Rice crop insurance in Indonesia: adaptation to climate and farm production support

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Abstract. Indonesia’s Rice Crop Insurance (AUTP) scheme has successfully protected farmers from significant crop losses due to natural disasters. However, the current amount of AUTP’s compensation is still unable to accommodate farmer’s financing costs (i.e., unpaid micro-loan and its interests) to support crops production. This results in higher micro-loan risk and hinder the sustainability of farming enterprises. In this regard, the existing People’s Business Credit (KUR) should supposedly be accessible as a micro-loan source to help farmers fund their farms. This study has two objectives: (1) formulate an integration scheme between KUR and AUTP, and (2) determine the appropriate insurance premiums to meet the farmer’s operational and financing costs. This research used 100,000 Monte Carlo Simulations using lognormal distributions with assumptions based on the results of focus group discussion and in-depth interviews with farmer groups, the local Agriculture Service, and micro-loan distributors, as well as the data from the Ministry of Agriculture from the period of 2018–2020. Additionally, Individual Area Yield Index (I-AWI) policy and loss ratio is used to determine and evaluate the new integrated crop insurance premiums. The study revealed that the farmers expect affordable, accessible, and beneficial insurance products with premium subsidies bundled with KUR. Therefore, the government should develop an integration of crop insurance with KUR and determine the affordable premium calculations along with the insurance companies. Based on the simulation results, the total pure premium is estimated around IDR 1 million for a minimum KUR loan of IDR 8 million (suitable for farming costs).

1. Introduction

As an agrarian country, agriculture is one of the main occupations for the rural population in Indonesia, in which most of the people are farmers, either as the owners or the tenants of a certain size of land. Most farmers in Indonesia have been struggling with many challenges, such as low average farming land and climate change which causes a big impact in the agriculture sector as a form of higher risk in crop failure. Limited land owned by farmers tends to result in low income and an increment in the vulnerability of farmers. As for climate change, Indonesia is one of the world’s most vulnerable regions
to climate change due to its long coastlines. Accordingly, Indonesia is subject to many climate-related hazards, e.g., floods, droughts, storms, landslides, and wildland fires [1], which affect the productivity of farming land and therefore strike the poor farmer’s household income.

Hence, the need for crop insurance is apparent. Crop insurance in Indonesia, known as Asuransi Usaha Tani Padi (AUTP) was introduced as a pilot project by the Ministry of Agriculture (MoA) in 2012 and suggested the Farmer’s Protection and Empowerment Act throughout Crop Insurance (Act No. 19/2013) as one of key elements in adapting the climate change and supporting the development of agriculture sector. The policy was based on Multi-Peril Crop Insurance (MPCI) with premium heavily subsidized by the government (80%), where with this option farmers will receive an indemnity of IDR6 million/ha if the insured land is at least 75% damage caused by any of these: pest, disease, drought, or flood [2]. With the indemnity paid, it is expected to cover the upcoming planting costs. To this connection, the zone-based area yield scheme in crop insurance would be an alternative policy to improve crop insurance (MPCI) in Indonesia [3]; and this alternative policy is in line with this study.

Besides risks, farmers also encounter limited access to financial support that becomes a hurdle for farmers to improve or increase their production and revenues. Specifically, this research would highlight the role of microfinance as a solution for handling financial constraints faced by the agriculture sector. In Indonesia, the agricultural sector is mostly included in the category of micro, small, and medium enterprises sector (MSMEs). Credit statistics show that agricultural credit or known as the People’s Business Credit (Kredit Usaha Rakyat/KUR) sector only has a share of 0.76 percent. Some of the factors that lead to low credit share of the agriculture sector include weak capital structure and lack of access to sources of financing and guarantors, the lack of market access to potential markets, and the quality of goods produced have not been standardized. Agricultural businesses are usually perceived as not achieved economies of scale so that the overhead expenses are high and cause very minimal profit for farmers [4].

KUR is a working capital loan and/or investment loan provided by banks for decent Micro, Small and Medium Enterprises and Cooperatives (MSME-C). KUR schemes for agriculture are given to farmers that are members of farmer’s groups where most of the farmer’s groups have a collaboration with off-takers. Based on the basic provisions of KUR, the loan amount is based on the agriculture type and farming cost structure (Rencana Definitif Kebutuhan Kelompok/RDKK) and productivity assumptions that are approved by the authorized local agriculture government office. For paddy (rice crop), the average cost structure is ranged between IDR 7.5 million to IDR 8.5 million for 1 hectare. In order to give an opportunity for farmers to improve their business and also have room for urgent personal needs, therefore currently credit limit of KUR is approved at IDR12 million to IDR15 million per hectare. In addition, the farmers should pass the credit checking against the Indonesian Financial Information Service System (SLIK). The bank also requires the farmers to pay off the outstanding loan before proposing the new loan. The KUR (micro category) requires no collateral. Thus, KUR is categorized as high-risk based on the banking perspective. Based on the government mandate, the state-owned banks in Indonesia are required to disburse KUR at an interest rate of 6%, a rate subsidized by the government. To manage the credit risk, the bank requires proper due diligence. The bank is likely to grant credit to farmers with a partnership with the local off-taker business and is clustered in a credible farmer group. In practice, the KUR for farmers is insured by AUTP. However, indemnities paid in occurrences of harvest failure are not sufficient to cover both planting costs and credit repayment.

Consequently, developing an integrated insurance policy that covers both planting costs and credit repayments is crucial both from the perspective of the farmer as debtor and also the bank as the creditor in order to manage the credit risk. However, most farmers are unlikely to pay the AUTP premium regardless of the benefit. Henceforward, further analysis was conducted through a survey to obtain relevant data and information and to observe the reasonable premium cost of an integrated scheme. Due to data limitations, Monte Carlo simulations were used based on cautiously defined assumptions. This study is expected to assist the government and insurance companies to consider this scheme and provide calculation of the affordable premium integration between AUTP and KUR.
2. Materials and methods

2.1 Materials

Currently, the integration program between AUTP and KUR is still being conducted as pilot studies. The pilot study was focused mainly in regencies of Ciamis (West Java Province) and Karanganyar (Central Java Province), where it was found that the integration between AUTP and KUR is still limited, and farmers only rely on current AUTP scheme which is not sufficient enough to cover their loans. Therefore, this research is intended as additional credit assistance in addition to the current benefits of AUTP. In order to calculate the sufficient pure premium, this research used simulation data because the indemnity data required is not yet available. Focus group discussions (FGD) were held to strengthen the assumptions used in the simulations. Three essential FGDs have been carried out since November 2020 with a total of 21 participants. The participants were key representatives from the Ministry of Agriculture (MoA) as policymakers and representatives of policy implementers (agribusiness microfinance institutions, banks, farmer cooperatives, and extension workers) that had experience in carrying out the integration of AUTP and KUR’s pilot studies. The FGD was conducted to obtain an overview of the integration program at the level of policyholders and policy implementers.

In order to strengthen the assumptions used, this study also conducted a by-phone survey of 100 farmers in Indonesia spread over several rice-producing areas in provinces of East Java, West Java, Central Java, Yogyakarta, North Sumatera, West Nusa Tenggara. Due to Covid-19 pandemic constraints, idle sampling methods cannot be applied. Therefore, this study was used purposive sampling of farmers who were able to be surveyed by phone. This survey aims to obtain an overview of the AUTP and KUR integration programs at the farmer’s level as users. The respondents were aged between 40 to 59 years old, had an average farming experience of 21 years, and 77% of respondents took at least 9 years of formal education. Information about farmer’s personal information, loans, and opinions/perceptions about the AUTP and KUR integration program were also obtained.

Based on the FGDs and surveys, the assumptions used in this study are as follows:
1. The land area for each farmer is assumed to be 1 hectare.
2. It is assumed that the productivity level for each farmer per hectare has a lognormal distribution with the estimated national minimum average productivity rate within the period of 2005 to 2015 is \( \mu_1 = 4.4 \) tons per hectare and \( \sigma_1 = 0.51 \). [5].
3. AUTP's sum insured (SI) is IDR 6,000,000/4.4 tons per hectare.
4. Credit Assistance’s sum insured (SI) is 70% to form the credit limit for each farmer.
5. Indonesian Ministry of Trade regulation No.24/2020 about Determination of Government Purchases for grain or rice stated that the price of harvested dry grain is IDR 4,200/kg [6].
6. The approved credit limit of KUR is IDR12 million to IDR15 million per hectare (based on pilot studies in Ciamis and Garut Regencies, West Java Province), that were considered as best practices from two state-owned bank, i.e., Bank BNI and Bank Mandiri. Both banks are the pioneers of KUR for agriculture sector in Indonesia.
7. All farmers are considered eligible borrow at the credit limit. We have also conducted simulations to calculate the integrated premium if farmers only borrow for average farming costs only.
8. Annual KUR interest rate is 6%/per planting season, where one planting season is assumed to be six months.
9. The insurance covers the basic AUTP indemnities (IDR 6 million per hectare per planting season) alongside indemnities that will cover total KUR repayment assistance.

2.2 Methods

Monte Carlo simulation is a test using mathematical equations with random numbers. Therefore, estimation using Monte Carlo requires testing the same data repeatedly with different random numbers but have uniformity so that the information obtained will be more efficient [7]. Equation from the
problems described is the actual situation on the field, which will be hard to model if using analytical methods [8]. This matter involves random sampling of observations depending on which distribution is needed/required [9]. In the simulation, testing is done using actual data and random numbers to produce estimated results for the problem that wishes to be solved either partially or totally [5].

The agricultural insurance model currently in use is Multi-Peril Crop Insurance (MPCI). However, this research uses an alternative Individual Area Yield Index policy (I-AYI), which was further developed based on Area Yield Index (AYI) principles. AYI itself is an insurance model based on the yield index in an area and the insurance will pay the sum insured if the farmers’ productivity in an area is below the index. The area is usually a group of districts or villages that have homogeneous agricultural production and products. The index value is determined based on historical data on the average yield of the area. AYI carries out many advantages such as promoting good farming practices, nevertheless it is dissimilar to current policies. Therefore, it will be more challenging to socialize the policy to farmers in Indonesia. Hence, we further developed AYI at an individual level where the productivity data was taken from farmer levels. It resembles the current policy but still has the advantages of AYI [5]. Thus, it is quite promising. The formula used to calculate the indemnity of I-AYI was driven from a modified formulation of Miranda’s model [10]:

\[
\text{Indemnity} = \max(y_c - y_{ij}, 0) \times \text{Sum Insured} \times \text{Land Area}
\]

\(y_c\) is the average production, while \(y_{ij}\) is the production for each farmer, and Sum Insured is the coverage of loss per ton. The sum insured were calculated differently for I-AYI and KUR assistance based on the formula below:

\[
\text{Sum Insured AUTP} = \frac{\text{IDR 6,000,000}}{4.4 \text{ tons}} = \text{IDR 1,363,63 per tons}
\]

\[
\text{Sum Insured KUR Assistance} = \frac{\text{credit limit} \times 1.03}{4.4 \text{ tons}}
\]

Therefore, the total integrated crop insurance premium can be calculated as:

\[
\text{Total Premium} = \text{Premium AUTP} + \text{Premium KUR}
\]

Where Premium AUTP and Premium KUR are calculated based on I-AYI, where the difference between AUTP and KUR is in the Sum Insured (SI).

3. Results and discussion

In depth discussion with farmer’s groups, the local Agriculture Service, micro-loan distributors, as well as the Ministry of Agriculture, indicate emerging support for integration of AUTP and KUR in Indonesia. In general, the farmer is not mandatory to buy AUTP products along with KUR. Nevertheless, in most situations, it is compulsory to integrate the AUTP with the KUR by the state-owned bank. Based on the bank perspective, AUTP is a supportive feature to manage the credit risk caused by unexpected natural events such as floods, drought, and pest attacks. Hence, the AUTP feature is not applied for personal mismanagement risk based on the farmer’s behavior and attitude in using the financial sources. Therefore, the other important consideration in granting for farmers consists of: (1) farmers membership in a reputable farmer’s group, (2) have no outstanding debts, and (3) have a clear and reasonable financial definitive plan. Estimated farming costs that will be set as the baseline threshold of credit are based on average area farming costs that are estimated to be around IDR 8 million per planting season. Banks are able to give credit for up to 2 hectares of land owned or cultivated by an individual farmer, thus paddy farmer KUR ranges up to IDR 30 million. The interest rate is 6% per year and most farmers take 4-month up to 6-month loans. Despite this, it is possible to extend the credit tenor or repayment date up to 12 months (1 year), especially for larger loans. When the farmers fail to repay their debt on time, the bank will offer a mitigation program by extending the due date for farmers to fulfill their obligations. In order to succeed in supporting farmer KUR, the MoA has not only relied on banks but also farmer’s cooperatives and micro financial institution in agribusiness (LKMA). Moreover, the role of farm agents and off-takers business is increasing. Farm agents work along with microfinance institutes to make sure the chosen farmers are reputable farmers and capable to pay their debts. The farm
agents also ensure the credit utilization is on track and used for the productive purpose as stated in the financial plan document during the credit proposal process. The bank has indicated that the bad quality credit is based on mismanagement and wrong utilization. Meanwhile, the off-takers businesses act as a guarantor to ensure the farmer’s income after the planting season by securing a partnership with the farmers to buy the harvest and ensure the repayment obligation is deducted from the selling amount. As a result, throughout the learning curve along the years, Non-Performing Loans (NPL) are managed in a very low percentage. Moving forward, providing an insurance that covers both farming costs and credit loans options can be seen as a key factor to increase the KUR program growth.

**Table 1. Loan sources for farmers.**

| Source of loan                | Percentage (%) | Total (%) |
|------------------------------|----------------|-----------|
| Bank                         | 52             |           |
| LKMA (Micro Financial Institution) | 2              |           |
| Cooperation                  | 3              |           |
| Combined formal              | 2              | 59        |
| Friends/family               | 25             |           |
| Money lender                 | 13             |           |
| Combined non-formal          | 0              | 38        |
| **Total**                    | 100            | 100       |

The integration policy has been appealing for farmers as well. Survey results show that 84% farmers support this insurance policy. Furthermore, the farmers expect that the insurance product will be affordable, accessible, beneficial, and subsidized such as AUTP scheme (96%). Therefore, further action is necessary to increase the farmers’ positive behavior and intention to buy the insurance product considering those important factors. Most farmers have had loans that were mainly used for farming purposes, including planting period (such as cost of seeds, fertilizers, land preparation, seeding), maintenance period (cost of pesticides, fertilizers), and to buy Agricultural equipment (such as tractors, field plows, buffalo). The source of loan is majorly from formal sources, especially banks (Table 1). As for non-formal sources, friends and family along with money launderers have also been reliable financial sources for farmers. The distribution of loans is skewed to the right indicating that in general most farmers have small loans, below IDR20 million (75%). Based on the data, the farmers with high loans amount use the loans for both farming purposes and personal need. It is also known that 82% of these loans do not include an insurance product. Meanwhile, survey data show that more than 75% of farmers experience losses in the past due to natural disasters or extreme climate. The impact of these events also tends to be abundant, where the average lost will reach up to 57%. Consequently, encouraging farmers that have credit to be insured is apparent.

This imply that the integration policy is not only promising for insurers but also farmers and the government. Next, if the integration insurance policy is implied based on the example of current farmer KUR offered by BNI (credit limit IDR12 million per hectare) and Bank Mandiri (credit limit IDR15 million per hectare) one can estimate the pure premium. The pure premium calculations were based on extensive Monte Carlo simulation under the I-AYI policy basis. The simulation had 100,000 repetitions, where each repetition consists of 100 farmers and the coverage include the interest costs of KUR. It is first calculating the estimated premium I-AYI that will cover the benefits offered by the current AUTP and then calculate the credit assistance premium of 70% from the credit ceiling for each farmer. There is no intention to give a full credit payment assistance in this scheme since most farmers need affordable priced premiums. Next step is to calculate the total premium of the integration crop insurance program. It is suggested that when farmers take KUR, they should be obligated to purchase this policy because it will not only allow farmers to keep on planting in the next season, but also, they can pay their debt and have a good accountably. This is very important in order to reapply KUR when necessary.
Table 2. Estimated pure premium results based on Monte Carlo simulations (in IDR).

| Estimated premium | Assumed credit ceiling IDR 12 million | Assumed credit ceiling IDR 15 million | Assumed credit ceiling IDR 8 million |
|-------------------|---------------------------------------|---------------------------------------|-------------------------------------|
|                   | I-AYI       | Credit assistance | Total | I-AYI       | Credit assistance | Total | I-AYI       | Credit assistance | Total |
| Average           | 386,945    | 557,975          | 944,920 | 386,945    | 697,469          | 1,084,415 | 387,029    | 372,064          | 759,093 |
| Lower level CI_{95%} | 303,545    | 437,713          | 741,258 | 303,545    | 547,141          | 850,686 | 304,629    | 292,850          | 597,480 |
| Upper level CI_{95%} | 473,455    | 682,721          | 1,156,176 | 473,455    | 853,401          | 1,326,856 | 473,727    | 455,409          | 929,137 |

Simulation results (Table 2) show that the estimated price of an I-AYI crop insurance premium is around IDR 380,000. After including other costs, this premium will be higher from the current AUTP, that is priced at IDR 180,000. Furthermore, we must see the potential strength of this policy, that is its ability to depress moral hazard issues and promote good farming practices. The credit assistance pure premium was estimated to be IDR 557,975 for the IDR 12 million ceiling loan and IDR 697,469 for the IDR 15 million ceiling loan. Henceforth, the total integration program premium is estimated to be around IDR 944,920 and IDR 1,084,415, depending on its ceiling loans. If farmers had loans that was just for farming cost purposes the total integrated premium will be much more affordable, that is around IDR 760,000. In order to have a more global understanding on the variations of the farmer’s KUR amount and its impact to the premium calculations, it is suggested that more in-depth studies should be implied in circumstances where each farmer receives a loan that is in accordance with their average seasonal farming income and also premium rates should also be applied for different credit amounts. Therefore, it can be adapted not only by BNI and Bank Mandiri, but also other banks or other micro financial institutions. When applied, it is suggested that these premiums should be attached to the farmer’s KUR agreements. The integration of KUR and AUTP will assist the farmers to survive during farm losses and continue producing in the next planting season. The proposed crop insurance product will cover most of the farming costs and enable them to pay their credit/outstanding balance. In addition, the government will also benefit from this integration by promoting better credit approval for farmers, therefore increase access to capital through credit (KUR). Nevertheless, the insurers will also manage their business profitably by calculating the premium correctly. Government supervision role is very important in orchestrating the stakeholder’s perspective and interests, hence achieve the better farming productivity, food sustainability, and promote welfare.

4. Conclusions
This study revealed that integration of rice crop insurance and farmer’s microcredit would offer multi-benefits for farmers, banks, insurers, and the government. This integrated scheme should be well implemented by local-based small banks as well as other credible micro-financial institutions. The farmers expect more options for their farm protection at which they expect affordable, accessible, and beneficial insurance products. Farmers also require insurance premium subsidies bundled with KUR credit.

With crop insurance and credit integration program, the rice farmers will secure the application of recommended input production and support national rice production development. When farmers are confronted with farm risks or harvest failure, they will also be secure as the insurance will cover their losses. Therefore, the integration of rice crop insurance and farmer’s microcredit is highly recommended. This implies that the government (both central and local) and insurance companies should work together to provide affordable premium rates (total pure premium is estimated to be around IDR 1 million for a minimum KUR loan of IDR 8 million, which is suitable for farming costs) with reasonable insurance compensation to support sustainable rice production.
Acknowledgements
The authors would like to acknowledge Prasetiya Mulya University for the Multidisciplinary Research Grant 2020 support. We would also like to acknowledge the Ministry of Agriculture, Bank Mandiri, Bank BNI, and LKMA for sharing their data and knowledge. Last, sincere thanks are extended to the READI Project of Global Affairs Canada for funding and support in related data collection process.

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