

特集2 / 脱炭素政策検討支援ツールの開発と地域将来ビジョンの共創に関する研究

## Risk factors affecting feed rice production in the Kyushu region of Japan

Associate Professor of Public Policy,  
Faculty of Law, Politics and Economics  
Chiba University

Xiang Li

Professor  
Department of Global Agricultural Sciences  
The University of Tokyo

Nobuhiro Suzuki

### **Abstract:**

This study examined risk factors affecting farmers' feed rice production in the Kyushu region, Japan. Risk perception of farmers were estimated and  $\chi^2$  tests were performed to examine the risk perception differences between experienced group and non-experienced group. It has been found that farmers perceived labour force, policy, revenue stability, and environmental change to be important risk factors. As expected, environmental change was the most selected risk factor. This is followed by revenue stability, policy and labour force. It has also been found that more farmers in the experienced group worried about these risks than those in the non-experienced group. With the increasing frequency of typhoons in the Pacific region in recent years, more farmers in this region showed concerns about climate-related disasters. Under most circumstances, the success or failure of a policy relies on farmers' cooperation. Farmers' risk perceptions can be important

information that helps policymakers understand the potential factors affecting feed rice production. The findings suggest that the government needs to consider additional supports to cover the loss from climate-related disasters.

**Keywords:** food self-sufficiency rate, fodder self-sufficiency rate, feed rice production subsidy, risk factors, climate change.

## Introduction

The food self-sufficiency rate in Japan is the lowest among developed countries. Despite the implementation of various policies these years, the calorie-based food self-sufficiency rate in Japan has been around 38% (Ministry of Agriculture, Forestry and Fisheries 2021). Its fodder self-sufficiency rate is even lower. It has been around 25% these years (Li 2019). At any time, ensuring food security is significantly important. The second goal of the Sustainable Development Goals (SDGs), “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”, also supports this view (The United Nations 2020).

Interestingly, the self-sufficiency rate of rice in Japan has been maintained at more than 95% despite the national self-sufficiency rate is low (Ministry of Agriculture, Forestry and Fisheries 2018). In recent years, domestic demand for rice has decreased by 80,000 tons annually due to the westernization of dietary patterns, whereas the consumption of meat and fats, which is supported by a large supply of feed grains (e.g., maize) has significantly increased. Since the demand for feed crops cannot be met by domestic supply, approximately 90% of feed grains are imported from overseas each year.

Different from geographic conditions in major crop-producing countries like the U.S. and Australia, Japan has more mountains and fewer flat land. Such land condition is not suitable for a large production of feed crops like

maize (*Zea mays*). Instead, it is suitable for producing feed rice. Generally speaking, promoting the production of feed rice is a logical choice in Japan. Doing so can enhance the overall fodder self-sufficiency rate in Japan. Moreover, the feed rice itself can be utilized as food when there are shortages of foods. Given such background Japanese government purposely developed a feed rice production subsidy program and set the subsidy of feed rice higher than those of other grains. This policy is a new measure to raise the food self-sufficiency rate and the fodder self-sufficiency rate in Japan.

At any time, it should not be neglected that farmers are the key stakeholders in making the final decision of feed rice production. Whether they react enthusiastically to the policy would determine the success or failure of a policy. Thus, understanding farmers' risk assessment is extremely important. However, what factors are perceived to be important risk factors and affect farmers' decision-making are unclear.

In Japan, the Kyushu region is one of major areas of feed rice production. Given this background, this study examined the risk perception among farmers in the Kyushu region. Also, risk perception differences between the group that had experiences to produce feed rice and the group without such experiences were examined.

## 2. Materials and methods

### *2.1 Participants and procedures*

To understand the risk factors affecting farmers' decision to produce feed rice, an online questionnaire was created and sent to farmers in the Kyushu region. Participants included farmers who had experiences to produce feed rice and those without experiences to do so. All survey data responses were collected during the period from November 2019 to March 2021. In this study,

a total of 68 complete responses were collected (Response rate 15%). Of the total collected responses, 50% of them (n=34) had experiences to produce feed rice, and 50% of them (n=34) did not have such experiences.

The survey was performed following the Code of Conduct for Scientists specified by Science Council of Japan and the Code of Conduct for Researchers specified by Chiba university. Before we conduct the surveys, we provided participants a clear explanation of survey's objectives, the way to process data, and the rights of participants such as the right of withdrawal and voluntary participations. Consents to participation were obtained from participants.

## *2.2 Measures*

To understand farmers' risk perception, we first conducted interviews with farmers and asked them to provide information about the perceived risks affecting their production decisions. Then, we conducted an online survey using information collected from the interview sessions. We asked farmers to answer several questions. For example, "Do you think labour force is a risk factor affecting your decision to produce feed rice?". Similar questions were asked for other factors such as revenue stability, policy, and environmental change. Participants were asked to answer either yes or no in each question. If participants answered yes, we considered he or she perceived it to be a risk factor. Otherwise, we considered he or she did not perceive it to be a risk factor.

We also asked farmers to report their experiences in feed rice production. Self-reported experiences in feed rice production were determined with the following question: "Do you have experiences to produce feed rice?". Participants who responded yes were classified into experienced group. Otherwise, they were considered to as non-experienced group.

Also, we asked participants to provide information about their gender, ages and educational attainment. Considering that gender is a sensitive question, we only asked participants to choose their ages from the following options: Under 29 years old, between 30 and 39 years old, between 40-49 years old, between 50-59 years old, and over 60 years old. With respect to the educational attainment three options were provided, including high school or lower, undergraduate degree or equivalent, and graduate degree.

### *2.3 Statistical analyses*

Characteristics of participants that include numbers and percentages were examined at first. Then, risk perception among farmers in the Kyushu region was analyzed. Tests were performed following this process to further examine the risk perception differences between the group that had experiences to produce feed rice and the group without such experiences. All statistical analyses were conducted using version 15.1 of STATA software.

## 3. Results

### *3.1 Descriptive statistics*

Descriptive statistics of participants were summarized in **Table 1**. Of the total 68 completed survey responses, 64 participants were male (94.12%) and 4 participants (5.88%) were female. Ages of most participants were between 40-49 years old, with 24 participants (35.3%) were between 40-49 years old, 22 participants (32.35%) were between 50-59 years old, 14 participants (20.59%) were older than 60 years old. Also, it has been found that 6 participants (8.82%) were between 30-39 years old, and 2 participants (2.94%) were under 29 years old. Educational attainment of most participants was high school or lower level (28 participants: 41.18%), with 22 participants (32.35%)

**Table 1. Descriptive statistics of participants in the survey (n=68).**

Characteristics of participants	n (%)
Gender	
Female	4 (5.88)
Male	64 (94.12)
Age	
≤29	2 (2.94)
30-39	6 (8.82)
40-49	24 (35.3)
50-59	22 (32.35)
≥60	14 (20.59)
Education attainment	
High school or lower	28 (41.18)
Undergraduate degree or equivalent	22 (32.35)
Graduate degree	18 (26.47)
Experience of feed rice production	
No	34 (50)
Yes	34 (50)

at the undergraduate degree or equivalent, and 18 participants (26.47%) at the graduate level. With regard to the experiences of feed rice production, 34 participants (50%) had experiences to do so, and 34 participants (50%) did not have such experiences.

### *3.2 Risk perception in the Kyushu region*

It has been found that labour force, policy, revenue stability, and environmental change were perceived to be important risk factors among farmers in the Kyushu region (**Figure 1**). The most selected risk factor was environmental change (50 participants, 73.53%). The second most selected risk factor was revenue stability (48 participants, 70.59%). The third most selected risk factor was policy where 46 participants (67.65%) chose it. The last selected risk factor was labour force (26 participants, 38.24%).

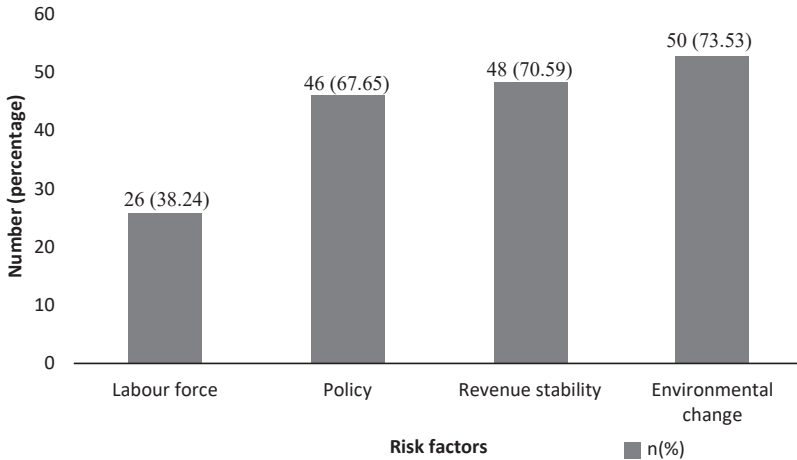


Figure 1. Farmers' risk perception in ascending order

### 3.3 Differences in the risk perception between experienced group and non-experienced group

$\chi^2$  tests were run to examine the risk perception differences between experienced group and non-experienced group. The numbers and percentages of participants who chose each of four variables in the experienced group and non-experienced group are summarized in **Table 2**. Of the total participants in the experienced group, 14 participants (41.18%) perceived labour force to be a risk factor, whereas 12 participants (35.29%) in the non-experienced group perceived it to be a risk factor,  $\chi^2 (1) = 0.25$ ,  $p=.62$ . As for policy, 26 participants (76.47%) in the experienced group perceived it to be a risk factor, and 20 participants (58.82%) in the non-experienced group perceived it to be a risk factor,  $\chi^2 (1) = 2.42$ ,  $p=.12$ . With respect to revenue stability, 26 participants (76.47%) in the experienced group perceived it to be a risk variable, and 22 participants (64.71%) in the non-experienced group

**Table 2. Risk perception differences between experienced group and non-experienced group in the Kyushu region: [n (%)]**

Factors	The Kyushu region		$\chi^2$
	Exp (n=34)	Non-exp (n=34)	
Labor force	14 (41.18)	12 (35.29)	0.25
Policy	26 (76.47)	20 (58.82)	2.42
Revenue stability	26 (76.47)	22 (64.71)	1.13
Environmental change	29 (85.29)	21 (61.76)	4.84*

\*p≤.05

perceived it to be a risk factor,  $\chi^2 (1) = 1.13$ ,  $p=.29$ . As for environmental change, 29 participants (85.29%) in the experienced group perceived it to be a risk variable, whereas 21 participants (61.76%) in the non-experienced group perceived it to be a risk,  $\chi^2 (1) = 4.84$ ,  $p=.03$ .

#### 4. Discussion

This study investigated the risk perception among farmers in the Kyushu region. It has been found that farmers considered labour force, policy, revenue stability, and environmental change to be important risk factors. Among these factors, environmental change was the most selected risk factor (**Figure 1**). Such a result reflects that climate disasters have increased over the past years (Meteorological Research Institute (MRI) 2020, Yamaguchi and Maeda 2020).

According to an analysis conducted by Japan agency for marine-earth science and technology, rainfall increases by 3% when the surface temperature rises by 1 degree in an average extratropical cyclone (Japan agency for marine-earth science and technology 2019). In a strong extratropical cyclone, rainfall can increase by 7% when the surface temperature rises by 1 degree (Japan agency for marine-earth science and technology 2019). Moreover, it has been detected that the number of days with daily precipitation of 100



mm or more in Japan has increased in the past 100 years (Ministry of Land, Infrastructure, Transport and Tourism 2005). Since environmental change has caused agricultural losses and affected revenue stability, it is reasonable that many farmers worried about this factor.

Like other types of economic activities, the purpose of working in the agricultural sector is to earn money. Under most circumstances, whether or not to take certain actions is influenced by the evaluation of profit and loss (Li et al. 2019). Although the amount of feed rice subsidy is set higher than other grain subsidies, transaction unit price of feed rice is significantly lower than that of rice for direct use as food. While the transaction unit price of unpolished feed rice is around 30 yen/kg, it is around 223 yen/kg to 351 yen/kg for unpolished rice for direct use as food (Tsunekawa 2015, Ministry of Agriculture, Forestry and Fisheries 2020). Whether the feed rice subsidy is high enough and whether farmers' revenue can be guaranteed are key evaluation items among farmers. The higher selection percentages of revenue stability and policy as risk factors reflect farmer's evaluation.

Besides, it should not be neglected that Japan has entered the phase of ageing. According to the statistics of 2020 Agriculture and Forestry Census (Ministry of Agriculture, Forestry and Fisheries 2020), 69.8% of farmers has become ages 65 or over. Both the agricultural workers and the employed workers in the agricultural sector have decreased in these years. In this study, 38.24% of farmers chose labour force as a risk factor. Such a selection ratio reflects the labour shortage issue in the region.

Following the analysis of regional risk perception, differences in the risk perception between experienced group and non-experienced group were examined. It has been found that more farmers in the experienced group were concerned about four types of risks than those in the non-experienced group (**Table 2**). Under most circumstance, actions and behaviors of a person

are determined by the evaluation of potential profits and loss (Li et al. 2019). As pointed out by the prospect theory, the pain of loss a person feels could be twice as strong as the joy if getting the same gain. Thus, it can often be observed that people take certain actions to avoid the risk of loss. The same logic applies to farmers. Since these four factors can affect revenue outcome, farmers in the experienced group are more sensitive to these variables.

Interestingly, as for environmental change variable, more farmers in the experienced group considered it to be a risk factor than those in the non-experienced group. With the increasing frequency of typhoons in the Pacific region in recent years, farmers belong to this area showed more concerns about climate disasters.

## 5. Conclusion

The findings of this study suggest that labour force, policy, revenue stability, and environmental change were important risk factors to farmers in the Kyushu region. Increases in climate disasters in recent years have made environmental change to be the most selected risk factor. Additionally, the selection of labour force reflects the labour shortage issue in the region.

Comparatively speaking, farmers who were producing feed rice in the experienced group were more concerned about these four types of risks than those in the non-experienced group. Moreover, the number of farmers who chose environmental change to be a risk factor in the experienced group is statistically higher than those in the non-experienced group. These findings reflect farmers' fears toward climate disasters.

Under most circumstances, the success or failure of a policy heavily relies on farmers' cooperation. Risk perception of farmers could be useful information that helps policymakers understand the potential factors affecting the feed rice production. The findings suggest that the government needs to consider

additional supports to cover the loss from climate-related disasters.

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