	2014	2015	2016	
a. Change consumption	① ②	① ②	① ②	① ②	① ②	
b. Increase household budgeting	① ②	① ②	① ②	① ②	① ②	
c. Utilize savings	① ②	① ②	① ②	① ②	① ②	
d. Borrowing from formal and informal sources	① ②	① ②	① ②	① ②	① ②	
e. Migrate to find a job	① ②	① ②	① ②	① ②	① ②	
f. Get help from relatives	① ②	① ②	① ②	① ②	① ②	
g. Sell household asset	① ②	① ②	① ②	① ②	① ②	
h. Sell production asset	① ②	① ②	① ②	① ②	① ②	
i. Default on loan	① ②	① ②	① ②	① ②	① ②	
j. Take children out from school	① ②	① ②	① ②	① ②	① ②	
k. Others:…….	① ②	① ②	① ②	① ②	① ②	

6.5.3 In the past five years, how many times do you adopt risk coping strategies to minimize the impacts of disasters?

Type of ex-post risk coping strategy	Frequency				
	2012	2013	2014	2015	2016
a. Change consumption					
b. Increase household budgeting					
c. Utilize savings					
d. Borrowing from formal and informal sources					
e. Migrate to find the job					
f. Get help from a relative					
g. Sell household asset					
h. Sell production asset					
i. Default on loan					
j. Take children out from school					
k. Others:……..					

7. Risk Behavior, Trust Behavior, and Discount Rate Measurement

7.1 Risk Behavior

Risk game procedure

- Respondents are given the amount of money. In this game Rp 30,000 (two-third of daily wage)
- They have to decide to bet or not to bet. They can decide not to bet (0) or to bet with the value of Rp5,000, Rp10,000, Rp15,000, Rp20,000, Rp25,000, and Rp30,000.
- Farmer, who has betted such amount, takes a piece of paper out of a transparent plastic bag, in which there are six pieces of paper that are printed numbers of 1 to 6.
- The result of the bet is represented by the number as follows:

  1 = Lose all of the money allocated for bet
  2 = Gain half (0.5) of money allocated for bet
  3 = Gain all of the money allocated for bet
  4 = Gain one and half of the money allocated for bet
  5 = Gain two times of the money allocated for bet
  6 = Gain two and half of the money allocated for bet
- The risk behavior is reflected by the value of money given (Rp30,000) minus the value of money for bet.

7.1.1 How much are you willing to bet Rp……

① 0 ② 5,000 ③ 10,000 ④ 15,000 ⑤ 20,000 ⑥ 25,000 ⑦ 30,000

7.1.2 Result of bet = Rp…….

7.2 Trust Behavior

Trust game procedure

- Respondents (trustor) are given amount of money (Rp30,000). They have to decide the amount of money that will be sent to the unknown respondents (trustee).
- The interviewer then tells to the trustor that the money given to the trustee will be tripled. After that, the trustee will be asked whether or not they will give back the money to the trustor. If yes, how much he/she will give money to the trustor
- The trustee will send back the money to the trustor, in which the amount of money that is sent back to the trustee depends on the decision of the trustees. We call it trustworthiness.

7.2.1 How much are you willing to give the money to someone who is unknown in the same village if the money that you give will be tripled and the trustee will be asked to give or not to give to you? Rp……

7.3 Discount Rate

Discount Rate Measurement Procedure

- To measure the discount rate will use a similar method conducted by Kirby et al. (2002). The discount rate estimated using the formula:

$$V = A/(1 + kD)$$

where V is the present values of the reward A with the delay D and the discount rate k

- The respondent will be asked some choices as follows

Present Value (V)	Future Value (A)	Delay (Day) (D)	Discount Rate (k)
80,000	82,000	150	0.00017
70,000	75,000	120	0.00060
60,000	65,000	90	0.00093
50,000	65,000	60	0.00500
40,000	50,000	30	0.00833
30,000	35,000	14	0.01190
20,000	25,000	7	0.03571
10,000	12,000	2	0.10000
10,000	12,000	1	0.20000
5,000	6,000	0.5	0.40000
5,000	6,000	0.25	0.80000

- The discount rate of the respondent will be calculated by the geometric average method when he/she strategy changes between the present and later decision

7.3.1 Which do you prefer in each combination, present value or future value?

a.	Rp 5,000	now	vs	6,000 the next 4 hours
b.	Rp 5,000	now	vs	6,000 the next 12 hours
c.	Rp 10,000	now	vs	12,000 the next 1 day
d.	Rp 10,000	now	vs	12,000 the next 2 days
e.	Rp 20,000	now	vs	25,000 the next 7 days
f.	Rp 30,000	now	vs	35,000 the next 14 days
g.	Rp 40,000	now	vs	50,000 the next 30 days
h.	Rp 50,000	now	vs	65,000 the next 60 days
i.	Rp 60,000	now	vs	65,000 the next 90 days
j.	Rp 70,000	now	vs	75,000 the next 120 days
k.	Rp 80,000	now	vs	82,000 the next 150 days

Discount rate value…….

8. Willingness to Join and Pay

8.1 Willingness to Join

8.1.1 Have you ever purchased any type of insurance

① No ② Yes

If No go to question No. 8.14, If Yes go to question No 8.1.2

8.1.2 Mention the type of insurance that you have purchased?.....

8.1.3 How long did you purchase this type of insurance?..... years

8.1.4 Do you know about agriculture production cost insurance (AUTP)?

① No ② Yes

If No go to Explanation 1 and after that go to question 8.1.6, If Yes go to question 8.1.5.

Explanation 1

Explain about the agricultural production cost insurance, including the scheme (indemnity, premium, guaranteed yield and etc).

8.1.5 Did you purchase agricultural production cost insurance?

① No ② Yes

8.1.6 How many times did you purchase agricultural production cost insurance?..... times

8.1.7 From whom/which institution etc. did you get the information about agriculture insurance?

① Agricultural advisor ② Newspaper ③ Television ④ Radio

⑤ Farmer group member ⑥ Other farmers ⑦ Insurance company ⑧ Other:…..

8.1.8 Are you willing to participate/joint in agriculture insurance in the next cropping season?

① No ② Yes

If No go to question No.9.1.1, If Yes go to question No 8.2.1

8.1.9 What is the reason for not participating?

Reason	Agreement Level ① Strongly disagree ②disagree ③ Agree ④ strongly agree			
Indemnity cannot compensate for rice production cost	①	②	③	④
Percentage of damage is too high as a claim requirement	①	②	③	④
Need more information	①	②	③	④
Risk is low in farmland	①	②	③	④
Don't have any additional budget to purchase insurance	①	②	③	④
No need insurance because of having other risk coping strategies	①	②	③	④
I have already purchased insurance but no disasters	①	②	③	④

8.2 Willingness to Pay

Procedure

- The method used is the dichotomous choice.
- The highest bid is Rp 60,000/ha/cropping season and the lowest is 10.000 /ha/cropping season. Each bid value will be asked to around 40 respondents to avoid starting bias.
- Farmers were proposed the hypothetical agricultural production cost insurance as follows:

  "*The government has a program called 'agricultural production cost insurance' for smallholder farmers. Farmers with the insurance will receive the indemnity equal to production cost, Rp6 mil/ha/cropping season ($444/ha/cropping season) if 75 percent of the farmland under the insurance is destroyed by disasters".*
- The bid amount was picked and randomly offered to each respondent. To avoid starting point bias, the maximum number of respondents asked about each bid was around 40.
- The question 8.2.1 is offered to each respondent.

8.2.1 Are you willing to pay for agricultural production cost insurance premium for Rp

Rp ① 10,000 ② 20,000 ③30,000 ④ 40,000 ⑤ 50,000 ⑥ 60,000/ ha/cropping season?

① No ② Yes

9. Satisfaction with the Insurance

9.1 Indemnity

9.1.1 In the previous insurance period, did you get indemnity from the insurance provider?

① No ② Yes

9.1.2 Why did you not get Indemnity?

① No disasters ② There was a disaster but percentage damage lower than 75 percent.

9.2 Perceived Service

Statement	Agreement Level ① Strongly disagree ②disagree ③ Agree ④ strongly agree			
9.2.1 Farmer is easy to access information about insurance when he/she desires to purchase insurance.	①	②	③	④
9.2.2 A farmer can quickly contact the insurance company and agriculture district office to inform the damage	①	②	③	④

9.3 Perceived Value

Statement	Agreement Level ① Strongly disagree ②disagree ③ Agree ④ strongly agree			
9.3.1 Indemnity can cover production costs.	①	②	③	④
9.3.2 Guaranteed yield reflects the percentage of damage of the area.	①	②	③	④
9.3.3 The premium is affordable by the farmer.	①	②	③	④

9.4 Perceived Outcome (Secure Feeling)

Statement	Agreement Level ① Strongly disagree ②disagree ③ Agree ④ strongly agree			
9.4.1 The purchase of agricultural production cost insurance provides a secure feeling.	①	②	③	④

9.5 Satisfaction

Statement	Agreement Level ① Strongly disagree ②disagree ③ Agree ④ strongly agree			
9.5.1 Overall, I am satisfied with agricultural production cost insurance.	①	②	③	④

Appendix B: Result of Econometrics Analyses

1. Principal Component Analysis (PCA)

1.1 PCA of Motivation

Unrotated Principal

Number of obs	=	240
Number of Comp	=	11
Trace	=	11
Rho	=	1.000

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	3.69447	1.81808	0.3359	0.3359
Comp2	1.87639	0.41228	0.1706	0.5064
Comp3	1.47411	0.41660	0.1331	0.6395
Comp4	1.04751	0.26963	0.0952	0.7348
Comp5	0.77788	0.05590	0.0707	0.8055
Comp6	0.72198	0.30033	0.0656	0.8711
Comp7	0.42165	0.02624	0.0383	0.9095
Comp8	0.39541	0.13856	0.0359	0.9454
Comp9	0.25685	0.05197	0.0233	0.9687
Comp10	0.20488	0.06599	0.0186	0.9874
Comp11	0.13889		0.0126	1

Rotated Varimax (4 components)

Rotation: orthogonal varimax (Kaiser off)

Number of obs	=	240
Number of Comp	=	4
Trace	=	11
Rho	=	0.7348

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	3.18055	1.26854	0.28910	0.28910
Comp2	1.91201	0.33624	0.17380	0.46300
Comp3	1.57577	0.16162	0.14330	0.60620
Comp4	1.41415		0.12860	0.73480

Rotated Components

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
Gain higher profit	0.5181	-0.0265	-0.0172	-0.0444	0.1614
Never change the crop grown	-0.2847	-0.2099	-0.0600	-0.5402	0.1344
Attain higher yield	0.4702	0.0368	0.0342	0.1026	0.2309
Avoid commodity price fluctuation	0.5175	-0.0208	-0.1799	-0.0733	0.2609
Avoid higher input cost	-0.2282	0.1950	-0.0792	0.4428	0.4781
Have knowledge and skill	-0.0680	-0.2124	-0.0174	0.6995	0.2620
Get higher cash flow	0.3122	-0.0481	0.2869	0.0251	0.3735
Reduce the occurrence of pests and diseases	-0.0259	0.6507	-0.0009	-0.0462	0.1781
Reduce the adverse impacts of environmental factor change	-0.0789	-0.0034	0.6618	0.0079	0.3787
Follow market demand	0.0184	0.0112	0.6601	-0.0226	0.3028
Improve soil fertility	0.0134	0.6666	0.0044	-0.0391	0.1566

1.2 PCA of Risk Impact Perception

Unrotated Principal

Number of obs	=	240
Number of Comp	=	11
Trace	=	11
Rho	=	1.000

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	7.91590	6.71256	0.71960	0.71960
Comp2	1.20334	0.66818	0.10940	0.82900
Comp3	0.53516	0.20911	0.04870	0.87770
Comp4	0.32605	0.06115	0.02960	0.90730
Comp5	0.26490	0.02494	0.02410	0.93140
Comp6	0.23996	0.07876	0.02180	0.95320
Comp7	0.16120	0.03176	0.01470	0.96790
Comp8	0.12945	0.03824	0.01180	0.97960
Comp9	0.09120	0.01433	0.00830	0.98790
Comp10	0.07687	0.02091	0.00700	0.99490
Comp11	0.05596		0.00510	1.00000

Rotated Varimax (4 components)

Rotation: orthogonal varimax (Kaiser off)

Number of obs	=	240
Number of Comp	=	2
Trace	=	11
Rho	=	0.8290

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	7.41229	5.70534	0.6738	0.6738
Comp2	1.70695		0.1552	0.829

Rotated Components

Variable	Comp1	Comp2	Unexplained
Yield Variability	0.34730	-0.02450	0.13500
Pests and diseases	0.32720	0.05240	0.14080
Water scarcity	0.32430	0.01930	0.18970
Soil fertility	0.35710	-0.10820	0.17130
Pollination failure	0.33660	0.01210	0.14530
Commodity Price	0.33090	0.01000	0.17650
Input price	0.35610	-0.08490	0.15460
Farmers' skill	-0.06650	0.77970	0.11300
Asset	0.15610	0.45780	0.20880
Government policy	0.16240	0.38720	0.32600
Capital return	0.36560	-0.09830	0.11970

1.3 PCA of Risk Probability Perception

Unrotated Principal

Number of obs	=	240
Number of Comp	=	11
Trace	=	11
Rho	=	1.000

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	7.43576	5.71507	0.67600	0.67600
Comp2	1.72069	1.10435	0.15640	0.83240
Comp3	0.61634	0.26402	0.05600	0.88840
Comp4	0.35232	0.08087	0.03200	0.92050
Comp5	0.27145	0.05761	0.02470	0.94510
Comp6	0.21384	0.07072	0.01940	0.96460
Comp7	0.14313	0.01616	0.01300	0.97760
Comp8	0.12697	0.05807	0.01150	0.98910
Comp9	0.06890	0.02304	0.00630	0.99540
Comp10	0.04586	0.04113	0.00420	0.99960
Comp11	0.00473	.	0.00040	1.00000

Rotated Varimax (4 components)

Rotation: orthogonal varimax (Kaiser off)

Number of obs	=	240
Number of Comp	=	2
Trace	=	11
Rho	=	0.8324

Component	Eigenvalue	Difference	Proportion	Accumulative
Comp1	5.23558	1.31470	0.47600	0.47600
Comp2	3.92088		0.35640	0.83240

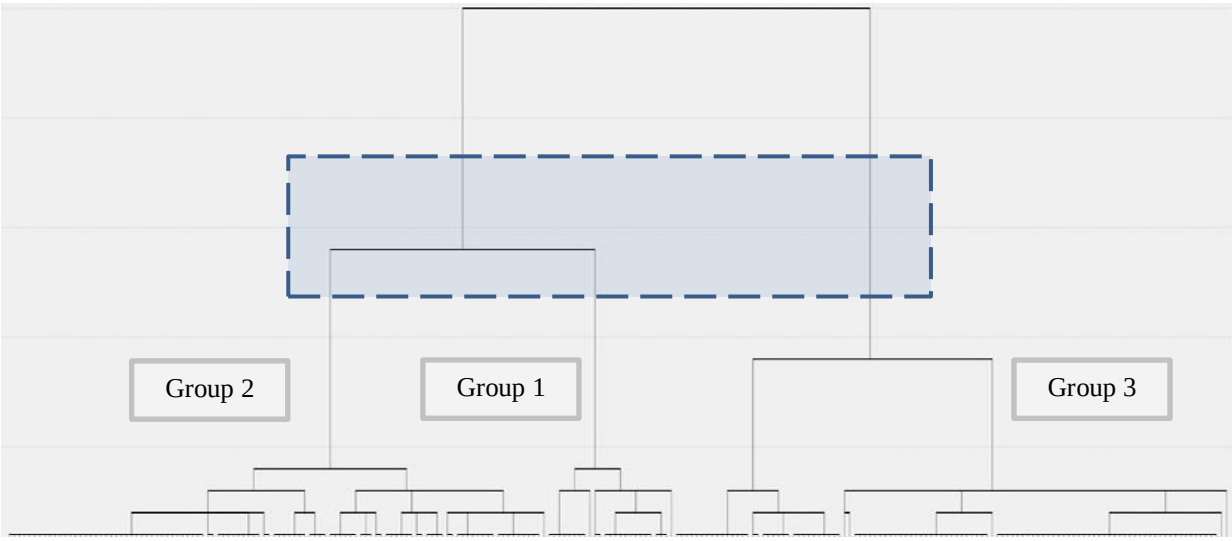
Rotated Components

Variable	Comp1	Comp2	Unexplained
Yield Variability	0.44870	-0.09090	0.14030
Pests and diseases	0.43470	-0.02030	0.05800
Water scarcity	0.41650	0.00240	0.08633
Soil fertility	0.38170	0.01360	0.20760
Pollination failure	0.43360	-0.01810	0.05793
Commodity Price	0.13850	0.35770	0.12230
Input price	0.09020	0.36150	0.26370
Farmers' skill	-0.22520	0.55020	0.23660
Asset	0.04430	0.41840	0.20010
Government policy	0.08810	0.36230	0.26710
Capital return	0.12130	0.35090	0.20350

2. Cluster Analysis

Variable	Cluster 1	2	3
CEI	0.040	0.131	0.284
Risk behavior	22,857	11,304	4,370
Economic	0.332	0.381	0.492
Technical	0.137	0.118	0.181
Environmental	0.161	0.132	0.167
Cultural	0.385	0.397	0.440
Impact P	1.593	1.974	3.053
Impact FCG	1.174	1.456	2.252
Probability P	1.119	1.651	2.795
Probability FCG	0.997	1.052	1.479

Dendrogram of the Three Clusters



3. Logit Regression Model

3.1 Result of the logit model

Number of obs	=	180
LR chi2(22)	=	138.61
Prob > chi2	=	0.0000
Log-likelihood = -32.9991	Pseudo R^2	= 0.6774

COP	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE^2	0.000297	0.0005549	0.54	0.592	-0.0007906	0.001385
EDU	0.4626921	0.3404466	1.36	0.174	-0.2045709	1.129955
SEX	0.4967118	1.426701	0.35	0.728	-2.299571	3.292994
RISK	0.0002044	0.0000875	2.34	0.019	0.0000329	0.000376
DISC	-4.743919	2.757411	-1.72	0.085	-10.14834	0.660507
TRUST	3.51E-06	0.0001128	0.03	0.975	-0.0002177	0.000225
DISEXP	4.348887	2.368031	1.84	0.066	-0.2923686	8.990143
PDM	-.0601079	0.0311859	-1.93	0.054	-0.1212312	0.001015
RIP	1.48289	1.924331	0.77	0.441	-2.288729	5.25451
RPP	0.8031229	1.417187	0.57	0.571	-1.974512	3.580758
CEA	2.090149	1.231571	1.7	0.09	-0.3236846	4.503984
SEA	3.318654	1.83042	1.81	0.07	-0.268903	6.906211
CA	-7.008671	2.202469	-3.18	0.001	-11.32543	-2.69191
EXPD	1.04963	0.395862	2.65	0.008	0.2737548	1.825505
ASST	0.006563	0.0116677	0.56	0.574	-0.0163052	0.029431
$LAND^2$	-4.124932	2.286693	-1.8	0.071	-8.606768	0.356903
TF	-0.1900068	1.305561	-0.15	0.884	-2.748859	2.368846
SHARE	-.6043064	0.903806	-0.67	0.504	-2.375734	1.167121
RIC	0.3559553	2.074818	0.17	0.864	-3.710612	4.422523
BANK	-.6749826	2.08812	-0.32	0.747	-4.767622	3.417657
DSTR	-5.356437	2.280417	-2.35	0.019	-9.825973	-0.8869
MSTR	-5.637336	1.740144	-3.24	0.001	-9.047955	-2.22672
CONSTANT	-11.39062	5.233299	-2.18	0.03	-21.6477	-1.13354

3.2 Link Test

Number of obs	=	180
LR chi2(2)	=	139.2
Prob > chi2	=	0.0000
Log-likelihood = -32.703922	Pseudo R2	= 0.6803

COP	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_hat	1.067091	0.1998517	5.34	0.000	0.6753885	1.458793
_hatsq	-0.0367268	0.0291317	-1.26	0.207	-0.0938238	0.02037
_cons	0.1008528	0.3320047	0.3	0.761	-0.5498644	0.75157

3.3 Varian Inflation Factor (VIF

Variable	VIF	1/VIF
EDU	3.77	0.265209
BANK	3.35	0.298275
ASST	2.47	0.404475
TF	2.44	0.409616
DSTR	2.43	0.412011
PDM	2.42	0.412445
RIP	2.38	0.420722
RPP	2.21	0.452539
MSTR	2.11	0.473548
DISEXP	2.03	0.492743
CA	1.92	0.520507
SHARE	1.78	0.560264
SEA	1.74	0.576095
LAND	1.71	0.583315
CEA	1.68	0.595535
AGE^2	1.65	0.604758
DISC	1.53	0.654606
RIC	1.51	0.660999
TRUST	1.48	0.676911
RISK	1.29	0.775286
EXPD	1.27	0.788949
SEX	1.22	0.822597
MEAN VIF	2.02	

3.4 Marginal Effect Estimation

COP	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE^2	0.00002	0.00003	0.54	0.592	-4.4E-05	7.79E-05
EDU	0.02608	0.01875	1.39	0.164	-0.01067	0.062818
SEX	0.02799	0.08027	0.35	0.727	-0.12932	0.18531
RISK	0.00001	0.00000	2.5	0.012	2.48E-06	2.06E-05
DISC	-0.26735	0.14957	-1.79	0.074	-0.56051	0.025815
TRUST	0.00000	0.00001	0.03	0.975	-1.2E-05	1.27E-05
DISEXP	0.24508	0.12786	1.92	0.055	-0.00551	0.495676
PDM	-0.00339	0.00171	-1.98	0.048	-0.00674	-3.3E-05
RIP	0.08357	0.10701	0.78	0.435	-0.12616	0.293299
RPP	0.04526	0.07952	0.57	0.569	-0.11059	0.201109
CEA	0.11779	0.06660	1.77	0.077	-0.01274	0.248326
SEA	0.18702	0.09889	1.89	0.059	-0.0068	0.380846
CA	-0.39498	0.10440	-3.78	0.000	-0.5996	-0.19036
EXPD	0.05915	0.02082	2.84	0.004	0.018354	0.099952
ASST	0.00037	0.00065	0.57	0.571	-0.00091	0.001651
$LAND^2$	-0.23246	0.12434	-1.87	0.062	-0.47616	0.011235
TF	-0.01071	0.07367	-0.15	0.884	-0.15511	0.133691
SHARE	-0.03406	0.05084	-0.67	0.503	-0.1337	0.065584
RIC	0.02006	0.11685	0.17	0.864	-0.20896	0.249084
BANK	-0.03804	0.11728	-0.32	0.746	-0.26791	0.191833
DSTR	-0.30187	0.11990	-2.52	0.012	-0.53686	-0.06687
MSTR	-0.31770	0.08244	-3.85	0.000	-0.47928	-0.15611

3.5 Odds Ratio

				Number of obs	=	180
				LR chi2(22)	=	138.61
				Prob > chi2	=	0.0000
Log-likelihood = -32.999161				Pseudo R^2	=	0.6774

COP	Odds Ratio	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE^2	1.00030	0.00056	0.54	0.592	0.99921	1.001386
EDU	1.58834	0.54075	1.36	0.174	0.814997	3.095518
SEX	1.64331	2.34451	0.35	0.728	0.100302	26.92336
RISK	1.00020	0.00009	2.34	0.019	1.000033	1.000376
DISC	0.00870	0.02400	-1.72	0.085	3.91E-05	1.935774
TRUST	1.00000	0.00011	0.03	0.975	0.999782	1.000225
DISEXP	77.39229	183.26730	1.84	0.066	0.746493	8023.603
PDM	0.94166	0.02937	-1.93	0.054	0.885829	1.001016
RIP	4.40566	8.47795	0.77	0.441	0.101395	191.4276
RPP	2.23250	3.16387	0.57	0.571	0.138829	35.90075
CEA	8.08612	9.95863	1.7	0.09	0.723478	90.37644
SEA	27.62314	50.56195	1.81	0.07	0.764217	998.4567
CA	0.00090	0.00199	-3.18	0.001	1.21E-05	0.067751
EXPD	2.85659	1.13082	2.65	0.008	1.314892	6.205931
ASST	1.00659	0.01174	0.56	0.574	0.983827	1.029869
$LAND^2$	0.01616	0.03696	-1.8	0.071	0.000183	1.428897
TF	0.82695	1.07964	-0.15	0.884	0.064001	10.68505
SHARE	0.54645	0.49389	-0.67	0.504	0.092946	3.212729
RIC	1.42754	2.96189	0.17	0.864	0.024463	83.3062
BANK	0.50917	1.06320	-0.32	0.747	0.008501	30.49786
DSTR	0.00472	0.01076	-2.35	0.019	0.000054	0.41193
MSTR	0.00356	0.00620	-3.24	0.001	0.000118	0.107882
CONSTANT	0.00001	0.00006	-2.18	0.03	3.97E-10	0.321891

3.6 Power of Prediction

Sensitivity	Pr(+/ D)	97.01%
Specificity	Pr(- / ~D)	89.13%
Positive predictive value	Pr(D/+)	96.30%
Negative predictive value	Pr(~D /-)	91.11%
False + rate for true ~D	Pr(+ /~D)	10.87%
False - rate for true D	Pr(- /D)	2.99%
False + rate for classified +	Pr(~D /+)	3.70%
False - rate for classified -	Pr(D/ -)	8.89%
Correctly classified		95.00%

4. Zero Truncated Poisson Regression Model (ZTPRM)

4.1 Result of ZTPRM

		Number of obs	= 134
		LR chi2(22)	= 90.90
		Prob > chi2	= 0.0000
Log-likelihood =	-122.0770	Pseudo R^2	= 0.2713

NCOP	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE^2	-0.00002	0.00017	-0.110	0.915	-0.0003566	0.00032
EDU	0.00019	0.05330	0.000	0.997	-0.1042652	0.104653
SEX	-0.18328	0.38780	-0.470	0.636	-0.9433522	0.576793
RISK	-0.00002	0.00003	-0.590	0.557	-0.0000651	3.51E-05
DISC	0.44581	0.51713	0.860	0.389	-0.5677407	1.459355
TRUST	-0.00001	0.00002	-0.700	0.482	-0.0000436	2.06E-05
DISEXP	0.68639	0.39998	1.720	0.086	-0.0975598	1.470333
PDM	0.00232	0.00561	0.410	0.680	-0.0086803	0.013316
RIP	0.76934	0.57546	1.340	0.181	-0.3585384	1.897215
RPP	0.27536	0.57169	0.480	0.630	-0.8451305	1.395851
CEA	-0.01661	0.52164	-0.030	0.975	-1.039002	1.005782
SEA	0.51590	0.54146	0.950	0.341	-0.5453342	1.577131
CA	-0.40757	0.54956	-0.740	0.458	-1.484686	0.669554
EXPD	0.06949	0.04102	1.690	0.090	-0.0109016	0.149876
ASST	0.00064	0.00113	0.560	0.574	-0.0015799	0.002851
$LAND^2$	0.86899	0.37020	2.350	0.019	0.1434161	1.594569
TF	0.42103	0.40413	1.040	0.297	-0.371049	1.21311
SHARE	-0.19040	0.29249	-0.650	0.515	-0.7636645	0.382861
RIC	-0.21644	0.65450	-0.330	0.741	-1.499242	1.066361
BANK	0.71490	0.36016	1.980	0.047	0.0089886	1.420805
DSTR	-0.47383	0.38620	-1.230	0.220	-1.23076	0.283101
MSTR	-0.35682	0.34932	-1.020	0.307	-1.041481	0.327837
CONSTANT	-2.99687	1.60407	-1.870	0.062	-6.140796	0.147049

4.2 Marginal Effect Estimation

NCOP	dy/dx	Std. Err.	Z	P>z	[95% Conf.	
AGE^2	-0.00002	0.00022	-0.110	0.915	-0.00045	0.00040
EDU	0.00024	0.06710	0.000	0.997	-0.13126	0.13175
SEX	-0.23073	0.48843	-0.470	0.637	-1.18804	0.72657
RISK	-0.00001	0.00003	-0.590	0.557	-0.00008	0.00004
DISC	0.56123	0.65211	0.860	0.389	-0.71688	1.83934
TRUST	-0.00001	0.00002	-0.700	0.483	-0.00005	0.00003
DISEXP	0.86410	0.50657	1.710	0.088	-0.12876	1.85696
PDM	0.00292	0.00707	0.410	0.680	-0.01093	0.01677
RIP	0.96853	0.72710	1.330	0.183	-0.45656	2.39361
RPP	0.34665	0.72020	0.480	0.630	-1.06491	1.75822
CEA	-0.02091	0.65670	-0.030	0.975	-1.30801	1.26619
SEA	0.64947	0.68274	0.950	0.341	-0.68867	1.98761
CA	-0.51309	0.69269	-0.740	0.459	-1.87073	0.84455
EXPD	0.08748	0.05193	1.680	0.092	-0.01430	0.18926
ASST	0.00080	0.00142	0.560	0.574	-0.00199	0.00359
$LAND^2$	1.09398	0.47161	2.320	0.020	0.16964	2.01833
TF	0.53004	0.50999	1.040	0.299	-0.46953	1.52961
SHARE	-0.23970	0.36858	-0.650	0.515	-0.96209	0.48269
RIC	-0.27248	0.82413	-0.330	0.741	-1.88775	1.34279
BANK	0.89999	0.45684	1.970	0.049	0.00461	1.79537
DSTR	-0.59651	0.48769	-1.220	0.221	-1.55236	0.35934
MSTR	-0.44921	0.44077	-1.020	0.308	-1.31310	0.41469

4.3 Incidence Rate Ratio (IRR)

	Number of obs	= 134
	LR chi2(22)	= 90.90
	Prob > chi2	= 0.0000
Log-likelihood = -122.0770	Pseudo R^2	= 0.2713

NCOP	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE^2	0.99998	0.00017	-0.110	0.915	0.99964	1.00032
EDU	0.00019	0.05331	0.000	0.997	0.90099	1.11033
SEX	0.83254	0.32286	-0.470	0.636	0.38932	1.78032
RISK	0.99999	0.00003	-0.590	0.557	0.99993	1.00004
DISC	1.56175	0.80762	0.860	0.389	0.56680	4.30318
TRUST	0.99999	0.00002	-0.700	0.482	0.99996	1.00002
DISEXP	1.98653	0.79457	1.720	0.086	0.90705	4.35069
PDM	1.00232	0.00562	0.410	0.680	0.99136	1.01341
RIP	2.15834	1.24203	1.340	0.181	0.69870	6.66730
RPP	1.31701	0.75292	0.480	0.630	0.42950	4.03841
CEA	0.98353	0.51305	-0.030	0.975	0.35381	2.73404
SEA	1.67514	0.90701	0.950	0.341	0.57965	4.84105
CA	0.66527	0.36561	-0.740	0.458	0.22657	1.95337
EXPD	1.07196	0.04397	1.690	0.090	0.98916	1.16169
ASST	1.00064	0.00113	0.560	0.574	0.99842	1.00286
$LAND^2$	2.38451	0.88274	2.350	0.019	1.15421	4.92620
TF	1.52353	0.61570	1.040	0.297	0.69001	3.36393
SHARE	0.82663	0.24178	-0.650	0.515	0.46596	1.46647
RIC	0.80538	0.52712	-0.330	0.741	0.22330	2.90479
BANK	2.04398	0.73617	1.980	0.047	1.00903	4.14045
DSTR	0.62261	0.24045	-1.230	0.220	0.29207	1.32724
MSTR	0.69990	0.24449	-1.020	0.307	0.35293	1.38796
CONSTANT	0.04994	0.08011	-1.870	0.062	0.00215	1.15841

5. Multinomial Logit Model

5.1 Result of Multinomial Logit Model

Number of obs	= 134
LR chi2(22)	= 212.63
Prob > chi2	= 0.0000
Pseudo R^2	= 0.6002

Log-likelihood = -70.809807

Low-stress	TCOP	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
	AGE	0.03479	0.04113	0.850	0.398	-0.04583	0.11541
	EDU	-0.66641	0.34382	-1.940	0.053	-1.34028	0.00746
	SEX	-2.06222	1.57042	-1.310	0.189	-5.14019	1.01576
	RISK	0.00010	0.00007	1.380	0.168	-0.00004	0.00025
	DISC	-2.21113	1.99065	-1.110	0.267	-6.11272	1.69047
	TRUST	0.00011	0.00008	1.250	0.212	-0.00006	0.00027
	DISEXP	-1.29945	1.56336	-0.830	0.406	-4.36358	1.76468
	PDM	0.06411	0.02393	2.680	0.007	0.01722	0.11101
	EXPD	-0.85484	0.29519	-2.900	0.004	-1.43340	-0.27627
	ASST	-0.00735	0.01382	-0.530	0.595	-0.03445	0.01974
	LAND	-3.29191	2.19264	-1.500	0.133	-7.58940	1.00558
	TF	0.21171	1.62380	0.130	0.896	-2.97087	3.39430
	SHARE	4.57429	1.13836	4.020	0.000	2.34314	6.80544
	RIC	3.18500	1.69619	1.880	0.060	-0.13947	6.50946
	BANK	-0.28317	1.58959	-0.180	0.859	-3.39870	2.83236
	DSTR	0.76318	1.10144	0.690	0.488	-1.39560	2.92197
	MSTR	-2.15239	1.09618	-1.960	0.050	-4.30087	-0.00391
	CONSTAN	5.47723	4.94408	1.110	0.268	-4.21298	15.16745
Middle-Stress	(BASE OUTCOME)						
High-Stress	AGE2	0.00259	0.04758	0.050	0.957	-0.09066	0.09583
	EDU	-0.53626	0.38016	-1.410	0.158	-1.28136	0.20883
	SEX	-1.01281	1.56523	-0.650	0.518	-4.08060	2.05498
	RISK	0.00005	0.00007	0.680	0.500	-0.00009	0.00019
	DISC	2.67656	2.34978	1.140	0.255	-1.92892	7.28204
	TRUST	0.00012	0.00010	1.180	0.239	-0.00008	0.00032
	DISEXP	-6.22419	2.78355	-2.240	0.025	-11.67984	-0.76853
	PDM	0.06691	0.02567	2.610	0.009	0.01659	0.11723
	EXPD	-0.22246	0.23087	-0.960	0.335	-0.67495	0.23003
	ASST	-0.04461	0.02098	-2.130	0.033	-0.08573	-0.00350
	LAND	-3.55804	2.81735	-1.260	0.207	-9.07995	1.96387
	TF	-2.23750	1.45557	-1.540	0.124	-5.09037	0.61536
	SHARE	2.02572	1.00843	2.010	0.045	0.04924	4.00220
	RIC	-0.34172	1.84165	-0.190	0.853	-3.95130	3.26785
	BANK	-15.15173	10.47200	-0.010	0.988	-20.52480	20.22177
	DSTR	4.28437	2.20821	1.940	0.052	-0.04364	8.61237
	MSTR	1.38924	1.46027	0.950	0.341	-1.47283	4.25131
	CONSTAN	8.45233	4.93112	1.710	0.087	-1.21249	18.11714

5.2 Marginal Effect of Low-Stress

	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE	0.00263	0.00302	0.870	0.384	-0.00328	0.00854
EDU	-0.03345	0.02159	-1.550	0.121	-0.07576	0.00886
SEX	-0.12592	0.08959	-1.410	0.160	-0.30152	0.04968
RISK	0.00005	0.00001	1.240	0.215	0.00000	0.00002
DISC	-0.26541	0.12911	-2.060	0.040	-0.51847	-0.01235
TRUST	0.00000	0.00001	0.680	0.495	-0.00001	0.00002
DISEXP	0.11425	0.12007	0.950	0.341	-0.12108	0.34958
PDM	0.00269	0.00159	1.690	0.091	-0.00043	0.00580
EXPD	-0.05904	0.01919	-3.080	0.002	-0.09665	-0.02142
ASST	0.00097	0.00100	0.970	0.332	-0.00099	0.00294
LAND	-0.13373	0.15682	-0.850	0.394	-0.44109	0.17363
TF	0.09408	0.10220	0.920	0.357	-0.10624	0.29439
SHARE	0.28697	0.06464	4.440	0.000	0.16027	0.41366
RIC	0.26053	0.12209	2.130	0.033	0.02125	0.49982
BANK	0.50300	36.02522	0.010	0.989	-70.10514	71.11114
DSTR	-0.08889	0.09194	-0.970	0.334	-0.26909	0.09131
MSTR	-0.21621	0.07968	-2.710	0.007	-0.37237	-0.06005

5.3 Marginal Effect of Middle-Stress

	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE	-0.00161	0.00288	-0.560	0.577	-0.00724	0.00403
EDU	0.04862	0.02401	2.030	0.043	0.00156	0.09568
SEX	0.12672	0.11453	1.110	0.269	-0.09776	0.35120
RISK	-0.00001	0.00000	-1.280	0.201	-0.00002	0.00000
DISC	-0.00220	0.14122	-0.020	0.988	-0.27899	0.27458
TRUST	-0.00001	0.00001	-1.480	0.138	-0.00002	0.00000
DISEXP	0.28484	0.13342	2.130	0.033	0.02335	0.54633
PDM	-0.00524	0.00143	-3.650	0.000	-0.00805	-0.00243
EXPD	0.04529	0.01590	2.850	0.004	0.01413	0.07644
ASST	0.00196	0.00106	1.850	0.065	-0.00012	0.00403
LAND	0.27352	0.16189	1.690	0.091	-0.04377	0.59081
TF	0.07292	0.10970	0.660	0.506	-0.14210	0.28793
SHARE	-0.27298	0.05804	-4.700	0.000	-0.38673	-0.15923
RIC	-0.12577	0.11067	-1.140	0.256	-0.34268	0.09114
BANK	0.56832	38.14593	0.010	0.988	-74.19632	75.33297
DSTR	-0.19037	0.10198	-1.870	0.062	-0.39025	0.00952
MSTR	0.04249	0.07730	0.550	0.583	-0.10901	0.19399

5.4 Marginal Effect of High-Stress

	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
AGE	-0.00102	0.00316	-0.320	0.747	-0.00722	0.00518
EDU	-0.01517	0.02221	-0.680	0.495	-0.05871	0.02837
SEX	-0.00080	0.08071	-0.010	0.992	-0.15898	0.15738
RISK	0.00000	0.00000	0.000	0.998	-0.00001	0.00001
DISC	0.26761	0.14096	1.900	0.058	-0.00866	0.54388
TRUST	0.00000	0.00001	0.750	0.451	-0.00001	0.00002
DISEXP	-0.39909	0.17427	-2.290	0.022	-0.74065	-0.05752
PDM	0.00255	0.00155	1.650	0.100	-0.00049	0.00559
EXPD	0.01375	0.01510	0.910	0.362	-0.01585	0.04335
ASST	-0.00293	0.00128	-2.290	0.022	-0.00544	-0.00042
LAND	-0.13979	0.18306	-0.760	0.445	-0.49858	0.21899
TF	-0.16699	0.07950	-2.100	0.036	-0.32281	-0.01117
SHARE	-0.01399	0.05548	-0.250	0.801	-0.12272	0.09475
RIC	-0.13477	0.12204	-1.100	0.269	-0.37397	0.10444
BANK	-1.07133	74.17073	-0.010	0.988	-146.44330	144.30060
DSTR	0.27926	0.14310	1.950	0.051	-0.00121	0.55972
MSTR	0.17372	0.09465	1.840	0.066	-0.01178	0.35923

6. Logit Model of Willingness to Pay Estimation

6.1 Result of the Logit Model

	Number of obs	= 194
	LR chi2(22)	= 123.99
	Prob > chi2	= 0.0000
Log-likelihood = -63.672236	Pseudo R^2	= 0.4933

WTP	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
BID	-0.00012	0.00004	-2.920	0.004	-0.00019	-0.00004
AGE^2	-0.00041	0.00032	-1.290	0.198	-0.00103	0.00021
EDU	0.31761	0.15559	2.040	0.041	0.01267	0.62256
SEX	0.29491	0.71754	0.410	0.681	-1.11145	1.70127
RISK	0.00012	0.00005	2.190	0.029	0.00001	0.00022
DISC	0.35793	1.51484	0.240	0.813	-2.61109	3.32695
TRUST	-0.00002	0.00006	-0.300	0.766	-0.00013	0.00009
DISEXP	0.07732	0.72276	0.110	0.915	-1.33926	1.49389
PDM	0.02931	0.01466	2.000	0.046	0.00058	0.05804
ENP	-1.23385	0.58402	-2.110	0.035	-2.37852	-0.08919
PPA	1.06224	0.70264	1.510	0.131	-0.31492	2.43939
EXPD	0.04613	0.12974	0.360	0.722	-0.20816	0.30041
ASST	0.03045	0.01000	3.050	0.002	0.01085	0.05004
LAND	2.67057	1.61391	1.650	0.098	-0.49264	5.83377
TF	-0.51997	0.77796	-0.670	0.504	-2.04475	1.00481
SHARE	-0.49096	0.66163	-0.740	0.458	-1.78772	0.80580
RIC	-0.85644	1.00151	-0.860	0.392	-2.81936	1.10648
PC	0.49119	0.22009	2.230	0.026	0.05982	0.92256
CES	2.47479	0.72761	3.400	0.001	1.04870	3.90089
BANK	-0.74214	0.65252	-1.140	0.255	-2.02105	0.53677
DSTR	1.79941	0.71146	2.530	0.011	0.40497	3.19385
MSTR	0.20470	0.80179	0.260	0.798	-1.36677	1.77618
CONSTANT	-13.71977	4.58380	-2.990	0.003	-22.70385	-4.73568

6.2 Link Test

Number of obs	=	194
LR chi2(2)	=	124.07
Prob > chi2	=	0.0000
Log-likelihood = -63.629068	Pseudo R2	= 0.4973

WTP	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_hat	1.01852	0.16521	6.160	0.000	0.69471	1.34233
_hatsq	-0.01940	0.06416	-0.300	0.762	-0.14516	0.10635
_cons	0.03998	0.26108	0.150	0.878	-0.47172	0.55168

6.3 Varian Inflation Factor (VIF)

Variable	VIF	1/VIF
CES	2.35	0.42924
PC	2.22	0.45036
PPA	2.18	0.45951
LAND	2.16	0.46284
MSTR	2.09	0.47754
RIC	1.99	0.50217
DSTR	1.94	0.51430
ASST	1.90	0.52627
SHARE	1.90	0.52743
EXPD	1.79	0.55740
TF	1.75	0.57257
EDU	1.68	0.59481
TRUST	1.67	0.59945
AGE2	1.65	0.60553
PDM	1.58	0.63148
RISK	1.55	0.64614
DISC	1.53	0.65305
BANK	1.51	0.66155
DISEXP	1.51	0.66430
ENP	1.49	0.67091
BID	1.40	0.71303
SEX	1.20	0.83512
MEAN VIF	1.77	

6.4 Marginal Effect Estimation

WTP	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
BID	-0.00001	0.00000	-3.200	0.001	-1.94E-05	-4.67E-
AGE^2	-0.00004	0.00003	-1.310	0.191	-0.00011	0.00002
EDU	0.03307	0.01550	2.130	0.033	0.00268	0.06345
SEX	0.03071	0.07452	0.410	0.680	-0.11535	0.17676
RISK	0.00001	0.00001	2.300	0.021	1.81E-06	2.26E-05
DISC	0.03727	0.15753	0.240	0.813	-0.27148	0.34602
TRUST	0.00000	0.00001	-0.300	0.766	-1.3E-05	9.61E-06
DISEXP	0.00805	0.07522	0.110	0.915	-0.13938	0.15548
PDM	0.00305	0.00147	2.080	0.037	0.00018	0.00592
ENP	-0.12847	0.05783	-2.220	0.026	-0.24181	-0.01513
PPA	0.11060	0.07194	1.540	0.124	-0.03041	0.25161
EXPD	0.00480	0.01349	0.360	0.722	-0.02164	0.03124
ASST	0.00317	0.00094	3.360	0.001	0.00132	0.00502
LAND	0.27806	0.16442	1.690	0.091	-0.04419	0.60031
TF	-0.05414	0.08060	-0.670	0.502	-0.21210	0.10383
SHARE	-0.05112	0.06840	-0.750	0.455	-0.18518	0.08295
RIC	-0.08917	0.10347	-0.860	0.389	-0.29196	0.11362
PC	0.05114	0.02189	2.340	0.019	0.00824	0.09405
CES	0.25767	0.06580	3.920	0.000	0.12871	0.38663
BANK	-0.07727	0.06738	-1.150	0.251	-0.20933	0.05479
DSTR	0.18735	0.06893	2.720	0.007	0.05225	0.32246
MSTR	0.02131	0.08345	0.260	0.798	-0.14225	0.18488

6.5 Odds Ratio

	Number of obs	= 194
	LR chi2(22)	= 123.99
	Prob > chi2	= 0.0000
Log-likelihood = -32.999161	Pseudo R^2	= 0.4933

WTP	Odds Ratio	Std. Err.	z	P>z	[95% Conf. Interval]	
BID	0.99988	0.00004	-2.920	0.004	0.99981	0.99996
AGE^2	0.99959	0.00032	-1.290	0.198	0.99898	1.00021
EDU	1.37385	0.21375	2.040	0.041	1.01275	1.86369
SEX	1.34300	0.96366	0.410	0.681	0.32908	5.48089
RISK	1.00012	0.00005	2.190	0.029	1.00001	1.00022
DISC	1.43037	2.16677	0.240	0.813	0.07345	27.85333
TRUST	0.99998	0.00006	-0.300	0.766	0.99987	1.00009
DISEXP	1.08038	0.78085	0.110	0.915	0.26204	4.45440
PDM	1.02974	0.01509	2.000	0.046	1.00058	1.05976
ENP	0.29117	0.17005	-2.110	0.035	0.09269	0.91467
PPA	2.89284	2.03263	1.510	0.131	0.72985	11.46609
EXPD	1.04721	0.13586	0.360	0.722	0.81208	1.35041
ASST	1.03091	0.01031	3.050	0.002	1.01091	1.05131
LAND	14.44816	23.31804	1.650	0.098	0.61101	341.64560
TF	0.59454	0.46253	-0.670	0.504	0.12941	2.73140
SHARE	0.61204	0.40494	-0.740	0.458	0.16734	2.23849
RIC	0.42467	0.42531	-0.860	0.392	0.05964	3.02370
PC	1.63426	0.35968	2.230	0.026	1.06165	2.51571
CES	11.87923	8.64349	3.400	0.001	2.85393	49.44634
BANK	0.47609	0.31066	-1.140	0.255	0.13252	1.71047
DSTR	6.04609	4.30156	2.530	0.011	1.49926	24.38212
MSTR	1.22716	0.98392	0.260	0.798	0.25493	5.90725
CONSTANT	0.00000	0.00001	-2.990	0.003	0.00000	0.00878

7. Probit Adapted Ordinary Least Square (POLS)

7.1 Result of POLS

Source	SS	df	MS
Model	10.1467	24	0.42278
Residual	2.1642	155	0.01396
Total	12.3109	179	0.068776

Number of obs	=	180
F(24, 155)	=	30.28
Prob > F	=	0.0000
R-squared	=	0.8242
Adj R-squared	=	0.7900
Root MSE	=	0.11816

STSF	Coef.	Std. Err.	t	P>[t]	[95% Conf. Interval]	
AGE	-0.00120	0.00129	-0.930	0.351	-0.00374	0.00134
EDU	-0.00457	0.00404	-1.130	0.259	-0.01254	0.00340
SEX	0.04671	0.04064	1.150	0.252	-0.03357	0.12700
RISK	0.00000	0.00000	-2.750	0.007	-0.00001	0.00000
DISC	-0.09034	0.05125	-1.760	0.080	-0.19158	0.01090
NOE	-0.06142	0.02230	-2.750	0.007	-0.10547	-0.01736
EXPD	-0.00904	0.00434	-2.080	0.039	-0.01761	-0.00047
ASST	0.00015	0.00009	1.640	0.104	-0.00003	0.00034
LAND	-0.00755	0.03592	-0.210	0.834	-0.07851	0.06342
SHARE	0.02455	0.02576	0.950	0.342	-0.02634	0.07545
RIC	0.08407	0.04910	1.710	0.089	-0.01292	0.18105
PC	-0.00336	0.00571	-0.590	0.556	-0.01464	0.00791
BANK	-0.00034	0.02891	-0.010	0.991	-0.05744	0.05677
DSTR	0.00526	0.04402	0.120	0.905	-0.08169	0.09221
MSTR	0.07452	0.04151	1.800	0.075	-0.00747	0.15651
DISEXP	-0.01867	0.04195	-0.450	0.657	-0.10153	0.06419
PDM	-0.00115	0.00056	-2.060	0.042	-0.00226	-0.00004
IDM	0.22175	0.13555	1.640	0.104	-0.04601	0.48951
GY	0.15591	0.15003	1.040	0.300	-0.14046	0.45227
PP	0.20530	0.09542	2.150	0.033	0.01681	0.39380
AIM	0.29999	0.11782	2.550	0.012	0.06726	0.53273
DID	0.06690	0.21771	0.310	0.759	-0.36316	0.49695
GIDM	0.15856	0.07990	1.980	0.049	0.00073	0.31640
SF	0.34373	0.06378	5.390	0.000	0.21773	0.46972
CONSTAN	0.10470	0.21611	0.480	0.629	-0.32220	0.53160

7.2 Link Test

Source	SS	df	MS
Model	10.17602	2	5.08801
Residual	2.13488	177	0.01206
Total	12.31090	179	0.06878

Number of obs	=	180
F(2, 177)	=	421.84
Prob > F	=	0.0000
R-squared	=	0.8266
Adj R-squared	=	0.8246
Root MSE	=	0.10982

STSF	Coef.	Std. Err.	t	P>[t]	[95% Conf. Interval]	
_hat	1.33145	0.21529	6.180	0.000	0.90659	1.75631
_hatsq	-0.28190	0.18074	-1.560	0.121	-0.63859	0.07478
_cons	-0.07935	0.05434	-1.460	0.146	-0.18659	0.02788

7.3 Varian Inflation Factor (VIF)

Variable	VIF	1/VIF
NOE	3.65	0.27275
MSTR	3.64	0.20262
DID	3.62	0.10391
DSTR	3.55	0.18017
PP	3.48	0.22298
GIDM	3.43	0.08748
IDM	3.39	0.18563
GY	3.28	0.12073
AIM	3.27	0.18975
SF	2.98	0.33515
RIC	2.37	0.42128
PC	2.21	0.45199
SHARE	2.12	0.47119
BANK	2.11	0.47470
DISEXP	2.03	0.49272
ASST	1.99	0.50150
LAND	1.92	0.52166
EDU	1.89	0.52909
RISK	1.82	0.54967
DISC	1.77	0.56548
AGE	1.67	0.59833
EXPD	1.64	0.60959
PDM	1.41	0.70980
SEX	1.22	0.81844
Mean VIF	2.53	