The Performance and Improvement strategies of Crop Natural Disaster Insurance in Korea

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1. Introduction

- **The Crop Natural Disaster Insurance** (referred to as “Crop Insurance”) in Korea, introduced in 2001, has achieved rapid quantitative and qualitative growth for the last 15 years.
  - The number of applicable items, which were only two including apple and pear in the early stage, jumped to 50 in 2016.

- In addition to such a quantitative growth, the Crop Insurance also showed an incredible growth from the qualitative aspect
  - By introducing the **Government Reinsurance System** in 2005, the government contributed to stabilizing the insurance market.
  - It also established the **Agricultural Policy Insurance & Finance Service** to reinforce the public functions of the insurance.

Despite such growth of the Crop Insurance, the assessment of how the Crop Insurance contributed to farm households, consumers and the entire society has been insufficient.
• This study measures how the **Crop Insurance** has contributed to stabilizing the income of farm households and how much impact the reduced price due to the **increase** in production has on the **welfare of consumers**.

• Based on this measurement, it comprehensively assesses the contribution of the insurance to the entire society.

• This study presents **solutions for the Crop Insurance** based on a quantitative analysis of the outcome.
1. Progress

1970s: The Crop Insurance was first considered for rice farming, but the attempt was halted.

1999: Many of farm households were hit hard by Typhoon Olga.

2001: The crop Insurance system was officially introduced for apple and pear farming in March 2001.

2002~2003: Typhoon Rusa and Maemi caused a significant loss and operational hardships to private insurance companies.

2005: The government introduced the Government Reinsurance System.

2006~: In recent years, the government has taken the initiative in improving the quality of the insurance system.
  - In 2013, It carried out the reform of the disaster insurance.
  - In 2014, The Government Reinsurance System was reorganize.
  - In 2015, The Agricultural Policy Insurance & Finance Service (APFS) was designated to reinforce the public functions of the insurance system.
II. Progress and Overview of the Crop Insurance

2. Current Status

2.1 Insured Items and Regions

- As of 2016, a total of 50 items are covered by the Crop Insurance.

- Insured regions vary according to the form of project.
  - As of 2016, various main projects are being implemented for 32 items including apple and pear, and pilot projects are conducted for 18 items such as peach and rice.

Main Project: It is implemented nationwide.

Pilot Project: It is carried out focusing on major producing areas for a certain period of time (three years) and then switched to a main project.
2. Current Status

2.2 Level of Coverage

- The Crop Insurance **does not cover all damages and losses** caused by disasters.

- The system requires farm households to bear a part of the burden to create the environment where they can prepare for potential disasters on their own and to prevent moral hazard.

The level of coverage is determined by considering the characteristics of each item and the financial capacity of each farm household.
2. Current Status

2.3 Method of Subscription

- In case of crops, the insurance is subscribed by each orchard (by farmland for rice), while it is subscribed by a greenhouse complex in case of agricultural facilities and greenhouse crops.

- Although the Crop Insurance is currently operated in the form of the optional entry system, the minimum standard for subscription is applied depending on the item to cover farms of a certain scale.
  - Farmland with the sum insured under USD 3,000 is excluded from the subject to be insured, and there is an additional limit to the scale of cultivation.
  - If the scale is too small, the expense is higher than the benefit for the farm, and it also makes the operation of the insurance business inefficient.
2. Current Status

2.4 Calculation of the Premium Rate and the Government Support

- Unlike private insurances calculated by combining the net premium and loading, the disaster insurance as a policy insurance is calculated based only on the net premium.

<table>
<thead>
<tr>
<th>Premium Rate</th>
<th>Net premium</th>
<th>Expected losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading</td>
<td>Expenses</td>
<td>Profit</td>
</tr>
</tbody>
</table>

- The government supports 50% of the net premium of farm households and 100% of the operating expense of the insurer.

- In addition, most local governments provide additional support (50% of the premium to be paid by farm households)

Therefore, farm households pay only 25% of the net premium.
2. Current Status

2.5 Risk Diversification System

**NHPCI**
- It is the only insurer of the Crop Insurance System
- It takes the primary burden of the operation of disaster insurance.

"quota share reinsurance"

**Domestic Private Insurance**
- Since there is a limit for NHPCI to bear all risks alone, domestic private insurance companies share the burden.

"Non Proportional Reinsurance"

**The government Reinsurance**
- In case of the outbreak of a massive disaster, private insurance companies alone cannot handle risks.
- The government can take the burden of such a huge disaster.
2. Current Status

2.6 Damage Assessment System

- Any damage occurs due to disasters.

- It organizes a damage assessment task force to conduct a site inspection and enter the result of the inspection on the data processing system.

- NHPCI selects a sample of damaged farm households (unit of land) and carries out a site investigation.
III. Outcome of the Crop Insurance

1. Expansion of Insurance Projects

- **The Crop Insurance** has increased the number of applicable items to **50 by 2016**.
  - Such a rapid expansion of the insured items in 16 years is a noteworthy growth, which is not common even in advanced countries.

- In the early stage, the applicable items were mostly fruit, but due to various demands of farm households, a diversity of food crops, greenhouse crops and even forest products are currently covered.

- In order to increase the subscription rate, the authorities are making efforts to **increase the applicable items and expand the range of coverage**.
  - The authorities have gradually introduced the **comprehensive risk insurance product** to fruit items since 2013.
  - For the **re-subscription** of the existing subscribers, a range of **incentives** are provided to farm households with **no accident record**, with multiple options to choose the level of coverage.
1. Expansion of Insurance Projects

- With the increase in applicable items and the expansion of the coverage range, the number of subscribers has also been on the steady rise.

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8,055</td>
<td>18,549</td>
<td>16,480</td>
<td>24,093</td>
<td>26,328</td>
<td>27,398</td>
<td>29,145</td>
</tr>
<tr>
<td>Total</td>
<td>32,538</td>
<td>45,882</td>
<td>52,738</td>
<td>67,653</td>
<td>74,983</td>
<td>95,102</td>
<td>89,033</td>
</tr>
</tbody>
</table>

< Annual Changes in the No. of Farm Households Subscribing the Crop Insurance >

Source: Ministry of Agriculture, Food and Rural Affairs (MAFRA).

The number of insured farm households is **89,000 in 2014**, up by **more than ten times from 2001**.
III. Outcome of the Crop Insurance

2. Management Support Considering Demands of Farms

- For efficiently providing support with consideration for demands of farms, the **insurance product improvement committee** was organized in 2013 to reflect opinions of experts and farmers of each item in the product development process.

< Major improvements >

<table>
<thead>
<tr>
<th>Diversifying the levels of coverage</th>
<th>The coverage levels were diversified, providing more options to farmers. (60%, 70%, 80%, 85%, 90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The extension of the coverage period</td>
<td>Considering that in the past the insurance period often ended too early before the completion of harvest.</td>
</tr>
<tr>
<td>The increase of standard price</td>
<td>The standard prices of 18 items were adjusted upward. (the price of apple and sweet persimmon by 10%)</td>
</tr>
<tr>
<td>The development of customized products</td>
<td>For example, the special contract for grapevine was revived.</td>
</tr>
<tr>
<td>The raising of limit for farms producing</td>
<td>The limit was raised to include those producing up to 150% of the standard yield, addressing the complaints of thriving farms.</td>
</tr>
</tbody>
</table>
3. Effect on the Stabilization of Farm Household Income

- Since the Crop Insurance guarantees the yield according to the contract for the damage of crops caused by natural disasters, farm households can expect to stabilize their income by subscribing the disaster insurance.

- The study analyzes in a quantitative way to identify how much the disaster insurance has affected to the stabilization of farm household income, by comparing each index of subscribers and non-subscribers.

- This study analyzes the figures concerning apple, pear and sweet persimmon, the items for which the largest number of farms subscribed the insurance.
3. Effect on the Stabilization of Farm Household Income

3.1 Method of Calculation of Risk Indices

- The **CV** is a representative index that indicates the variability, which is calculated by the standard deviation of annual income ($\sigma_Y$) divided by the average ($E(Y)$).

  - The lower the CV is, the more stable the farm income is.

  \[
  CV = \frac{\sigma_Y}{E(Y)}
  \]

- The **VaR** refers to the maximum losable sum that farms have to deal with due to a variety of risks.

  - The VaR is calculated by multiplying the constant corresponding to the confidence level ($\alpha$) by the standard deviation of the profit rate ($\sigma$) by the asset value ($V$).

  - The higher the income variability is, the higher VaR is.
3. Effect on the Stabilization of Farm Household Income

3.1 Method of Calculation of Risk Indices

- The CE indicates the cash that surely provides the utility equal to the expected utility, which is anticipated in an uncertain situation.

- It is related to the risk aversion level of the producer, so it is needed to define the utility function that reflects the risk appetite of the producer.
  - In this study, the power utility function is used. when the income \((Y)\) increases, the utility \((U(Y))\) also goes up, while the range of increase of the utility gradually goes down.
  - This study assumes 0.5, the medium level of risk aversion \((\gamma)\), for convenience.
    \[
    U(Y) = \frac{Y^{1-\gamma}}{1-\gamma} \quad (\gamma: \text{the risk aversion level of the producer})
    \]

- The CE is derived by taking an expected value for the power utility function and arranging it with regard to the income \((Y)\).
  \[
  CE(Y) = ((1-\gamma)E[U(Y)])^{1/(1-\gamma)}
  \]

- The expected income (assumed income in an unstable situation) minus the CE equals to the RP.
  \[
  RP = E(Y) - CE
  \]
### III. Outcome of the Crop Insurance

#### 3. Effect on the Stabilization of Farm Household Income

#### 3.2 Analysis Result

- For all of the three items, those who subscribed the disaster insurance recorded lower CV, VaR and RP and higher CE compared to those who did not.

< Effect of the Crop Insurance on the Stabilization of Farm Income (Based on average farm households; period: 2006-2012) >

<table>
<thead>
<tr>
<th>Item</th>
<th>Subscription status</th>
<th>CV</th>
<th>VaR (USD 1,000)</th>
<th>CE (USD)</th>
<th>RP (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>95%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>Apple</td>
<td>Non-subscriber</td>
<td>41.3</td>
<td>153</td>
<td>216</td>
<td>46,568</td>
</tr>
<tr>
<td></td>
<td>Subscriber</td>
<td>34.3</td>
<td>68</td>
<td>96</td>
<td>49,138</td>
</tr>
<tr>
<td>Pear</td>
<td>Non-subscriber</td>
<td>33.7</td>
<td>577</td>
<td>81</td>
<td>34,339</td>
</tr>
<tr>
<td></td>
<td>Subscriber</td>
<td>31.6</td>
<td>41</td>
<td>58</td>
<td>37,969</td>
</tr>
<tr>
<td>Sweet Persimmon</td>
<td>Non-subscriber</td>
<td>29.2</td>
<td>45</td>
<td>64</td>
<td>30,701</td>
</tr>
<tr>
<td></td>
<td>Subscriber</td>
<td>26.9</td>
<td>30</td>
<td>55</td>
<td>31,441</td>
</tr>
</tbody>
</table>

Note 1: CV (coefficient of variation), VaR (value at risk), CE (certainty equivalence), RP (risk premium)
2: The more stable the farm income is, the lower the CV, VaR and RP are and the higher CE is.
3: In the calculation of the VaR, the underlying asset is based on the income in 2012.
4: The CE is an estimated figure by assuming that γ (risk aversion index)=0.5.

This indicates that the **insurance subscription led to the stabilization of farm household income for the seven years.**
III. Outcome of the Crop Insurance


- Farm household income is stabilized
- Welfare of Producers $\uparrow$
- Welfare of Consumers $\uparrow$

$\Rightarrow$

Welfare of the entire society $\uparrow$

However, such an increase of social welfare is brought about by the government support (tax revenues), so it is need to calculate the net benefit of the entire country based on the cost-benefit analysis.
III. Outcome of the Crop Insurance


4.1 Welfare of Producers

- The increase in the amount of welfare of producers is calculated by subtracting the CE of non-subscribers from that of subscribers.

< Estimated Amount of Increase in Welfare of Producers due to the Subscription of the Crop Insurance in 2015 >

<table>
<thead>
<tr>
<th>Item</th>
<th>Planned yield (ton)</th>
<th>Premium rate (%)</th>
<th>Insurance subscription rate (%)</th>
<th>Amount of increase in welfare of producers (USD 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>333,728</td>
<td>0.96</td>
<td>75.3</td>
<td>1,248</td>
</tr>
<tr>
<td>Pear</td>
<td>254,752</td>
<td>2.44</td>
<td>87.3</td>
<td>3,605</td>
</tr>
<tr>
<td>Sweet Persimmon</td>
<td>62,290</td>
<td>0.13</td>
<td>35.5</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>4,870</strong></td>
</tr>
</tbody>
</table>

Note 1: These are figures estimated by assuming that $\gamma$ (risk aversion index)=0.5.

2: The planned yield is the Olympic average of the actual yield of farms between 2010 and 2014.

3: In the calculation of the premium rate and the amount of increase in welfare of producers, the guarantee rate of 80% is applied to all three items.

4: The data of the insurance subscription rate is based on that of 2014.

The total amount of welfare increase is estimated to be USD 4.9 million.
### 4. Effect on the Enhancement of Social Welfare

#### 4.2 Welfare of Consumers

< Estimated Amount of Increase in Consumer Welfare as the Effect of the Subscription of the Crop Insurance by Farm Households in 2015 >

<table>
<thead>
<tr>
<th>Item</th>
<th>Planned yield (ton)</th>
<th>Expected wholesale price (USD/kg)</th>
<th>Increase in yield</th>
<th>Changes in the wholesale price (USD/kg)</th>
<th>Increase in consumer welfare (USD 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>443,198</td>
<td>4.247</td>
<td>4,544</td>
<td>-0.03396</td>
<td>15,128</td>
</tr>
<tr>
<td>Pear</td>
<td>291,812</td>
<td>2.969</td>
<td>3,469</td>
<td>-0.01976</td>
<td>5,769</td>
</tr>
<tr>
<td>Sweet Persimmon</td>
<td>175,465</td>
<td>2.420</td>
<td>848</td>
<td>-0.01122</td>
<td>1,969</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>22,866</strong></td>
</tr>
</tbody>
</table>

Note 1: For the planned yield and the expected wholesale price, the Olympic average of the actual yield and the wholesale price between 2010 and 2014 are applied.

2: The increase in consumer welfare due to the introduction of the Crop Insurance is calculated based on the survey result in Chung et al (2013). It was calculated by applying the intention of the increase in the yield of grape (7.4%), the one in the same category of item, and the average amount of increase (18.4%), and then multiplying it by the subscription rate of each item.

As the subscription of the insurance leads to the rise in yield and the decrease in market prices, the consumer welfare soars by USD 22.9 million.
III. Outcome of the Crop Insurance


4.3 Cost-Benefit Analysis

- The cost-benefit analysis based on these estimated changes in the welfare of producers and consumers shows how the Crop Insurance contributes to insured farm households and even the entire country.

4.3 Cost-Benefit Analysis

- The benefits and costs for the three items are a total of USD 49.1 million and USD 27.8 million, respectively, and accordingly, the net benefit is USD 21.4 million.

< Cost-Benefit Analysis of the Crop Insurance in 2015 >

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Premium paid by farms</td>
<td>Government financial support</td>
</tr>
<tr>
<td></td>
<td>Risk premium</td>
<td>Damage assessment cost</td>
</tr>
<tr>
<td>Apple</td>
<td>4,596</td>
<td>4,167</td>
</tr>
<tr>
<td>Pear</td>
<td>7,129</td>
<td>6,463</td>
</tr>
<tr>
<td>Sweet Persimmon</td>
<td>84</td>
<td>76</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: The guarantee rate of 80% is applied to all three items
Note 2: The producer welfare is a figure estimated by assuming that $\gamma$ (risk aversion index) = 0.5.

- It implies that the Crop Insurance contributes to not only farm households but also the entire society.

If it covers all items (50 items as of 2016), the net benefit is expected to be higher.
IV. Suggestions for Improving the Crop Insurance

1. The subscription rate of the insurance should be increased.

   - After the introduction of the insurance, the subscription rate has gone up, but the average rate remains at 16.2% as of 2014, which is absolutely low.
   - It is crucial to identify problems of the product for each item and supplement the insurance.
   - In addition, the continued monitoring is needed even for the items with the high subscription rate to encourage re-subscription.

2. The authorities should expand the insurance product improvement committee.

   - They should improve the existing insurance products and develop new ones with consideration for the demand of farms.
   - The promotion and campaign should be carried out focusing on producing areas to inform farmers of such improvements.
IV. Suggestions for Improving the Crop Insurance

3. The damage assessment system should be managed in a fair and efficient way.
   - The biggest current challenge is that a majority of damage assessors are those engaged in the agricultural industry.
   - It is essential to expand the re-investigation of the assessment result to secure the fairness in the process, and come up with an incentive and penalty system for the NACF and assessors to reinforce their responsibility.

4. The Government Reinsurance System should be stabilized.
   - Although the system was reformed in 2014 to lighten the burden of farms and private insurance companies and effectively distribute risks, there should be additional research on the system.
   - It is needed to conduct a thorough examination of the system in the similar form to that of the US, which is currently applied only to pilot projects, and expand the system to items of main projects.

5. The statistical data management system should be managed in an effective.
V. Conclusion

- According to the result of the quantitative analysis of the income stabilization effect based on the data of apple, pear and sweet persimmon farms, subscribers have enjoyed lower CV, VaR and RP and higher CE.

  This implies that the subscription of the insurance has stabilized the income of farms.

- The result of the cost-benefit analysis of the Crop Insurance finds that the social cost and benefit are USD 27.8 million and USD 49.1 million, respectively, which means the social net benefit is USD 21.4 million.

  It suggests that the Crop Insurance contributes to increasing not only the benefit of individual farms but also that of the entire society.
V. Conclusion

- Given the accelerated opening of the markets and abnormal weather issues, the instability of the farm management is on the rise.

In this condition, the need for the Crop Insurance is expected to grow further.

- The Crop Insurance in Korea has been stabilized to some degree and utilized as a risk management method by a large number of farms.

- Still, there is the need to improve the system in the multiple aspects, concerning issues related to insurance products (applicable items, methods of subscription and coverage), the damage assessment system and the risk distribution system.

- In order to expand its role of stabilizing the management of farm households, such problematic issues should be resolved with continued efforts.
Thank you for listening!