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# Smallholder Farmers' Willingness to Pay for Agricultural Production Cost Insurance in Rural West Java, Indonesia: A Contingent Valuation Method (CVM) Approach

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**Abstract:** To reduce the negative impacts of risks in farming due to climate change, the government implemented agricultural production cost insurance in 2015. Although a huge amount of subsidy has been allocated by the government (80 percent of the premium), farmers' participation rate is still low (23 percent of the target in 2016). In order to solve the issue, it is indispensable to identify farmers' willingness to pay (WTP) for and determinants of their participation in agricultural production cost insurance. Based on a field survey of 240 smallholder farmers in the Garut District, West Java Province in August–October 2017 and February 2018, the contingent valuation method (CVM) estimated that farmers' mean willingness to pay (WTP) was Rp 30,358/ha/cropping season ($2.25/ha/cropping season), which was 16 percent lower than the current premium (Rp 36,000/ha/cropping season = $2.67/ha/cropping season). Farmers who participated in agricultural production cost insurance shared some characteristics: operating larger farmland, more contact with agricultural extension service, lower expected production for the next cropping season, and a downstream area location.

**Keywords:** willingness to pay; agricultural production cost insurance; smallholder farmers; contingent valuation method (CVM); rural West Java

## 1. Introduction

Boer and Suharnoto (2014) noted that climate change in Indonesia is associated with the occurrence of the El-Nino Southern Oscillation (ENSO), which has hampered the land-based sector performance, particularly agriculture. Risks in farming have increased and consequently made farming vulnerable. For example, due to changes in weather patterns, during the warm period of ENSO, the dry season is longer, and accordingly, this delays the onset of the wet season (Supari et al. 2017). As a result, the planting season is also delayed. Naylor et al. (2007) found that a one-month delay of the wet season will reduce January–April rice production by 11 percent in East Java and Bali Island and by 6.5 percent in West Java and Central Java. Moreover, the number of pest and disease attacks has increased during the last three years. The Ministry of Agriculture of the Republic of Indonesia (MoA 2017a) reports that there was an increase in stem borer attacks in paddy by 21.5 percent in 2016 compared to that in 2014.

According to Smith and Skinner (2002), there are various adaptations to climate change in farming that are implemented at different scales and involve various stakeholders. They can be grouped into four types: government programs and agricultural insurance, technological developments, production practices, and financial management. The first two are conducted by public agencies and agribusinesses at a wide scale (macrowide), while the other two by producers (farm-level decision-making).

Agricultural insurance has a potential to increase smallholder farmers' resilience by providing pay out during bad years to help farmers to survive and protect their assets (Greatrex et al. 2015). Di Falco et al. (2014) found that agricultural insurance can decrease variability of revenues from farming and prevent them from falling below a given threshold level.

To minimize the adverse impacts of risks on smallholder farmers, the Indonesian government has implemented agricultural insurance for rice production since 2015. As a type of agricultural insurance, the government selected agricultural production cost insurance, of which the indemnity is equal to the cost of production (MoA 2017b), while other countries adopted other types, such as named-peril crop insurance and yield-based multiperil crop insurance (Mahul and Stutley 2010). This is because the objective of agricultural insurance in Indonesia is to guarantee that farmers can sustain production. If production falls below a certain guaranteed yield, farmers with the agricultural insurance will get indemnity as an initial investment capital which is equal to production cost (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 premium has been highly subsidized by the government, farmers' participation in the agricultural production cost insurance has still been low, and farmland areas covered by the insurance equaled only around 23 percent of the 2016 target (1 million ha/year) (Asuransi Jasa Indonesia (Jasindo) 2017). There are various reasons 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 and McConnell 2002; Barnett and Mahul 2007). When the premium (after the government subsidy) 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 improves the rate of farmers' participation in the insurance.

Thus, in order to improve the agricultural production cost insurance policy, the present study aimed to identify farmers' WTP and its mean values for agricultural production cost insurance[1] 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.

## 2. Indonesian Agricultural Production Cost Insurance

Agricultural production cost insurance is one of the priority programs of the Indonesian government in the agriculture sector. It has been implemented since 2015. The Ministry of Agriculture (MoA) 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 farmland areas that could be covered by the insurance and to endorse farmers who are eligible to receive a subsidy[2] 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 1. According

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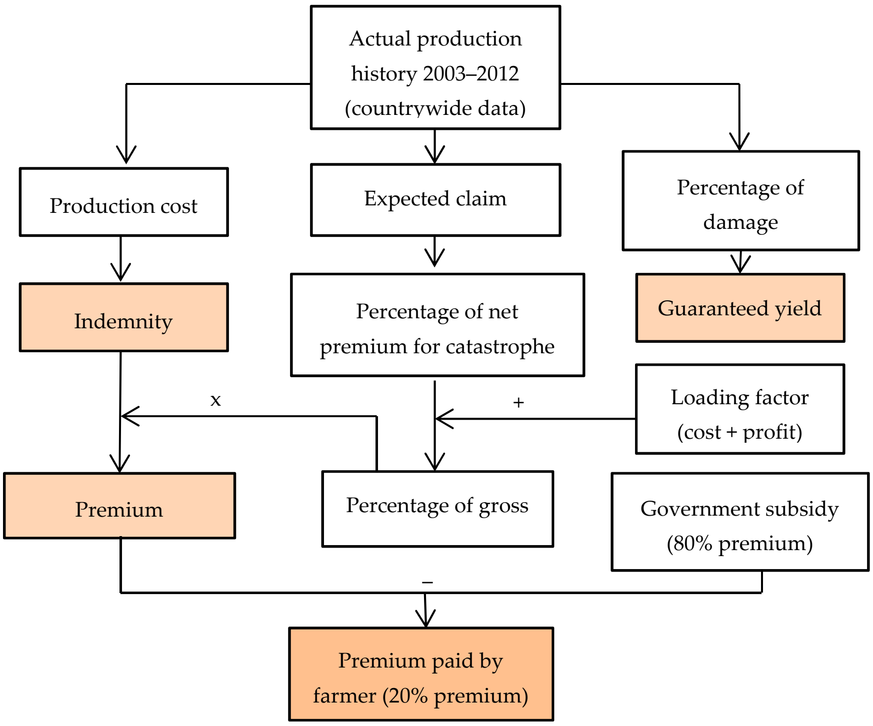
[1] It is only in Indonesia that the production cost insurance is fully implemented without being mixed with other types of insurance. Meanwhile, in other countries, such as India and the Philippines, the agricultural production cost insurance is mixed with yield insurance.

[2] 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.

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 countrywide basis). Based on this calculation, indemnity of the insurance is equal to Rp 6 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 insurance if 75 percent of the covered farmland area is destroyed by disasters.




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

**Figure 1.** Indemnity, guaranteed yield, and premium determination.

As shown in Figure 1, the premium is calculated based on the expected claim during the same period, 2003–2012, and determined by estimating the expected claim. It is calculated by taking the average value of production failures in rice production during the period 2003–2012 (10 years). Its value is around 1.11 percent of the total farmland area 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 $(\lambda)$, which is equal to 10 percent of the 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 $(\beta)$, 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[3]. Thus, the premium is determined by multiplying gross premium with indemnity (production cost), which is equal to Rp 193,200/ha/cropping season $(premium = 3.22\% \times Rp\ 6\ mil)$. In 2017, the government decided to set the premium at Rp

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

180,000ha/cropping season, and subsidized 80 percent of the premium (MoA 2017b). As a result, farmers paid around Rp 36,000/ha/cropping season for the premium.

The government has not applied any different method to determine the expected claim, compared to what happens in other countries (Zhang et al. 2015). However, regarding the type of data, there are differences among different countries. The majority of countries do not use countrywide basis data to determine indemnity, guaranteed yield, and premiums. In India, data are collected from cross-cutting experiments (CCEs) at village, *mandal*, *taluka*, and district levels.[4] The minimum number of CCEs at each level is 4, 10, 16, and 24, respectively (Parliament Library and Reference (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, then the premium is differentiated based on the season (Reyes et al. 2015).

Smith and Baquet (1996) point out that using countrywide 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 estimated properly as they cannot reflect levels of individual risk (Goodwin and Smith 1995). In the case of agricultural production cost insurance, there are two impacts of adverse selections 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.

## 3. Methodology

### 3.1. Area and Data Collection

Based on discussions with key stakeholders including the Ministry of Agriculture, the insurance agent (PT. Jasindo), and the Agriculture District Offices, the Garut district in West Java Province was chosen as a study area (Figure 2). This area was selected because the participation of farmers in that area in agricultural production cost insurance was one of the lowest among districts in the province.[5] The area of farmland covered by insurance was around 1920 ha in 2017, compared to the approximate 48,034 ha of farmland that could be covered by insurance (CBS 2016).

Multistage cluster sampling was carried out to select respondents in the northern part of the district, the district most vulnerable to disasters (National Disaster Management Authority (BNPB) 2017). There are 21 subdistricts located in the upstream, midstream, and downstream areas of the Cimanuk River. From each area, two subdistricts were randomly sampled. These subdistricts were Banyuresmi and Leuwigoong in the downstream area, Tarogong Kidul and Tarogong Kaler in the midstream, and Samarang and Bayongbong in the upstream. After this, two villages were randomly chosen from each subdistrict. Based on the appropriate sample size of respondents calculated by the statistical theory, the total number of respondents was 240, of whom 20 farmers were selected from each village, including 10 farmers who had already purchased agricultural production cost insurance and 10 farmers who had not yet purchased the insurance.

Face-to-face interview surveys were conducted in August–October 2017 and February 2018. Items of data include the following: (i) personal characteristics, (ii) economic characteristics, (iii) farming characteristics, (iv) institutional characteristics, (v) access to financial institution, and (vi) WTP for

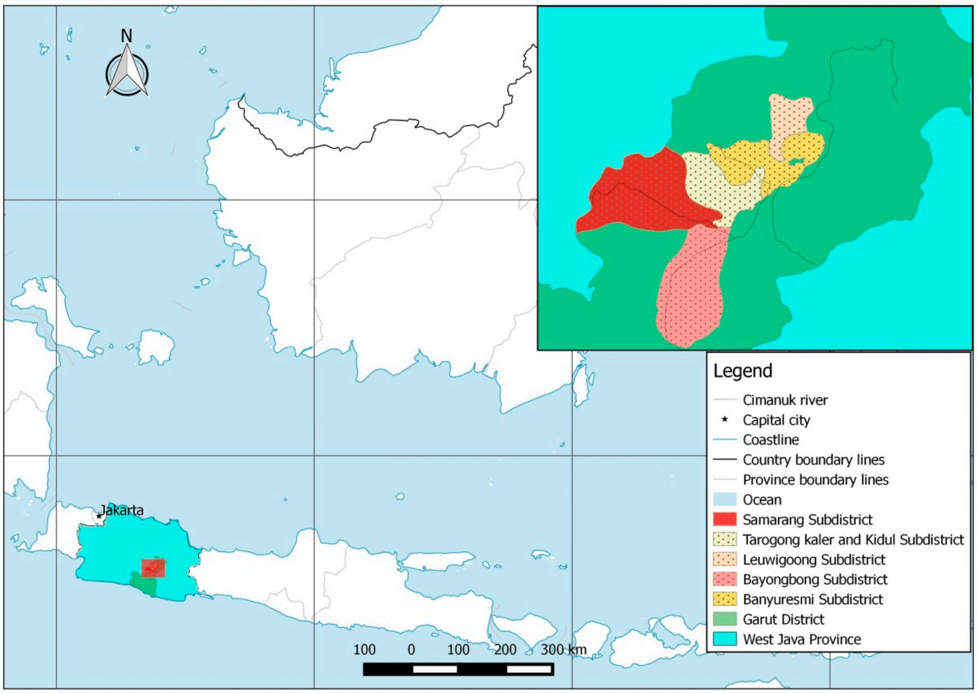
[4] *Taluka and mandal* are subdivisions of a district which consist of several villages (Collins English Dictionary 2012). *Taluka* is used in certain states such as Gujarat, Goa, and Karnataka, while *mandal* appears in Andhra Pradesh and Telanggana. *Taluka* and *mandal* are equal to subdistrict in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

[5] Farmers' participation in agricultural production cost insurance in 2017 in West Java Province was 36.9 percent of the target (112,213 ha out of 304,000 ha), while in the Garut district, 24 percent of farmland was insured from the target amount (1920 ha out of 8000 ha) (MoA 2018).

agricultural production cost insurance. 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, Rp 6 mil/ha/cropping season ($444/ha/cropping season), if 75 percent of farmland area under the insurance is destroyed by disasters"*.

After the hypothetical agricultural production cost insurance was introduced, farmers were asked two questions: (i) whether they were willing to pay "in principle" (willing to join) for agricultural production cost insurance in the next cropping season; and (ii) if farmers said "yes" to (i), whether they were 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 Rp 10,000/ha/cropping season ($0.74/ha/cropping season) to Rp 60,000/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.




Source: Geospatial Information Agency (BIG) (2017).

**Figure 2.** Location of study area.

### *3.2. CVM and Variables*

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

In CVM, as explained later, in order to estimate WTP (that is, Equation (8)), a set of coefficients of parameters (variables) and bids are required. Those coefficients can be estimated through an analysis of the probability of farmer's willingness to pay for the agricultural insurance at a certain level of bid. Alongside this, the present study can identify determinants to participation in agricultural insurance.

Variables for the analysis of the probability of farmer's willingness to pay for the agricultural insurance at a certain level of bid are based on those taken into account by previous studies. In addition to farmer's characteristics (Table 1) like age (AGE), sex (SEX), education (EDU), farmland (size (LAND), landholding arrangement (SHARE and RIC), and type of farmland (TF)), finance (asset (ASST), access to capital (BANK)), living expenditure (EXPD), contact with an extension service (CES), and locations (DSTR and USTR) (Ali 2013; Long et al. 2013; McCharty 2003; Sarris et al. 2006) that are influential to decision making, the present study also takes into account premium (BID), risk behavior (RISK), discount rate or time preference (DISC), disaster experience (DISEXP), percentage of damage (PDM), expected production next cropping season (ENP), trust (TRUST), previous purchase of agricultural insurance (PPA), and production cost (PC) as variables due to attributes of agricultural insurance. There are no previous studies that take discount rate, trust, percentage of damage, and production cost into account as variables determining farmers' WTP for agricultural insurance.

**Table 1.** Variables taken 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 taken by a farmer in risk game (Rp) | RISK | Positive |
| Discount rate | Farmer's preference in discount rate game | DISC | Negative |
| Trust | Money given by farmer in trust game (Rp) | TRUST | Positive/negative |
| Disaster experience | Average disaster experience (disaster number/cropping season) | DISEXP | Positive |
| Percentage of damage | The highest percentage of damage (percentage) | PDM | Positive |
| Expected production next cropping season | 1 = high, if expected production next cropping season > average, 0 = otherwise | ENP | Negative |
| Previous purchase of 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 (nonland) and financial asset values (Rp) | ASST | Positive |
| *Farming characteristics* | | | |
| Farmland size | Farmland managed by farm household (ha) | LAND | Positive |
| Type of farmland | 1 = rain-fed, 0 = irrigation | TF | Positive |
| Landholding | | | |
| Dummy sharecropping | 1 = sharecropping, 0 = otherwise | SHARE | Positive |
| Dummy 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/cropping season) | PC | Positive |
| *Institutional characteristics* | | | |
| Contact with extension service | 1 = contact with extension service, 0 = otherwise | CES | Positive |
| *Access to financial institution* | | | |
| Bank account | 1 = own bank account, 0 = otherwise | BANK | Positive/negative |
| *Locations* | | | |
| Dummy downstream | 1 = living in the downstream area, 0 = otherwise | DSTR | Positive/negative |
| Dummy midstream | 1 = living in the midstream area, 0 = otherwise (Upstream as a base case) | USTR | Positive/negative |

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

Just et al. (1999) and Smith and Baquet (1996) argued that the premium (BID) determines the expected benefit from taking agricultural insurance. The expected benefit will be the difference between the indemnity and premium. Increase in the expected benefit is likely to encourage farmers to participate in agricultural insurance. Regarding risk behavior (RISK), Barret et al. (2001) argued that risk-averse farmers are more likely to undertake risk coping strategies (e.g., agricultural insurance) to minimize the adverse impact of risks. Sherrick et al. (2004) found that risk behavior significantly influences farmers' participation in agricultural insurance.

Trust (TRUST) among community members might positively or negatively influence farmers' participation in agricultural insurance. Social connection among community members might improve if there is a higher level of trust among them (Adger 2003; Stone 2001). When social connection increases, there will be many alternative risk-coping strategies, such as farmers' self-help groups and rotating savings and credit associations (ROSCA). These strategies might act as substitutes for agricultural insurance. When farmer self-help groups work properly, farmers might rely on this strategy to minimize the adverse impact of risks instead of purchasing agricultural insurance that requires investing some money in an insurance premium. There is a condition that a higher level of social connection might improve farmers' willingness to participate in agricultural insurance because it will involve more sharing accurate information concerning the benefits of agricultural insurance when some community members (farmers) have a good experience of insurance as an alternative risk coping strategy.

Discount rate (DISC) is predicted to determine farmers' participation in agricultural insurance. Purchasing insurance involves a comparison of current cost (premium) with expected loss due to disaster in the future. Farmers, who have a higher discount rate, value present money higher than that in the future; therefore, they might spend their money in the present rather than invest in agricultural insurance. Meanwhile, farmers with a lower discount rate might invest in agricultural insurance to minimize losses from a 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. Although Fukui and Miwa (2016) presented a case of micro-insurance in Cambodia, they found that individuals who have higher discount rate are associated with lower participation in health insurance.

Disaster experience (DISEXP) and percentage of damage (PDM) might positively or negatively influence farmers' participation in agricultural insurance. If farmers are exposed to disasters more often, they are more likely to purchase agricultural insurance to minimize losses resulting from disasters. Freedy et al. (1992) argued that a range of adverse experiences due to the occurrence of natural hazards influence the individual adoption of a risk coping strategy. Higher percentages of damage reflect a high degree of risk faced by farmers. Rothschild and Stiglitz (1976) and Ito and Kono (2010) stated that individuals at greater risk tend to purchase insurance to minimize any negative impacts. On the other hand, Warner et al. (2012) argued that a higher percentage of damage might reduce individuals' resources. As a result, their capacity to purchase insurance might be reduced.

Expectation for next cropping season's production (ENP) is predicted to influence farmers' participation in agricultural insurance. When farmers expect that the production next cropping season will be 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 production in the next cropping season will be lower than that of the previous season, their willingness to pay might increase (Fraser 1992; Sherrick et al. 2004; Smith and Baquet 1996).

Boyd et al. (2011) found that purchase of agricultural insurance in the previous year (PPA) positively influences the purchase of agricultural insurance in the current one. Repeating the purchase of agricultural insurance might indicate that there is a lucrative benefit from it. Cohen and Houston (1972) argued that the experience of consuming goods and services develops a customer's perception of the performance of the same goods and services.

Kabede and Bogale (1992) found that there is a positive significant impact on WTP for agricultural insurance from contact with an extension service (CES). Extension services provide farmers with information (on management and technology and so on) and remove any doubts/worries concerning innovation in farming. Moreover, extension services might improve farmers' trust in the government that channels agricultural insurance to farmers through the agent.

In Indonesia, the indemnity of agricultural production cost insurance is limited only to production cost (PC) fixed at a certain level. The sense of premium payment as a burden is dependent on a farmer's own production costs, while the production cost itself means a scale of risk/loss. A higher production cost is associated with higher WTP for the insurance.

### 3.3. 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 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 bid $(P_1)$ can be written as follows:

$$P_1 = (y_i = 1) = \frac{e^{C+\lambda BID+\sum_{k=1}^{K}\beta_k x_{ki}}}{1+\ e^{C+\lambda BID+\sum_{k=1}^{K}\beta_k x_{ki}}}, \tag{1}$$

where $BID$ is level of the bid; $C$ is constant; $\lambda$ is coefficient of $BID$; $k$ is the number of variables; and $\beta$ is coefficient of farmers' characteristics $(x)$.

WTP measurement follows Haab and 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 $\beta$; and $\varepsilon$ is the error term, the utility function of income of farmer $i$ without the insurance $(U_{i0})$ can be written as follows:

$$U_{i0}(M_i) = \lambda M_i + \sum_{k=1}^{K}\beta_{k0}x_{ki} + \varepsilon_{i0}. \tag{2}$$

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

$$U_{i1}(M_i) = \lambda(M_i - WTP_i) + \sum_{k=1}^{K}\beta_{k1}x_{ki} + \varepsilon_{i1}. \tag{3}$$

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:

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

$$U_{i1}(M_i) = \lambda(M_i - WTP_i) + \sum_{k=1}^{K}\beta_{k1}x_{ki} + \varepsilon_{i1}. \tag{4}$$

WTP value can be estimated using the equation:

$$WTP_i = \frac{\sum_{k=1}^{K}\beta_k x_{ki}}{-\lambda} + \frac{\varepsilon_i}{-\lambda}, \tag{5}$$

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

$$WTP_i = \frac{\sum_{k=1}^{K} \beta_k x_{ki}}{-\lambda}. \quad (6)$$

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

$$\overline{WTP_i} = \frac{\sum_{k=1}^{K} \beta_k \overline{x}_{ki}}{-\lambda}. \quad (7)$$

Using variables from logit model (Equation (1)), Equation (7) can be rewritten as follows:

$$\begin{gathered}\overline{WTP} = (C + \beta_1\overline{AGE} + \beta_2\overline{EDU} + \beta_3\overline{SEX} + \beta_4\overline{RISK} + \beta_5\overline{DISC} + \beta_6\overline{TRUST} + \beta_7\overline{DISEXP} + \\ \beta_8\overline{PDM} + \beta_9\overline{ENP} + \beta_{10}\overline{PPA} + \beta_{11}\overline{EXPD} + \beta_{12}\overline{ASST} + \beta_{13}\overline{LAND} + \beta_{14}\overline{TF} + \beta_{15}\overline{SHARE} + \\ \beta_{16}\overline{RIC} + \beta_{17}\overline{PC} + \beta_{18}\overline{CES} + \beta_{19}\overline{BANK} + \beta_{20}\overline{DSTR} + \beta_{21}\overline{USTR}) / -\lambda\end{gathered} \quad (8)$$

## 4. Results and Discussion

### 4.1. Farmers' Characteristics

Respondent farmers' characteristics are summarized in Table 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, around 79 percent of which 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 Rp 10.1 mil/year, and around two-thirds of income was from farming.

**Table 2.** Summary of farmers' characteristics.

| Independent Variables | 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) | 9020 | 5312 |
| Expected production next cropping season | 0.48 | 0.50 |
| Disaster experience (times/cropping season) | 1.7 | 0.38 |
| Percentage of damage (%) | 73.9 | 25.6 |
| Previous purchase of agricultural production cost insurance (%) | 50 | 50 |
| *Economic characteristics* | | |
| Per-capita living expenditure (Rp mil/year) | 10.1 | 2.482 |
| Asset (Rp mil) | 80.9 | 88.06 |
| *Farming characteristics* | | |
| Farmland size (ha) | 0.47 | 0.32 |
| Type of farmland (% rain-fed) | 21 | 41 |
| Landholding | | |
| Dummy sharecropping (%) | 51 | 5.01 |
| Dummy rent in cash (%) | 10 | 3.06 |
| (Privately owned land as a base case) | | |
| *Institutional characteristics* | | |
| Contact with extension service (% farmers) | 51 | 50 |
| *Access to financial institution* | | |
| Bank account (% ownership) | 25 | 43.39 |

Source: Field survey data.

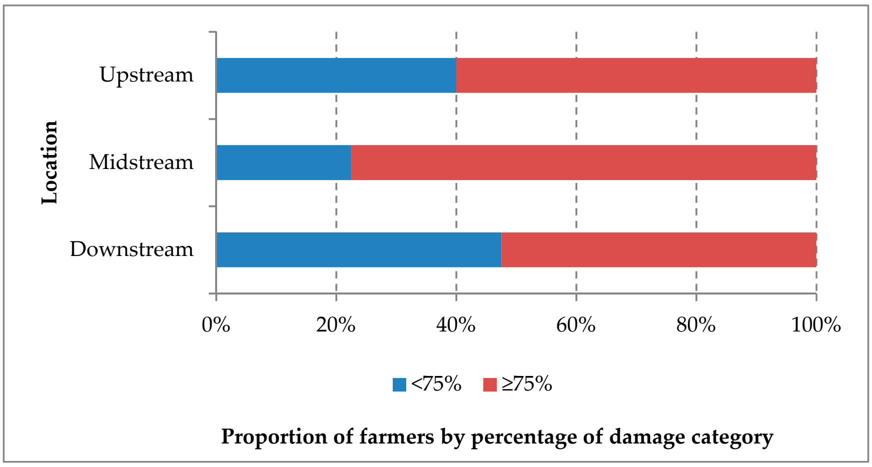
Since the indemnity of agricultural production cost insurance is equal to the average production cost and the guaranteed yield is estimated based on the average percentage of damage, the decision on purchasing the insurance might be influenced by a farmer's own production costs as well as his/her percentage of damage. Table 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 midstream area (as it is closer to the capital city of the district), compared to the other areas. Average rice production cost with and without in-kind were around Rp 10.62 mil/ha and 6.45 mil/ha, respectively. This finding showed that the indemnity (Rp 6 mil/ha) of agricultural production cost insurance was lower than the average rice production cost both with in-kind and without in-kind.

**Table 3.** Cost of rice production without and with in-kind by farmland size and location.

| 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. Note: In 2017, $1 = Rp 13,500.

Average percentage of damage in the study area was around 73.9 percent. As shown in Figure 3, 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 3.** Proportion of farmers by percentage of damage category and location.

## *4.2. Farmers' Willingness to Join*

The pattern of farmers' willingness to join in the insurance is presented in Figure 4. 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:

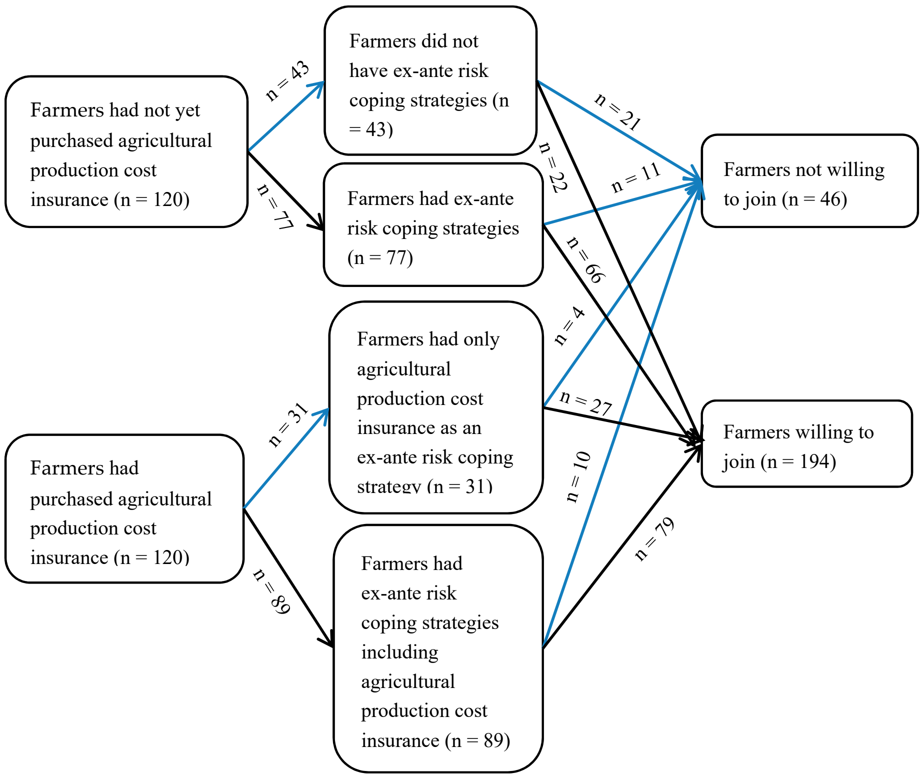
  (a) Out of 120 farmers who had not yet purchased agricultural production cost insurance, 43 farmers (35.8 percent) had no ex-ante risk coping strategies, of whom 22 farmers (51 percent) were willing to join in the insurance. Therefore, farmers who had the willingness to join and did not have the willingness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

  (b) Farmers who had not yet taken agricultural production cost insurance but had other ex-ante risk coping strategies numbered 77 (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 a higher number 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 insurance, 31 farmers (25 percent) had taken out only agricultural production cost insurance as an ex-ante coping strategy. Of these 31 farmers, 27 (87 percent) were willing to continue to join in the insurance;

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




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

**Figure 4.** Pattern of farmers' willingness to join.

As a whole, the major pattern was that farmers who had already adopted ex-ante coping strategies were likely to join with 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. There were changes in the behaviors of farmers when they were offered agricultural production cost insurance, which were as follows:

(1) For farmers who had not yet purchased agricultural production cost insurance, 22 out of 43 farmers (51 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 the 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 demonstrated willingness to join in the insurance as one risk management strategy, including farmers who had not adopted an ex-ante risk coping strategy (51 percent of farmers willing to join). However, there were farmers who, having purchased the insurance, decided not to join in the insurance in the next cropping season; their number was quite low.

Several reasons were found for why farmers were not willing to join in agricultural production cost insurance (Table 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, which suggests that these reasons were not considered as obstacles to purchasing the insurance. As a whole, the reasons 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 4.** Reasons for not willing to join in agricultural production cost insurance.

| Reason | Rank |
|---|---|
| Indemnity cannot compensate rice production cost | 3.08 |
| Percentage of damage is too high as a 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 |
| Not need insurance because of having other risk coping strategies | 1.67 |
| I have already purchased insurance but no disasters | 1.30 |

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

### *4.3. 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 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%~75%) of them had WTP.

**Table 5.** Farmers' willingness to pay (WTP) by location and previous purchase of agricultural production cost insurance.

| 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 ratio of the logit model of WTP analysis are summarized in Table 6. The chi-square test is significant at the 1 percent level. The model can predict 83.5 percent of the survey data (power of prediction is 83.5 percent). As the highest variance inflation factor (VIF) is 2.35, there is no multicollinearity in the model. The linktest shows that the model is properly specified. Moreover, the logit model analysis found 10 variables as determinants of WTP: bid, education, risk behavior, expected production next cropping season, percentage of damage, asset value, farmland size, production cost, contact with extension service, and dummy of the downstream area.

**Table 6.** Estimated coefficients, marginal effects, and odds ratios of the logit model.

| Variables | 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 production next cropping season ($x_8$) | −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 of agricultural production cost insurance ($x_{11}$) | 1.0622 | 0.7026 | 0.1106 | 0.0719 | 2.8928 | 2.0326 |
| *Economic characteristics* | | | | | | |
| Per-capita 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 | | | | | | |
| Dummy sharecropping ($x_{16}$) | −0.4910 | 0.6616 | −0.0511 | 0.0684 | 0.6120 | 0.4049 |
| Dummy 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 an extension service ($x_{19}$) | 2.4748 *** | 0.7276 | 0.2577 *** | 0.0658 | 11.8792 *** | 8.6435 |
| *Access to financial institution* | | | | | | |
| Bank account ($x_{20}$) | −0.7421 | 0.6525 | −0.0773 | 0.0674 | 0.4761 | 0.3106 |
| *Locations* | | | | | | |
| Dummy downstream ($x_{21}$) | 1.7994 ** | 0.7115 | 0.1874 ** | 0.0689 | 6.0461 ** | 4.3016 |
| Dummy midstream ($x_{22}$) | 0.2047 | 0.8019 | 0.0213 | 0.0834 | 1.2272 | 0.9839 |
| (Upstream as a 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 | |
| Linktest: | | | Variance Inflation Factor (VIF) | | 2.35 | |
| _hat | 0.000 | | | | | |
| _hatsq | 0.762 | | | | | |

Source: Author. Notes: *** significant at 1% level, ** significant at 5% level, * significant at 10% level. [a] Marginal effects are computed at the average 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 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; namely, expected production next cropping season (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 having small farmland size, low contact with extension services, and farmers in the midstream and upstream areas should be the target of the government program to improve farmer' participation in agricultural production cost insurance.

### *4.4. Mean Value of WTP*

Using coefficients of independent variables in Table 6 and their mean values, the mean value of WTP is estimated by the following equation:

$$\begin{aligned}\overline{WTP} = (&-13.7198 - 0.0004\overline{x}_2 + 0.3176\overline{x}_3 + 0.2949\overline{x}_4 + 0.0001\overline{x}_5 \\ &+0.3579\overline{x}_6 - 0.0001\overline{x}_7 - 1.2339\overline{x}_8 + 0.0773\overline{x}_9 + 0.0293\overline{x}_{10} + 1.0622\overline{x}_{11} \\ &+0.0461\overline{x}_{12} + 0.0304\overline{x}_{13} + 2.6706\overline{x}_{14} - 0.5200\overline{x}_{15} \\ &-0.4910\overline{x}_{16} - 0.8564\overline{x}_{17} + 0.4912\overline{x}_{18} + 2.4748\overline{x}_{19} - 0.7421\overline{x}_{20} \\ &+1.7994\overline{x}_{21} + 0.2047\overline{x}_{22})/-0.0001\end{aligned}$$

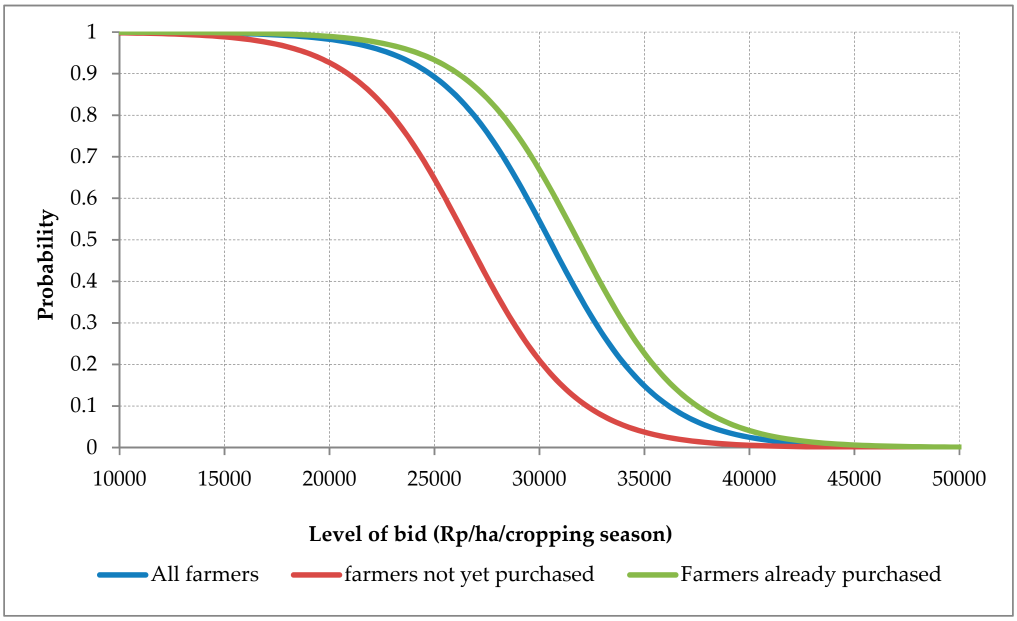
As shown in Table 7 and Figure 5, the mean value of WTP for farmers was Rp 30,358/ha/cropping season ($2.25/ha/cropping season), being lower by 16 percent than the current premium of Rp 36,000/ha/cropping season ($2.67/ha/cropping season). Using a similar equation, the mean value of WTP was estimated at Rp 26,369/ha/cropping season ($1.95/ha/cropping season) for farmers who had not yet purchased agricultural production cost insurance but at Rp 31,853/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.

**Table 7.** Mean value of WTP (farmers).

| Indicator | All Farmers | Farmers Had Not Yet Purchased | Farmers Had Already Purchased |
|---|---|---|---|
| WTP (Rp/ha/cropping season) | 30,358 | 26,369 | 31,853 |
| Standard error | 12,475 | 9403 | 9769 |
| n | 240 | 120 | 120 |

Source: Author.

Moreover, as shown in Table 8 and Figure 6, 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 (Rp 36,318/ha/cropping season, $2.69/ha/cropping season) was higher than that in the downstream area (Rp 28,794/ha/cropping season, $2.13/ha/cropping season) and that in the upstream area (Rp 26,267/ha/cropping season, $1.94/ha/cropping season).



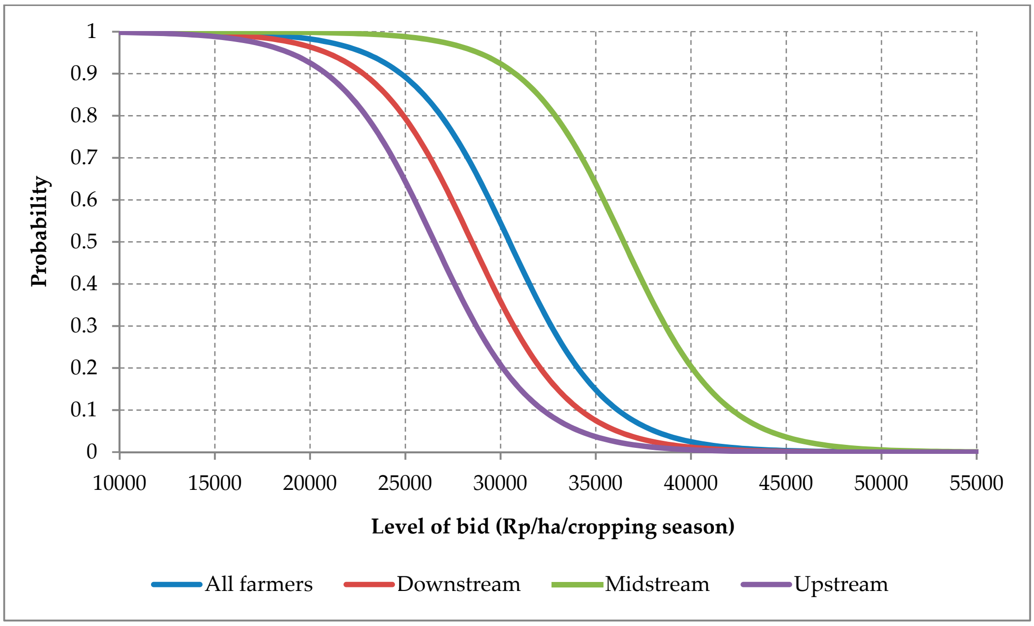

Source: Author.

**Figure 5.** WTP of farmers who had already purchased and not yet purchased.

**Table 8.** Mean value of WTP by location (farmers).

| Indicator | All Farmers | Downstream | Midstream | Upstream |
|---|---|---|---|---|
| WTP (Rp/ha/cropping season) | 30,358 | 28,794 | 36,318 | 26,267 |
| Standard error | 12,475 | 8881 | 10,046 | 9680 |
| n | 240 | 80 | 80 | 80 |

Source: Author.




Source: Author.

**Figure 6.** WTP of farmers in the downstream, midstream, and upstream areas.

## 5. 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 unwilling to join as well. It means that those farmers hold the key to 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 farmer participation in the agricultural production cost insurance was low. Moreover, there were four variables that were considered as main factors of farmers' WTP for the agricultural production cost insurance; namely, expected production next cropping season, farmland size, contact with extension services, 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 midstream and upstream areas, as the target of the government program associated with improving 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 a countrywide basis to regional-wide (for example, district level). Therefore, each region (district) might have different premiums that would reflect its level of risks. 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 aware and understand agricultural production cost insurance, they might participate in it.

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