Collective reputation and externalities in agriculture:  
 Lessons from Fukushima nuclear accident[[1]](#footnote-1)

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Abstract

The existence of collective reputation implies an important externality. Among farmers, reputational loss could affect the demand for agricultural products, nonetheless, they do not have causes. We study such reputational damage in the context of a sensational issue that affected the Japanese agrarian sector in 2011 due to the Fukushima Nuclear Accident. Using an agriculture census panel dataset and a Difference-in-Differences approach, we document sizable effects on areas that are not contaminated but located in Fukushima prefecture. Our findings suggest that the reputational loss due to negative externalities affects farmers’ input decision-making such as renting out their farmland and adoption of highly-valued agricultural practices.

**Keywords**: Collective reputation, Negative externality, Information friction, Supply shock, Organic agriculture

1. Introduction

In commodity markets, collective reputation crises, driven by information friction, can disrupt supply chains and influence consumer behaviors. Collective reputation, an aggregation of individual reputations (Tirole, 1996), plays a crucial role in sectors like agriculture, where geographical indicators influence markets. Farmers using a geographical indicator may face repercussions, despite their quality standards, due to issues with other products from the same area. Negative externalities from environmental pollution are believed to affect collective reputation, and measuring these effects poses challenges. This study is the first to identify and explore the reputational impact on farmers' input decision-making in the face of such challenges.

Collective reputation from While collective reputation has been extensively studied in various sectors such as the vehicle industry, garment industry, and food industry (Bachmann et al., 2023; Bai et al., 2022; Gergaud et al., 2017; Jin & Leslie, 2009; Koenig & Poncet, 2022; Matsumoto & Hoang, 2020), From consumer perspectives, collective reputation affects consumers’ preferences (Ito & Kuriyama, 2017). The growing empirical literature focuses primarily on its effects on output measures. Empirical research on the relationship between collective reputation and input decisions is limited and remains understudied.

This study has two main contributions. First, we show that the collective reputation due to negative externalities affects suppliers’ decision-making, taking advantaging of a quasi-experimental situation and an agricultural census panel dataset. This study is one of the first studies to investigate the reputational effect on input decision-making while the literature has mainly focused on consumers’ preferences and suppliers’ output. Second, our results demonstrate that collective reputation with information friction can have important implications for high-value-added industries.

This paper is consisted as follow. Section 2 describes background information about the rice market in Japan and what Fukushima nuclear accident it. Data we used for this study is explained in Section 3 while Section 4 discusses our econometric model and the estimated results. Finally, Section 5 concludes.

1. Background on the rice market in Japan and the Fukushima nuclear accident
2. Rice production in Japan

In Japan, one of the most famous rice brands is *Koshihikari*. The name of *Koshihikari* varies across local areas of the production. For example, if Koshihikari is cultivated in a part of Niigata prefecture, it is called as “*Uonuma Koshihikari*” while it is called as “*Aizu Koshihikari*” when it is cultivated in western part of Fukushima prefecture. Figure 1 shows the year-level value added of rice production in Fukushima prefecture and Niigata prefecture. Overall, the rice production is decreasing, but the production value of Niigata prefecture in 2011 is slightly increased from the production in 2010 while the value is decreased of Fukushima prefecture after the accident in 2011.

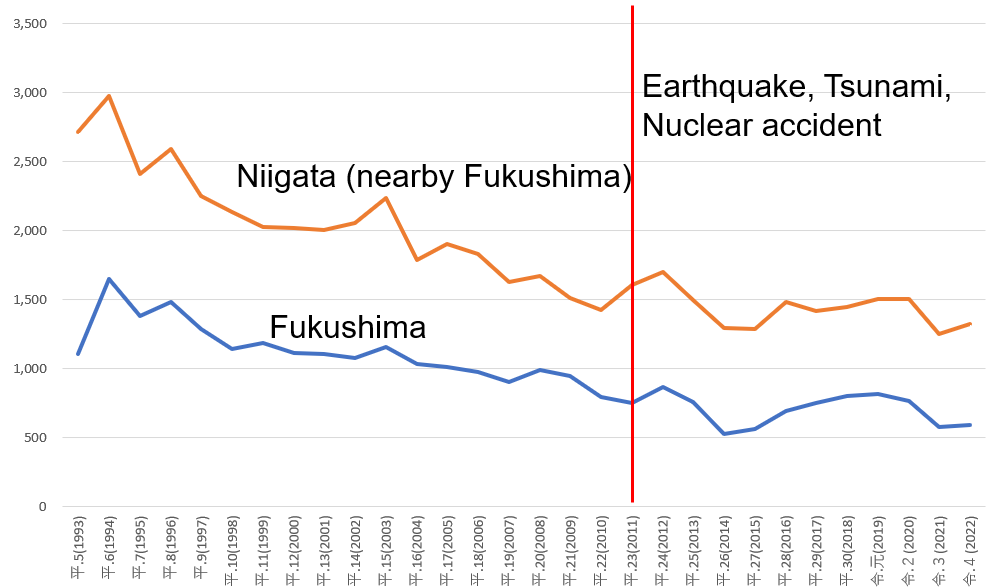


Figure 1 Value added of rice production in Fukushima and Niigata (100k JPY)

Source: Author’s calculation based on Statistics of Agricultural Income Produced by MAFF.[[7]](#footnote-7)

1. Fukushima nuclear accident

On March 11, 2011, the Great East Japan Earthquake struck, causing a tsunami that hit the Fukushima nuclear power plant and resulted in a meltdown of the reactors. This incident led to a significant release of radioactive material, raising nationwide concerns about nuclear safety. While the middle and coastal areas of Fukushima prefecture experienced partial contamination, the western part remained unaffected. Despite government inspections confirming the safety of rice shipments from the western part after the accident, concerns persisted about the potential contamination of agricultural products in that region.

Figure 2 shows the contaminated areas in Fukushima.

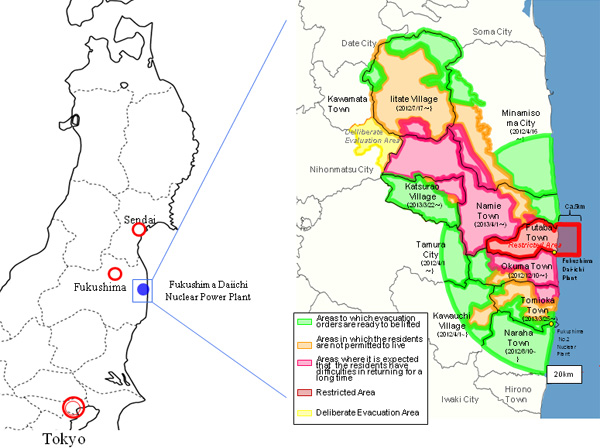


Figure 2 Evacuation map regarding the Fukushima nuclear accident

Source: Adopted from Reconstruction Agency, Government of Japan. (https://www.reconstruction.go.jp/english/topics/2013/03/the-status-in-fukushima.html).

1. Data

We use the Agriculture and Forestry census of Japan collected in 1995, 2000, 2005, 2010, and 2015[[8]](#footnote-8). We consider farm households in four Hinoemata-village, Tadami-town, Kaneyama-town, and Nishi Aizu-town in Fukushima prefecture as treatment groups that are supposed to be affected by the collective reputation and the accident. Other farm households in Aga-town, Sanjo-city, and Uonuma-city in Niigata prefecture are considered as control groups which are supposed not to be affected by the collective reputation and the accident. Figure 3 shows the geographical boundaries between Fukushima and Niigata prefecture and the boundaries of rural communities. The communities falling inside the contiguous towns formed by the boundary of the prefectures contribute to the treatment groups.

Table 1 shows the summary statistics of the used data for this study.

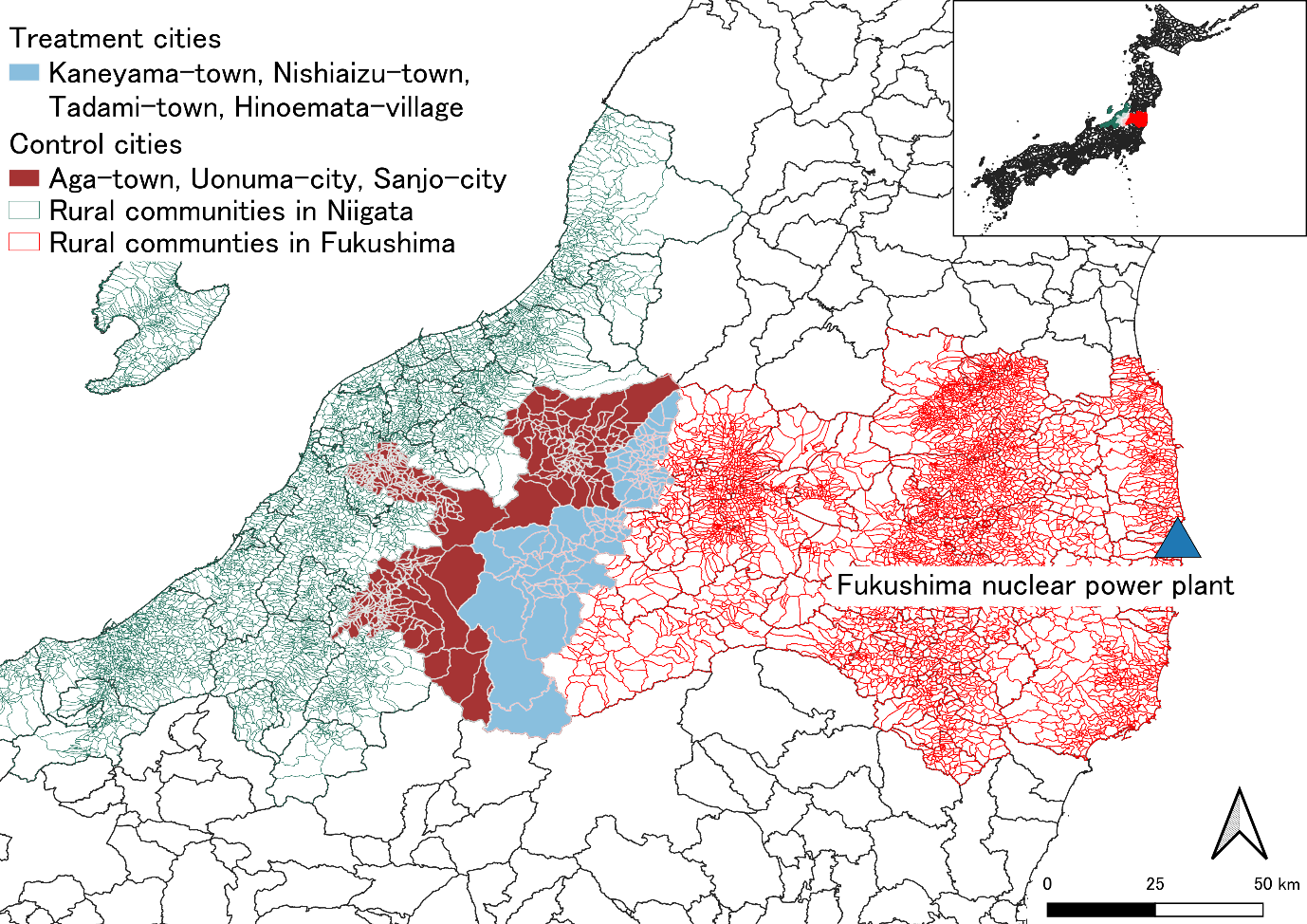
 Figure 3 Geographical relationship between Fukushima and Niigata prefectures.  
Source: Authors’ design.

Table 1 Descriptive statistics from 1995-2010: Pre-trend

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Definition | Treatment |  | Control |  |  |
|  |  | Mean | SD | Mean | SD | Dif |
| Rice production |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |

Source: Agriculture and Forestry census 1995, 2000, 2005, 2010, 2015.

Note: Author calculation.

1. Conceptual framework

To estimate the effects of the reputational loss on rice farmers in Japan after the Fukushima nuclear accident, we propose the following conceptual framework with hypothesis to be tested.

We consider a basic model which assumes that price is determined by the collective reputation and farmers choose quality at a cost (Winfree, 2023). The objective profit function for farmers may be given as follows:

where is a farmer *i*'s profits, is the farmer’s quantity, is the price, represents quality for the farmer’s product, represents group *j*'s reputation (farmer *i* is a member of this group), is the total production in the market, and *c* is the cost of production.

A collective reputation may induce stronger incentives to invest than an individual brand because it induces less extreme good and bad reputations (Neeman et al., 2019). Collective reputation is greater when public information is disseminated more rapidly (Saak, 2012). Moreover, past bad collective behavior increases the probability of being stuck in a “bad reputation trap.” (Castriota & Delmastro, 2015). Therefore, we hypothesize that the collective reputation is heavily affected by the Fukushima nuclear accident, thus the reputational damage affects

1. Reputational damage on farmers’ rice production
2. Impact of the accident on rice farm activities

We hypothesize that collective reputation is damaged by information friction between producers and consumers.

To examine the reputational effects on farmers, we outline the difference-in-difference approach following the model:

where is the outcome variables of household *i* in year *t*. is an indicator variable whether a household *i* is in Fukushima Prefecture. is an indicator variable showing that the accident happened in 2011. is a vector of covariates. and are respectively household and year fixed effects. is an error term. The coefficient measures the change in outcome variables for rice farmers in Fukushima Prefecture that experienced the Fukushima nuclear accident. The model requires parallel trend assumption. Our additional analysis, event study design, confirms the parallel trend assumption, regarding the results of from Columns (1) to (4) of Table 3 and Column (3) of Table 4[[9]](#footnote-9)

There are some concerns about the treatment variable. Supply chain disruption due to an earthquake and a tsunami in 2011(Barrot & Sauvagnat, 2016). Moreover,

Table 2 shows the effect of the accident on farmer’s rice revenue. Column (1) shows that 12.4% of annual rice revenue is lost after the accident happened in Fukushima Prefecture compared to

Table 2 Reputational effects after the Fukushima nuclear accident (TWFE)

|  |  |
| --- | --- |
|  | (1) |
|  | Rice revenue |
| Fukushima | -0.124\*\* |
|  | (0.593) |
| Household FE | *No* |
| Year FE | *Yes* |
| Control variables | *Yes* |
| Mean dep. var of control |  |
| Parallel trend | *No* |
| Observations | 39,558 |

Note: Two-way cluster standard errors at household and rural community-level in parenthesis. \*, \*\*, and\*\*\* denote significance at the 10%, 5%, and 1% level, respectively. The outcome variable is transformed by inverse hyperbolic sine. Control variables include age and sex of household head, household size, dummy variables of incorporated farmers, farmers who gain non-farm income, and self-sufficient farmers.

1. The effects of the reputation damage on farmers’ decision-making

Table 3 reveals that the accident led to a 3.9 percentage point reduction in paddy fields for Fukushima farmers compared to those in Niigata (Column (1)). Additionally, Column (2) indicates a 6.7% decrease in cultivated paddy fields due to the accident. These findings highlight the significant and economically impactful influence of reputational damage on farmers' input-related decision-making. Despite government assurances on product quality, collective reputational damage persists.

Table 3 Impact of the accident on farmers' decision-making (TWFE)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
|  | Owned paddy field | Cultivated paddy field | Total field rent out | Paddy field rent out |
| Fukushima | -0.060\*\* | -0.103\*\*\* | 0.164\*\* | 0.223\*\*\* |
|  | (0.027) | (0.038) | (0.070) | (0.066) |
| Household FE | No | No | No | No |
| Year FE | *Yes* | *Yes* | *Yes* | *Yes* |
| Control variables | *Yes* | *Yes* | *Yes* | *Yes* |
| Mean Dep. Var of Control |  |  |  |  |
| Parallel trend | *Yes* | *Yes* | *Yes* | *Yes* |
| Observations | 39,558 | 39,558 | 39,558 | 39,558 |

Note: Two-way cluster standard errors at household and rural community-level in parenthesis. \*, \*\*, and\*\*\* denote significance at the 10%, 5%, and 1% level, respectively. The outcome variables are transformed by inverse hyperbolic sine. Control variables include age and sex of household head, household size, dummy variables of incorporated farmers, farmers who gain non-farm income, and self-sufficient farmers.

1. Who gets more affected by the reputational damage?

In this section, we investigate what kind of farmers are more affected by the collective reputation loss. We estimate the effects of the accident on the decision of environmentally friendly agriculture which has premium. In Table 4, Column (1) shows a statistically significant coefficient of -0.046 for Fukushima, indicating a 4.6% decline in environmentally friendly agricultural practices due to the accident's collective reputation damage from information friction.

Table 4 Reputation effect on eco-friendly farming (TWFE)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | No-pesticide | Manure fertilizer | Compost soil |
| Fukushima | -0.129\*\*\* | -0.159\*\*\* | -0.065\*\*\* |
|  | (0.023) | (0.023) | (0.018) |
| Household FE | *No* | No | *No* |
| Year FE | *Yes* | *Yes* | *Yes* |
| Control variables | *Yes* | *Yes* | *Yes* |
| Mean Dep. Var of control |  |  |  |
| Parallel trend | *No* | *No* | *Yes* |
| Observations | 28,501 | 28,501 | 28,501 |

Note: Two-way cluster standard errors at household and rural community-level in parenthesis. \*, \*\*, and\*\*\* denote significance at the 10%, 5%, and 1% level, respectively. The outcome variable is a dummy variable. Control variables include age and sex of household head, household size, dummy variables of incorporated farmers, farmers who gain non-farm income, and self-sufficient farmers.

Table 5 shows that ----. This is consistent with an empirical study showing that men became more risk tolerant after the earthquake than women (Hanaoka et al., 2018) The result indicate that

1. Conclusions and policy implications

We investigate whether the loss of the collective reputation due to the Fukushima nuclear accident negatively affected rice production and farmers’ input decision making. To this end, we use the Difference-in-Differences methods and

Our study finds two important policy implications. First, the reputational damage from negative externalities influences farmers' input-decision making, even with government quality assurances, highlighting the economic significance of collective reputation as an externality. Secondly, the study emphasizes that incentives for investing in high-value-added practices are significantly affected by the collective reputation, urging policymakers to reconsider the promotion of such practices through strategic consideration of collective reputation.

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1. We thank the valuable comments from xxx, xxx. This paper does not represent opinions of the authors’ affiliation. We acknowledge research grants from the Tokyo Center for Economic Research and JSPS Grant-in-Aid for Challenging Research (Pioneering) 22K18353. All errors are our own. [↑](#footnote-ref-1)
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4. Nihon University [↑](#footnote-ref-4)
5. Kyoto University [↑](#footnote-ref-5)
6. Meiji University [↑](#footnote-ref-6)
7. The dataset is available from https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00500215&tstat=000001013427&cycle=0&tclass1=000001032288&tclass2=000001034728&tclass3val=0. [↑](#footnote-ref-7)
8. The data is available for onsite access at Kyoto University, Meiji University, Fukushima University with permission from Ministry of Agriculture, Forestry and Fisheries. [↑](#footnote-ref-8)
9. The graphical description of the event study analysis is shown in Appendix. The following regression is estimated for the event study analysis; [↑](#footnote-ref-9)